Ninth International Fermi Symposium

Report of Contributions

Contribution ID: **5** Type: **Invited**

New Perspectives onto the Universe in the era of multi-messenger astronomy

Monday, April 12, 2021 4:00 PM (25 minutes)

Presenter: ANDREONI, Igor

Session Classification: Gravitational Waves and VHE Emission from GRBs

Track Classification: Gravitational Waves

Contribution ID: **6** Type: **Invited**

Fermi-GBM in the Multimessenger Era

Monday, April 12, 2021 4:25 PM (25 minutes)

The Fermi Gamma-ray Burst Monitor (GBM) is an all-sky monitoring instrument designed to detect the prompt emission from a gamma-ray burst (GRB) and provide near-real time locations for follow-up observations. Over the past 11 years of operation, the GBM has detected over 240 gamma-ray bursts per year and provided timely community notices with localization to few-degree accuracy such as GRB 170817A. Its wide field of view and high uptime is ideal for observing the gamma-ray sky simultaneously with gravitational wave observatories. This collaborative effort proved fruitful when GRB 170817A was identified as the first short GRB unambiguously associated with binary neutron star merger event GW170817. This multi-messenger discovery and the intense follow-up observations by many instruments enabled new measurements of the speed of gravity, the Hubble constant, and expanded our understanding of relativistic jets. In this talk, I will discuss the ongoing efforts searching for more GRBs coincident with gravitational wave source candidates in addition to the onboard triggering.

Primary author: HUI, Michelle

Presenter: HUI, Michelle

Session Classification: Gravitational Waves and VHE Emission from GRBs

Track Classification: Gamma-ray Bursts

Contribution ID: **7** Type: **Invited**

Very high energy emission from Gamma-Ray Bursts

Monday, April 12, 2021 5:05 PM (25 minutes)

High energy radiation (0.1-100 GeV) from GRBs is regularly detected by Fermi-LAT in a sizable fraction of bright GRBs. The presence of emission at even higher energies instead has been discovered only recently, thanks to detections by the MAGIC and H.E.S.S. Cherenkov telescopes. These detections have shown that very high energy (VHE) emission up to at least 1 TeV can indeed be produced in these sources and have revealed the presence of a distinct emission component, carrying an energy comparable to the energy emitted in the lower frequency component. In this talk I give an overview on past observations and recent detections. I discuss the origin of the VHE emission and the implications on the understanding of the emission region. Finally, I comment on the prospects for future detections with CTA.

Primary author: NAVA, Lara

Presenter: NAVA, Lara

Session Classification: Gravitational Waves and VHE Emission from GRBs

Track Classification: Gamma-ray Bursts

Contribution ID: **8** Type: **Contributed**

First detection of very high energy emission from a gamma-ray burst

Monday, April 12, 2021 5:30 PM (15 minutes)

Gamma-ray bursts (GRBs) are the most luminous explosions in the Universe. Their nature has been well studied using enormous amounts of GRB data in a broad range of the electromagnetic spectrum, from radio frequencies up to GeV energies. However, several theoretical studies had been predicting TeV emission as well, but it could not be detected for a long time.
The MAGIC collaboration had been continuously improving its stereoscopic telescope system in order to detect GRBs. Its light-weight structure and automatic repositioning system allow to quickly point the telescopes towards any location in the sky within 30 seconds after a GRB alert is received. Also, the developments of observations at large zenith angles or under moonlight greatly extended the duty cycle of the telescopes, increasing MAGIC's capabilities in GRBs follow-up.
On January 14th, 2019, for the first time since its operation started 15 years ago, the MAGIC telescopes have undoubtedly detected a very high energy gamma-ray emission up to TeV energies from GRB 190114C. With a preliminary significance of over 20 sigma in the first 20 minutes of observation, this very strong detection started a wide campaign of multi-wavelength follow-up observations ranging from radio to infrared, optical, UV, X-ray and gamma-ray.
In this contribution, the data results such as light curve and time-resolved spectral energy distributions will be shown. Also, the theoretical interpretations of these results will be briefly discussed.

Primary author: SUDA, Yusuke

Presenter: SUDA, Yusuke

Session Classification: Gravitational Waves and VHE Emission from GRBs

Track Classification: Gamma-ray Bursts

Contribution ID: **9** Type: **Contributed**

H.E.S.S. detection of extremely energetic afterglow in Gamma-Ray Bursts

Monday, April 12, 2021 5:45 PM (15 minutes)

Current Imaging Atmospheric Cherenkov Telescopes (IACTs) have only recently begun to detect very-high energy emission (VHE; >100 GeV) from Gamma-Ray Bursts (GRBs). Here we report on the observations of the extremely bright and rather nearby GRB 180720B by the High Energy Stereoscopic System (H.E.S.S.), leading to its detection in the 100–440 GeV energy range. This detection was achieved over 10 hours after the end of the prompt gamma-ray emission phase, which was seen by Swift-BAT, Fermi-GBM and LAT. We will present the VHE late-time detection in the context of observations at lower energies, discussing possible scenarios for the radiation mechanisms at work. Finally, we will stress how this VHE detection is crucial for future IACT facilities, leading to a considerable revision of their GRB-detection rate estimate.

Primary author: Dr BISSALDI, Elisabetta

Presenter: Dr BISSALDI, Elisabetta

Session Classification: Gravitational Waves and VHE Emission from GRBs

Track Classification: Gamma-ray Bursts

Contribution ID: **10** Type: **Contributed**

Observation of the LIGO/Virgo GW190425 by SPI-ACS/INTEGRAL

Monday, April 12, 2021 6:00 PM (15 minutes)

Observations of the gravitational-wave event GW190425 registered by the LIGO/Virgo detectors with the Anti-Coincidence Shield (ACS) of the gamma-ray spectrometer SPI aboard the INTEGRAL observatory are presented. This is only the second event of binary neutron star merging type (> 99% probability) after GW170817. A weak gamma-ray burst, GRB190425, consisting of two pulses in 0.5 and 5.9 s after merging was detected by SPI-ACS. The pulses had a priori reliability of 3.5 sigma and 4.4 sigma as single events and 5.5 sigma as a combined event. Analysis of the SPI-ACS count rate as a test recording has shown that the rate of the appearance of two close pulses with characteristics of GRB190425 by chance does not exceed 6.4 × 10^{−5} s^{−1}. We note that the time profile of GRB190425 has a lot in common with the profile of the gamma-ray burst GRB170817A accompanying the GW170817 event. We present details of the INTEGRAL observations and comparison of properties of GRB190425 and GRB170817A.

Primary author: POZANENKO, Alexei

Presenter: POZANENKO, Alexei

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gravitational Waves

Contribution ID: **11** Type: **Contributed**

Can we constrain the aftermath of binary neutron star mergers with short gamma-ray bursts?

Monday, April 12, 2021 6:15 PM (15 minutes)

The joint observation of GW170817 and GRB170817A proved that binary neutron star (BNS) mergers are progenitors of short Gamma-ray Bursts (SGRB): this established a direct link between the still unsettled SGRB central engine and the outcome of BNS mergers, whose nature depends on the equation of state (EOS) and on the masses of the NSs. We propose a novel method to probe the central engine of SGRBs based on this link. We produce an extended catalog of BNS mergers by combining recent theoretically predicted BNS merger rate as a function of redshift and the NS mass distribution inferred from measurements of Galactic BNSs. We use this catalog to predict the number of BNS systems ending as magnetars (stable or Supramassive NS) or BHs (formed promptly or after the collapse of a hypermassive NS) for different EOSs, and we compare these outcomes with the observed rate of SGRBs. Despite the uncertainties mainly related to the poor knowledge of the SGRB jet structure, we find that for most EOSs the rate of magnetars produced after BNS mergers is sufficient to power all the SGRBs, while scenarios with only BHs as possible central engine seems to be disfavoured.

Primary author: PATRICELLI, Barbara

Presenter: PATRICELLI, Barbara

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gravitational Waves

Contribution ID: **12** Type: **Contributed**

Telltale signs of a hypermassive neutron star: a search for kHz QPOs in short GRBs

Monday, April 12, 2021 6:30 PM (15 minutes)

It is known from theoretical models and the observation of GW170817 that short gamma ray bursts (SGRBs) can be emitted by the merger of two neutron stars. The outcome of this merger may produce a short-lived (~ 100 ms) hypermassive neutron star (HMNS) before collapsing to a black hole. If the SGRB is emitted during the HMNS phase, it may be modulated by oscillations of the HMNS, with expected QPOs in the 1-5 kHz range. We review this scenario and present preliminary results from our search of the QPO signal in Fermi/GBM and Swift/BAT data using a Bayesian model, discussing the implications of possible candidates.

Primary author: CHIRENTI, Cecilia

Presenter: CHIRENTI, Cecilia

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gravitational Waves

Contribution ID: **13** Type: **Contributed**

Critical tests of GRB prompt emission models

Monday, April 12, 2021 6:45 PM (15 minutes)

Being discovered more than 40 years ago, gamma-ray bursts (GRBs) remain one of the mysterious astrophysical objects. In fact, the physics of relativistic jets formation, their composition, dissipation processes are still some of the biggest unknown in GRBs. The inability to establish the radiative processes shaping the observed prompt emission spectra does not allow us to make a big step towards understanding the fundamental properties of the GRB physics.
Most of the observed spectra in the 10 keV - 1 MeV energy range are too hard to be consistent with the straightforward synchrotron model in the fast cooling regime. Many alternative solutions have been proposed to solve this discrepancy. The possible explanations include modifications of the standard synchrotron model or invoke more complex scenarios with additional thermal components. I present recent investigations of the prompt emission that have
started with extension of the spectral energy range down to soft X-rays (to 0.5 keV). These studies have led to the discovery of the low-energy breaks at 2-20 keV below which the spectra harden. The inclusion of the breaks
into the empirical modelling has changed the distribution of the spectral shapes.
The averaged shapes of the spectra below and above the break energy are found
consistent with the synchrotron radiation. These findings are naturally interpreted in the synchrotron radiation scenario in the marginally fast cooling regime. The inclusion of the break energy in the modelling of one of the brightest GRB 160625B has resulted in similar findings with the break energy at ~100 keV.
Motivated by the empirical results, the realistic synchrotron model has been tested for the number of GRBs with optical data which allowed us to probe this model in the broad-band energy range. While the synchrotron model is capable to account for the entire optical-to-gamma-rays spectrum, the alternative thermal plus non-thermal model fails to reproduce the optical emission in the presence or absence of the contaminating afterglow radiation. I discuss the
parameter space of the basic prompt emission model derived from the direct application of the synchrotron model to the spectral data. The overall results showed the importance of the soft X-ray/optical data for discriminating the prompt emission spectral models.

Primary author: OGANESYAN, Gor

Presenter: OGANESYAN, Gor

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gamma-ray Bursts

Contribution ID: **14** Type: **Contributed**

Synchrotron footprints in GRB prompt emission spectra

Monday, April 12, 2021 7:00 PM (15 minutes)

At last, after more than 40 years from their discovery, the long-lasting tension between predictions and observations of GRBs spectra could be solved. We realized that the observed spectra can be produced by the synchrotron process from a distribution of electrons truncated at low energies. This low energy cut-off demands that electrons do not completely cool. Evidence for incomplete cooling was recently found in Swift GRBs with prompt observations down to 0.5 keV (Oganesyan et al. 2017, 2018). In this talk, I will review the most recent results drawn from the spectral analysis of the brightest short and long GRBs detected by the Fermi satellite (Ravasio et al. 2018, 2019). We found that in 8/10 long GRBs there is compelling evidence of a low energy break (below the peak energy) and a good agreement with the photon indices (below and above that break) predicted by the synchrotron spectrum (-2/3 and -3/2, respectively). Interestingly, none of the ten short GRBs analysed shows a break, but the low energy spectral slope is consistent with -2/3. In a standard scenario, these results imply a very low magnetic field in the emitting region, at odds with expectations.

Primary author: RAVASIO, Maria Edvige

Presenter: RAVASIO, Maria Edvige

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gamma-ray Bursts

Contribution ID: **15** Type: **Contributed**

The MAGIC multi-messenger transient VHE searches

Monday, April 12, 2021 7:15 PM (15 minutes)

Very high energy astrophysical sources show flaring and transient behaviour on different timescales, from fraction of seconds to years. These transient sources are usually observed and monitored over the whole electromagnetic spectrum. This contribution will outline the very high energy (VHE, $E > 100$ GeV) transient search program operated by the MAGIC telescopes. In this context, Imaging Atmospheric Cherenkov telescopes like MAGIC face many challenges in the observation of transient sources at VHE, due to their intrinsic low duty cycle and their limited field of view. Nonetheless, the planning of targeted follow-up strategies proved to be successful in the observation of transients.
Transient sources are associated with the most powerful progenitor systems comprising compact objects like black holes and neutron stars. The newly born multi-messenger astrophysics connects the information obtained by electromagnetic observations with those obtained by gravitational wave and neutrino experiments. The extreme environments at play in VHE transient phenomena are exquisite multi-messenger sources.
In this contribution, a particular highlight will be given to the rapid follow up operated by MAGIC responding to alerts provided by EM and multi-messenger facilities like Gamma-ray burst (GRB) detectors, the LIGO/Virgo and IceCube experiments. Such synergies were the key to many outstanding results, as demonstrated by the detection of the flaring blazar TXS~0506+06 in coincidence with a high energy neutrino and the first time detection of a GRB at VHE by MAGIC, GRB~190114C.

Primary author: LONGO, Francesco

Presenter: LONGO, Francesco

Session Classification: Gravitational Waves and Gamma-ray Bursts

Track Classification: Gamma-ray Bursts

Contribution ID: **16** Type: **not specified**

Welcome

Monday, April 12, 2021 3:00 PM (10 minutes)

Presenter: RAZZAQUE, Soebur (University of Johannesburg)

Session Classification: Opening session

Contribution ID: **17** Type: **not specified**

Virtual meeting and poster session logistics

Monday, April 12, 2021 3:15 PM (15 minutes)

Presenter: RACUSIN, Judith

Session Classification: Opening session

Contribution ID: **18** Type: **not specified**

Fermi mission overview/status

Monday, April 12, 2021 3:30 PM (25 minutes)

Presenter: RACUSIN, Judith

Session Classification: Opening session

Contribution ID: **19** Type: **Contributed**

Origin of the broad band emission from gamma-ray binaries with a radio pulsar

Monday, April 12, 2021 6:00 PM (15 minutes)

Gamma-ray binaries are a relatively new subclass of High Mass X-ray binaries visible from radio up to very high (TeV) energies. At the moment only a handful such sources (less than 10) are regularly observed at TeV and GeV energies. Only in two of these systems, PSR B1259-63 and PSR J2032+4127 we are sure on the nature of the compact objects, as these systems are wide enough to detect pulsations far from periastron (they have 3.4 and ~50 years orbital periods correspondingly). Broad band emission from these systems have common features, but also lots of differences. In particular they have a drastically different behaviour at GeV band, where we observe a huge GeV flare around the periastron in the case of PSR B1259-63, and only stable pulsed magnetospheric emission in the case of PSR J2032+4127. In my talk I will compare broadband emission (from radio to VHE) of these two systems and propose a theoretical model which explain the observed similarities and differences.

Primary author: CHERNYAKOVA, Maria (DCU)

Presenter: CHERNYAKOVA, Maria (DCU)

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **20** Type: **Contributed**

Determining the orbital parameters for the gamma-ray binaries LMC P3 and 1FGL J1018.6-5856 using SALT/HRS

Monday, April 12, 2021 6:15 PM (15 minutes)

Gamma-ray binaries are a rare class of binary system which produce non-thermal emission which peaks in the gamma-ray regime and so far, only seven sources have been firmly identified. These systems consist of a O/B type star and either a neutron star or a black hole compact object. Establishing the orbital parameters of gamma-ray binaries is a crucial requirement for modelling the emission production in these systems and for the sources where no pulsed emission is detected the best orbital parameters are obtained from radial velocity observations of the O/B-type companion. We present results of high resolution spectroscopy undertaken with SALT of two gamma-ray binaries, LMC P3 and 1FGL J1018.6-5856. For LMC P3 we show the peak in the Fermi-LAT and H.E.S.S. light curves can be associated with the phases of superior and inferior conjunction respectively. In addition we present the preliminary results for observations of 1FGL J1018.6-5856 being undertaken to improve the accuracy of the orbital parameters. The consequences for modelling the non-thermal emission in these systems is also briefly discussed.

Primary author: VAN SOELEN, Brian

Presenter: VAN SOELEN, Brian

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **21** Type: **Contributed**

The origin of the powerful jets from Cyg X-3 in the soft spectral state

Monday, April 12, 2021 6:30 PM (15 minutes)

The high-mass accreting binary Cyg X-3 is distinctly different from low-mass X-ray binaries (LMXBs) in having radio and gamma-ray emitting jets in its soft spectral state. Furthermore, those jets are much brighter in both radio and gamma-rays than those in the hard state of this object. Analysis of those emissions (Zdziarski et al. 2018) yields the location and the profiles of the orbital modulation of both, as well as the physical processes responsible for the emission. The transition from the hard state to the soft one in Cyg X-3 is first associated with quenching of the hard-state radio emission, similarly to LMXBs. The powerful soft-state jets form, on average, ~50 d later. The initial jet quenching appears to be due to the hard-state vertical magnetic field quickly diffusing away in the thin disc present in the soft state. The subsequent formation of the gamma-ray emitting jets occurs due to advection of the magnetic field from the donor, as proposed in Cao & Zdziarski (2020). We find this happens only above certain threshold accretion rate associated with appearance of magnetically driven disc outflows. The ~50 d lag is of the order of the viscous timescale in the outer disc, while the field advection is much faster. This process does not happen in LMXBs due to the magnetic fields of their donors being weaker than that in the Wolf-Rayet donor of Cyg X-3. Our results provide a unified scenario of the soft and hard states in both Cyg X-3 and LMXBs.

Primary author: ZDZIARSKI, Andrzej

Presenter: ZDZIARSKI, Andrzej

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **22** Type: **Contributed**

Gamma-ray heartbeat powered by the microquasar SS 433

Monday, April 12, 2021 6:45 PM (15 minutes)

Microquasars, the local siblings of extragalactic quasars, are binary systems comprising a compact object and a companion star. By accreting matter from their companions, microquasars launch powerful winds and jets, influencing the interstellar environment around them. Steady gamma-ray emission is expected to rise from their central objects, or from interactions between their outflows and the surrounding medium. The latter prediction was recently confirmed with the detection at the highest (TeV) energies of SS 433, one of the most interesting microquasars known. We analyzed more than ten years of GeV gamma-ray data on SS 433. Detailed scrutiny of the data reveal emission associated with a terminal lobe of one of the jets and with another position in the SS 433 vicinity, co-spatial with a gas enhancement. Both gamma-ray sources are relatively far from the central binary, and the latter shows evidence for a periodic variation at the precessional period of SS 433, linking it with the microquasar. This result challenges obvious interpretations and is unexpected from any previously published theoretical models. It provides us with a chance to unveil the particle transport from SS 433 and to probe the structure of the local magnetic field in its vicinity.

Primary author: LI, Jian (Deutsches Elektronen-Synchrotron DESY)

Presenter: LI, Jian (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **23** Type: **Contributed**

Probing orbital parameters of gamma-ray binaries with TeV light curves

Monday, April 12, 2021 7:00 PM (15 minutes)

Gamma-ray binaries are a small but growing class of sources which comprises of binary systems where the spectral energy distribution peaks above 1 MeV. Gamma-ray photons emitted in binary systems are subject to gamma-gamma absorption as they travel through a photon field created by a massive star. Moreover, gamma-gamma absorption might be the main reason for the characteristic decrease of the TeV flux close to periastron observed in such objects as PSR B1259-63/LS 2883 or the recently discovered highly eccentric and long period (40-50 years) PSR J2032+4127/MT91 213. If this is really the case, the location of the minimum in the light curve contains information on the geometry of the system. Such orbital parameters as the inclination angle and the longitude of periastron can be recovered from the shape of the TeV light curve. In this study we propose a method to probe orbital parameters of gamma-ray binaries based on the shape of the observed TeV light curve. It can be used for additional constraints for already known objects and may be particularly useful in the upcoming era of CTA which might discover gamma-ray binaries not previously detected at other wavebands.

Primary author: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Presenter: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **24** Type: **Contributed**

Discovery of an orbital period in HESS J1832-093

Monday, April 12, 2021 7:15 PM (15 minutes)

Unlike in supernova remnants or pulsar-wind nebulae, the characterization of high-energy and very-high-energy emission in binary systems allows the study of particle acceleration in shocks under periodically varying conditions. However, less than ten massive stars with non-accreting neutron star companions have been found to radiate most of their electromagnetic emission in gamma-rays. Therefore, each discovery of a gamma-ray binary provides new insights into these processes and allows us to distinguish between individual properties and general characteristics of the overall population.

Here, we present the discovery of an orbital period from the TeV source HESS J1832-093 using Swift-XRT and Fermi-LAT data (Martí-Devesa and Reimer 2020), allowing the identification of the 9th gamma-ray binary. This new binary resembles the system HESS J0632+057, providing evidence of a sub-population of binaries that display a notoriously faint GeV component.

Primary author: MARTÍ-DEVESA, Guillem

Presenter: MARTÍ-DEVESA, Guillem

Session Classification: Exploring the Galaxy: Binaries

Track Classification: Binaries

Contribution ID: **25** Type: **Contributed**

Dark matter and diffuse radio emission in spiral galaxies

Monday, April 12, 2021 6:00 PM (15 minutes)

Diffuse radio emission in the form of the “WMAP/Planck haze” has been established to exist within 1-2 kpc of the center of the Milky Way. If this haze is a product of dark matter annihilations, it should be detectable in spiral galaxies that are similar to the Milky Way. In this project, we use the cosmic ray propagation software, Galprop, to predict the flux, morphology and spectrum of a dark matter induced haze in the Milky Way and in several candidate spiral galaxies. We present constraints obtained by comparing the observed WMAP/Planck haze to our Galprop simulations at 23 GHz. These constraints are used to predict the fluxes of our candidate galaxies at 1.49 GHz. With the inauguration of the MeerKAT telescope in South Africa, this project has the potential to use the state of the art telescope to observe galaxies at L-band frequencies (900 - 1670 MHz). In this work, we evaluate whether MeerKAT observations of nearby spiral galaxies will indeed achieve tight constraints on dark matter parameters.

Primary author: RAMBURUTH-HURT, Tanita

Presenter: RAMBURUTH-HURT, Tanita

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **26** Type: **Contributed**

Search for Dark Matter Annihilation from the Milky Way Dwarf Spheroidal Galaxies with Twelve Years of Fermi-LAT Data

Monday, April 12, 2021 6:15 PM (15 minutes)

The upper limits from the Milky Way (MW) dwarf spheroidal galaxies remain one of the most important constraints on dark matter (DM) annihilation, and specifically, they are crucial for DM interpretations of the Galactic center excess. The last detailed analysis by the Fermi-LAT Collaboration dedicated to studying the dwarfs was published in 2017, using roughly 6 years of data. Now, with over twice as much data, an updated MW satellite census, and in anticipation for the upcoming Vera Rubin Observatory, it is an ideal time for an updated dwarf DM analysis. With this in mind, we have undertaken a new study of the dwarfs, and in this talk I will outline the analysis and present preliminary results. Additionally, as part of the analysis we make use of DMSky (a tool for calculating J-factors and cataloging the different values from the literature), and we work to further develop this tool to make it increasingly useful to the DM community.

Primary author: MICHAEL KARWIN, Christopher

Presenter: MICHAEL KARWIN, Christopher

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **27** Type: **Contributed**

Dark Matter search in dwarf irregular galaxies with the Fermi Large Area Telescope

Monday, April 12, 2021 6:30 PM (15 minutes)

Dwarf irregular (dIrr) galaxies have been shown to be dark matter (DM) dominated systems and proposed as interesting targets for the indirect search for DM with gamma rays. In this work, we analyze 11 years of Fermi-LAT data corresponding to the sky regions of 7dIrrs at a distance of less than ~1 Mpc. Due to the current uncertainty in the DM density distribution in these objects, we consider two different DM profiles, based on both the fit to the rotation curve (in this case a Burkert cored profile) and results from N-body cosmological simulations (i.e., NFW cuspy profile). We also include halo substructure in our analysis, which is expected to boost the DM signal importantly in field halos such as those of dIrrs. For each DM model and dIrr, we create a spatial template of the expected DM-induced gamma-ray signal to be used in the analysis of Fermi-LAT data. No significant emission is detected from any of the targets in our sample. Thus, we compute upper limits on the DM annihilation cross-section versus mass parameter space. Among the 7dIrrs, we find IC10 and NGC6822 to yield the most stringent individual constraints, independently of the adopted DM profile. We also produce combined DM limits for all objects in the sample. These results are independent from and complementary to those obtained by means of other targets. They also show the great potential of this type of objects in the context of DM searches, this work representing the first step in that direction.

Primary author: GAMMALDI, Viviana (SISSA)

Presenter: GAMMALDI, Viviana (SISSA)

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **28** Type: **Contributed**

A search of dark matter subhalos with the Fermi-LAT

Monday, April 12, 2021 6:45 PM (15 minutes)

ΛCDM predicts the existence of dark matter (DM) subhalos, most of them not massive enough to retain gas (i.e., baryons) and become visible. If DM is composed of Weakly Interacting Massive Particles (WIMPs), we expect them to annihilate in subhalos, producing gamma rays which can be detected with the Large Area Telescope (LAT) onboard the Fermi satellite, and appearing as unidentified sources (unIDs) in the gamma-ray sky. We characterize the LAT sensitivity to DM and compare the sample of unIDs in LAT catalogs - previously filtered according to the expected DM annihilation signal - to predictions from the Via Lactea II (VL-II) N-body cosmological simulation, repopulated with low-mass subhalos below its mass resolution limit. This exercise allows us to place conservative and robust constraints on the annihilation cross section vs. WIMP mass parameter space. A spectral and spatial dedicated analysis is then performed for the best DM subhalo candidates, using a decade of Fermi-LAT data. Finally, we also quantify whether spatial extension is, as often claimed, a "smoking gun"for DM subhalo detection, by simulating the LAT response to extended subhalos. This talk will be based on [1906.11896, 1910.14429] and ongoing work within the Fermi-LAT collaboration.

Primary author: CORONADO-BLÁZQUEZ, Javier (IFT UAM-CSIC)

Presenter: CORONADO-BLÁZQUEZ, Javier (IFT UAM-CSIC)

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **29** Type: **Contributed**

Multimessenger constraints on the dark matter interpretation of the Fermi-LAT Galactic center excess

Monday, April 12, 2021 7:00 PM (15 minutes)

The excess of gamma rays in the data measured by the Fermi Large Area Telescope from the Galactic center region is one of the most intriguing mysteries in Astroparticle Physics. This Galactic center excess (GCE), has been measured with respect to different interstellar emission models, source catalogs, data selections and techniques. Although several proposed interpretations have appeared in the literature, there are not firm conclusions as to its origin. The main difficulty in solving this puzzle lies in modeling a region of such complexity and thus precisely measuring the characteristics of the GCE. In this presentation I will show the results obtained for the GCE by using 11 years of Fermi-LAT data, state of the art interstellar emission models, and the newest 4FGL source catalog to provide precise measurements of the energy spectrum, spatial morphology, position, and sphericity of the GCE. I will also present constraints for the interpretation as dark matter particle interactions using the GCE, a gamma-ray analysis of dwarf spheroidal galaxies with LAT data and AMS-02 cosmic-ray antiprotons and positrons flux data

Primary author: DI MAURO, Mattia

Presenter: DI MAURO, Mattia

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **30** Type: **Contributed**

Indirect search of Dark Matter signatures in the gamma-ray flux towards the Sun with the Fermi LAT

Monday, April 12, 2021 7:15 PM (15 minutes)

Dark matter particles in the Galactic halo could interact with the nuclei in the solar environment and be then gravitationally trapped by the Sun. In this framework, the overdensity of dark matter particles in the Sun core or in external orbits will result in annihilations of these particles producing gamma rays outside the Sun, either directly or via long-lived intermediate states.

We perform a dedicated analysis of 10-years of Fermi Large Area Telescope searching for the possible features that these processes would yield in the energy spectrum of gamma rays from the Sun. In the case of dark matter annihilation via long-lived mediators, our results constrain the dark matter-nucleon spin-dependent and spin-independent scattering cross sections in a dark matter mass range from a few GeV up to about 100 GeV at the level of 10^-46 - 10^-45 cm^2 and 10^-48 - 10^-47 cm^2 respectively.

Primary author: SERINI, Davide (Universita e INFN, Bari (IT))

Presenter: SERINI, Davide (Universita e INFN, Bari (IT))

Session Classification: Indirect Dark Matter Searches

Track Classification: Dark Matter

Contribution ID: **31** Type: **Contributed**

On the measurement of handedness in Fermi Large Area Telescope data

Tuesday, April 13, 2021 3:00 PM (15 minutes)

A handedness in the arrival directions of high-energy photons from outside our Galaxy can be related back to the helicity of the inter-galactic magnetic field. Previous estimates by Tashiro et al. (2014) showed a hint of a signal present in the photons observed by the Fermi Large Area Telescope (LAT). An update on the measurement of handedness in the arrival direction of photons observed by the LAT is presented, using more than 10 years of observations. Simulations are performed to study the uncertainty of the measurements, taking into account the structure of the exposure caused by the energy-dependent instrument response and its observing profile, as well as the background from the interstellar medium. The uncertainties found from these simulations exceed those estimated previously, rendering the signal seen in the earlier Fermi-LAT data insignificant.

Primary author: JOHANNESSON, Gudlaugur

Presenter: JOHANNESSON, Gudlaugur

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **32** Type: **Contributed**

Updated Interstellar Inverse Compton Models and Dependency from the Large-Scale Magnetic Field

Tuesday, April 13, 2021 3:15 PM (15 minutes)

Standard models of the large-scale interstellar emission officially adopted so far for studies of the Fermi-LAT data are very uncertain and show some discrepancies with respect to the data especially in the inner Galaxy where the degeneracy with the various components is large, underlining the necessity of more realistic models.
We focus here on the large-scale Inverse Compton (IC) component of the interstellar emission, which is produced by cosmic-ray (CR) electrons and positrons on the CMB and Galactic photons. We have updated the IC model accounting for latest precise CR measurements, with AMS02 and Voyager, and for a more realistic magnetic field model consistent with synchrotron emission, which is observed in radio, produced by the same electrons and positrons. We show the effects of such improvements in the spectral and spatial distribution of the IC model.
For example, we found that the updated magnetic field model, which we constrain by synchrotron observations, produces a more peaked IC emission in the inner Galaxy with respect to the standard models used to analyze Fermi LAT data so far.
Predictions for future missions at MeV, such as AMEGO and GECCO, are also shown.
This presentation is mainly based on our results from Orlando (2019) Physical Review D 99, 043007 and Orlando (2018) MNRAS 475, 2724.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **33** Type: **Contributed**

Study of the Cosmic Rays and Interstellar Medium in local HI Clouds using Fermi-LAT Gamma-Ray Observations

Tuesday, April 13, 2021 3:30 PM (15 minutes)

An accurate estimate of the interstellar gas density distribution is crucial to understanding the interstellar medium (ISM) and Galactic cosmic rays (CRs). However, a significant amount of gas not traced properly by standard radio line surveys ("dark gas") has been preventing accurate measurement of the total neutral gas column density and CR intensity. To overcome this difficulty, we performed a detailed study of the ISM and CRs in the mid-latitude region of the third quadrant. We used the Fermi-LAT data in the 0.1-25.6 GeV range and other interstellar gas tracers such as the HI4PI survey and the Planck dust model. Even though this region was analyzed in an early publication of the Fermi-LAT collaboration using six months of data, the analysis was significantly improved using eight years of Fermi-LAT data with the aid of newly available gas tracers and with the northern and southern regions treated separately. We used gamma-rays as a robust tracer of the ISM gas and obtained the integrated gamma-ray emissivities above 100 MeV as (1.58 +/- 0.04) * 10^-26 photons s^-1 sr^-1 H-atom^-1 and (1.59 +/- 0.02) * 10^-26 photons s^-1 sr^-1 H-atom^-1 in the northern and southern regions, respectively, supporting the existence of a uniform CR intensity in the vicinity of the solar system. Our emissivity agrees with the calculation using the model based on the directly measured CR proton spectrum. However, we caution that the uncertainty of the gamma-ray emissivity model is still at the 20% level. In this contribution, we will present the details of the data analysis, results, and implications of CRs and ISM in the local environment.

Primary author: MIZUNO, Tsunefumi (Hiroshima University)

Presenter: MIZUNO, Tsunefumi (Hiroshima University)

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **34** Type: **Contributed**

Discovery of 100 TeV gamma-rays from HESS J1702-420: a new PeVatron candidate

Tuesday, April 13, 2021 3:45 PM (15 minutes)

The identification of active PeVatrons, hadronic particle accelerators reaching the knee (at the energy of few PeV), is crucial to understand the origin of cosmic rays in the Galaxy. In this context, we report on new H.E.S.S. observations of the PeVatron candidate HESSJ1702-420, close to the source 2FHL J1703.4-4145, that have revealed the presence of gamma-rays up to 100 TeV at 5 sigma confidence level. This is the first time in H.E.S.S. history that photons with such high energy are clearly detected. Remarkably, the new deep observations allowed the discovery of a new gamma-ray source component, called HESS J1702-420A, that was previously hidden under the bulk emission traditionally associated with HESSJ1702-420. This new object has a power-law spectral slope < 2 and a gamma-ray spectrum that, extending with no sign of curvature up to 100 TeV, makes it an excellent candidate site for the presence of extremely high-energy cosmic rays. This discovery brings new information to the open debates on the nature of the unidentified source HESSJ1702-420, one of the most compelling PeVatron candidates in the gamma-ray sky, and on the origin of Galactic cosmic rays.

Presenter: GIUNTI, Luca

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **35** Type: **Contributed**

Search for features in the cosmic-ray electron and positron energy spectra

Tuesday, April 13, 2021 4:00 PM (15 minutes)

The Large Area Telescope onboard the Fermi Gamma-ray Space Telescope has collected more than 15 millions of cosmic-ray electron and positron (CRE) events in the energy range from 42 GeV to 2 TeV in about 7.5 years since its launch in 2008. We have searched for possible features in the energy spectrum of Galactic CREs, which could be interpreted as a signature of the presence of a nearby dark matter source. A similar search has been performed looking at the energy spectrum of CREs towards the Sun. No significant DM signal was detected and we set constraints on the velocity averaged dark matter annihilation cross section into electron-positron pairs and on the dark matter-nucleon scattering cross section in the case of DM captured by the Sun. The last results have been derived assuming two different models: 1) elastic scatterings of dark matter particles with nuclei creating an overdensity of dark matter particles in the core of the Sun, which annihilate into long-lived light mediators decaying into e+e- pairs outside the Sun; 2) inelastic scatterings of dark matter particles with solar nuclei, which yield an enhanced density of dark matter particles around the Sun annihilating directly into e+e- pairs.

Primary author: LOPARCO, Francesco (Universita e INFN, Bari (IT))

Presenter: LOPARCO, Francesco (Universita e INFN, Bari (IT))

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **36** Type: **Contributed**

The ASTRI Mini-Array: a breakthrough in the Cosmic Ray study

Tuesday, April 13, 2021 4:15 PM (15 minutes)

Despite the enormous efforts done in very recent years, both theoretically and experimentally, the basic three questions about the CR origin remain without clear answers: what are their sources, how are they accelerated, how do they propagate?

Gamma-ray astronomy plays a fundamental role in this field. Both relativistic protons and electrons can emit in the gamma-ray band with different processes but only the detection of hadronic gamma-ray emission is a direct proof of Cosmic-Ray acceleration. Distinguishing leptonic and hadronic components is one of the most tricky issues in the high energy astrophysics, however, a gamma-ray detection at about 100 TeV would be a direct proof of the hadronic origin of the emission. Consequently, not only it would directly confirm the presence of CR acceleration in a source but also it gives us a large amount of information about their sources, their parent protons and their propagation.The ASTRI Mini-Array, with its unprecedented sensitivity at E > 10 TeV, will provide a fundamental contribution to close some of the most important CR open issues.

Primary author: CARDILLO, Martina (INAF - Osservatorio astrofisico di Arcetri)

Presenter: CARDILLO, Martina (INAF - Osservatorio astrofisico di Arcetri)

Session Classification: Diffuse Gamma Rays & Cosmic Rays

Track Classification: Diffuse

Contribution ID: **37** Type: **Contributed**

Unbiased Monitoring of Active Galactic Nuclei in Gamma Rays

Tuesday, April 13, 2021 3:00 PM (15 minutes)

To understand extremely variable sources like Active Galactic Nuclei, unbiased monitoring is of great importance. Often multi-wavelength observations are triggered by flaring activities of the sources which biases the overall data sample towards higher fluxes. Studying flux correlations between different wavelengths or flux distributions, an unbiased data sample is crucial. In the GeV energy range, Fermi-LAT is continuously monitoring the MeV-GeV-sky with a large field of view. At TeV energies, different monitoring programs are available. While for large imaging air Cherenkov telescopes the time dedicated to monitoring is limited, FACT and HAWC dedicate their observation time to unbiased monitoring.

Observing a small sample of bright blazars at TeV energies as much as possible, FACT has collected an unprecedented data sample of more than 14700 hours of physics data. For each of the bright, monitored sources, a total of 1900 hours to 3200 hours of physics data are available. Per night, the sources are observed between 40 minutes and 7 hours depending on their visibility. This provides the possibility to probe time scales from minutes to years. Comparing light curves, variability characteristics and flux distributions from Fermi-LAT and FACT allows for constraining the mechanisms responsible for the gamma-ray emission at GeV and TeV energies.

The presentation will summarize results from an unbiased data sample from more than eight years of monitoring.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **38** Type: **Contributed**

The Fermi-LAT view of misaligned Active Galactic Nuclei

Tuesday, April 13, 2021 3:15 PM (15 minutes)

While still outnumbered by sources with a small viewing angle, i.e. blazars, the population of misaligned active galactic nuclei (MAGN) has been steadily growing thanks to a decade of continuous all-sky monitoring by the Fermi-Large Area Telescope (LAT). The recently released Fermi-LAT fourth catalogue of AGN includes over 50 MAGN objects. These sources allow us to investigate different locations and emission processes for the high energy radiation, including extended lobes and structured jets seen at intermediate viewing angles. We will present a summary of the properties of LAT-MAGN, reporting on the number of sources and their distributions in gamma-ray luminosity, photon index, FR type, and multi-wavelength properties. Outstanding sources such as M87 and 3C 84 will be described in detail. Finally, we will present the prospects offered by future observations in gamma rays with the LAT and the Cherenkov Telescope Array, as well as in radio with the new upcoming facilities eventually leading to the Square Kilometre Array.

Primary author: GIROLETTI, Marcello

Presenter: GIROLETTI, Marcello

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **39** Type: **Contributed**

Multiwavelength observations in 2019-2020 of a new very-high-energy gamma-ray emitter: the flat spectrum radio quasar QSO B1420+326

Tuesday, April 13, 2021 3:30 PM (15 minutes)

The flat-spectrum radio quasar QSO B1420+326 underwent an enhanced gamma-ray flux state seen by Fermi-LAT at the turn of 2019/2020. Compared to the low state both the position and luminosity of the two spectral energy distribution peaks changed by at least two orders of magnitude. The high state resulted in the discovery of the very-high-energy (>100 GeV) gamma-ray emission from the source by the MAGIC telescopes. The organized multiwavelength campaign allow us to trace the broadband emission of the source through different phases of the flaring activity. The source was observed by 20 instruments in radio, near-infrared, optical, ultra-violet, X-ray and gamma-ray bands. We use dedicated optical spectroscopy results to estimate the accretion disk and the dust torus luminosity. The optical spectroscopy shows a prominent FeII bump with flux evolving together with the continuum emission and a MgII line with varying equivalent width. The gamma-ray flare was accompanied by a rotation of the optical polarization vector and emission of a new superluminal radio knot. We model spectral energy distributions in different flare phases in the framework of combined synchrotron-self-Compton and external Compton scenario in which the shape of the electron energy distribution is determined from cooling processes.

Primary author: SITAREK, Julian (University of Lodz)

Presenter: SITAREK, Julian (University of Lodz)

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **40** Type: **Contributed**

Modelling blazar SEDs and spectral variability with time-dependent diffusive shock acceleration

Tuesday, April 13, 2021 3:45 PM (15 minutes)

In recent work, we have developed a self consistent two-zone model of time-dependent diffusive shock acceleration in the relativistic jets of blazars and the resulting multi-wavelength spectral and variability features. In this paper, we report the results of detailed fitting of this model to recent multi-wavelength data from two blazars detected during bright gamma-ray flares by Fermi-LAT and H.E.S.S.: the flat spectrum radio quasars 3C 279 and PKS 1510-089. Simultaneous fits to snap-shot SEDs and multi-wavelength light curves are presenbted. Well sampled, continuous GeV gamma-ray light curves by Fermi-LAT are crucial to tightly constrain the energy-dependent mean-free path to pitch-angle scattering of relativistic electrons and its temporal change during the passage of a mildly relativistic shock, along with changes of other emission-region parameters. This allows deep insights into the nature of hydromagnetic turbulence induced by the shock.

Primary author: BOETTCHER, Markus (North-West University)

Presenter: BOETTCHER, Markus (North-West University)

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **41** Type: **Contributed**

Gamma-ray Flare and Optical Polarization Angle Swing Reveal Magnetic Reconnection in Blazars

Tuesday, April 13, 2021 4:00 PM (15 minutes)

Recent optical polarimetry monitoring programs have discovered optical polarization angle swings during blazar flares. Observations have shown that these swings are mostly simultaneous with Fermi gamma-ray flares. While angle swings are found in both flat spectrum radio quasars and BL Lac objects, blazars that have shown swings tend to be more active and brighter in gamma-rays. These features strongly suggest that at least some blazar flares may be driven by magnetic field. Magnetic reconnection is a very promising physical mechanism that can efficiently accelerate non-thermal particles by dissipating magnetic energy. We have performed detailed particle in cell simulations coupled with comprehensive polarization-dependent radiation transfer on magnetic reconnection in blazar emission environment. Our approach uniquely connects first principles with observations. Our results clearly show that magnetic reconnection can drive optical polarization angle swings with Fermi gamma-ray flares. The essential mechanism is the secondary reconnection due to large plasmoid mergers in the reconnection layer. For the first time, we have explicitly shown that the strength of the guide field in the reconnection layer is the key parameter that affects gamma-ray light curves and optical polarization signatures. Specifically, the frequently seen erratic fluctuations in optical polarization signatures during flares are due to reconnection with relatively large guide fields; but if the reconnecting magnetic field lines are almost anti-parallel, it will lead to strong angle swings and highly variable gamma-ray flares. We suggest that Fermi gamma-ray and optical polarimetry together can pinpoint the mechanism of blazar flares and the physical conditions in the emission region.

Presenter: ZHANG, Haocheng

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **42** Type: **Contributed**

Jet physics of gamma-ray-emitting narrow-line Seyfert 1 galaxies

Tuesday, April 13, 2021 4:15 PM (15 minutes)

The discovery by the Large Area Telescope on-board the Fermi satellite of variable gamma-ray emission from radio-loud narrow-line Seyfert 1 galaxies (NLSy1) revealed the presence of an emerging third class of AGN with powerful relativistic jets. Considering that NLSy1 are usually hosted in late-type galaxies with relatively small BH masses, this finding opened new challenging questions about the nature, disc/jet connection, high-energy emission mechanisms and formation of powerful relativistic jets in these objects.

Multi-wavelength observational properties of gamma-ray-emitting NLSy1 are similar to those seen in blazars. The X-ray emission is one of the most intriguing aspects. The X-ray spectra of these sources are completely dominated by the jet emission above 2 keV, while good-quality X-ray spectra show below 2 keV a significant contribution from the accretion flow, such as the soft X-ray excess, making them different from typical blazars. There are also increasing evidence that gamma-ray-emitting NLSy1, unlike radio-quiet NLSy1, are hosted in elliptical galaxies. Moreover, estimates of the BH mass obtained with different techniques (accretion disc model fitting, optical spectro-polarimetry, IR bulge luminosity) are larger than the virial masses for the gamma-ray-emitting NLSy1. These results are confirming that a massive SMBH is a key ingredient for developing powerful relativistic jets and among the radio-loud NLSy1 only those hosted in massive elliptical galaxies are able to produce these structures.

In this talk, we show new results on radio-to-gamma-ray observational properties, jet collimation, host galaxy, BH mass estimation of gamma-ray-emitting NLSy1, and discuss jet physics and accretion process of these sources.

Primary author: D'AMMANDO, Filippo

Presenter: D'AMMANDO, Filippo

Session Classification: Exploring the Cosmos: AGN-1

Track Classification: AGN

Contribution ID: **43** Type: **Contributed**

COMPTEL Reloaded: An updated view on the MeV Sky

Tuesday, April 13, 2021 3:00 PM (15 minutes)

The COMPTEL experiment aboard the Compton Gamma-Ray Observatory (CGRO) surveyed the MeV sky (0.75 - 30 MeV) almost uninterruptedly for more than 9 years between April 1991 and June 2000, thereby providing a first all-sky view in the MeV band. Now, about 20 years after the de-orbit of CGRO, COMPTEL data analyses are being still pursued. New imaging techniques allow updated all-sky images (Strong & Collmar 2019) to be produced and new and improved background reduction methods are available. Because no instrumental successor is yet operating or accepted, the COMPTEL data are still the forefront of our knowledge on the MeV sky, and will stay so for the next years to come. The COMPTEL source catalogue (Schönfelder et al. 2000), covering the first 5.5 years of the mission, lists 32 steady sources. This number increased to more than 45 sources in recent analyses, covering now the full COMPTEL mission and applying the improved analysis methods. About half of them are jet sources, mainly blazars (e.g. 3C 273, 3C 279) and some compact binaries (e.g. Cyg X-1, LS 5039). We will summarise the current observational status on sources at soft MeV energies, by providing the latest all-sky maps for different energy bands and various time periods. We also provide an updated COMPTEL source-list which will be compared to the sources listed in the "First catalog of Fermi-LAT sources below 100 MeV"(Principe et al. 2018). Finally we discuss the scientific perspectives of the still ongoing COMPTEL data analyses.

Primary author: COLLMAR, Werner

Presenter: COLLMAR, Werner

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **44** Type: **Contributed**

MeVCube: a CubeSat for MeV astrophysics

Tuesday, April 13, 2021 3:15 PM (15 minutes)

Despite the great success achieved both by X-ray and gamma-ray observatories in the past two decades, the region of the electromagnetic spectrum around 1 MeV remains largely unexplored. COMPTEL, on board CGRO (1991-2000), was the last telescope to observe this region, with a modest sensitivity. New gamma-ray observatories, like AMEGO and e-Astrogam, have been proposed for the future, in order to fill this gap in observations. However, the timescale for development and launch of such big missions is around 10 years, with substantial costs.
Looking at this scenario a nano-satellite Compton telescope, based on the CubeSat standard, may be profitable for the immediate future. The small cost and relatively short development time are clear advantages. Moreover such instrument could also be used as a pathfinder mission to test technologies and algorithms for future telescopes.
MeVCube is a 6U CubeSat concept currently under investigation at DESY. MeVCube will be based on Cadmium-Zinc-Telluride (CdZnTe) detectors, coupled with low-power read-out electronics (ASIC, VATA450). The high atomic number of CdZnTe enhance the interaction probability; moreover with a pixelated detectors, we can reach both good spatial resolution and energy resolution. Concerning the read-out electronics, VATA450 shows promising results in terms of dynamic range, noise and reliability. We estimated via simulations that such a small telescope could cover the energy range between 100 keV up to few MeV with a sensitivity comparable to that of missions like COMPTEL and INTEGRAL. Experimental tests on the read-out electronics and CdZnTe detectors are ongoing at DESY as well.

Primary author: LUCCHETTA, Giulio

Presenter: LUCCHETTA, Giulio

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **45** Type: **Contributed**

All Sky Medium Energy Gamma-ray Observatory (AMEGO): Exploring the Extreme Multimessenger Universe

Tuesday, April 13, 2021 3:30 PM (15 minutes)

The All sky Medium Energy Gamma-ray Observatory (AMEGO) is a probe class mission that will provide ground breaking new capabilities for multi-messenger astrophysics - identifying and studying the astrophysical objects that produce gravitational waves and neutrinos; along with a rich menu of additional science in astrophysical jets, compact objects, dark matter and nuclear line spectroscopy. AMEGO will cover the energy range from 200 keV to over 20 GeV, with more than an order of magnitude improvement in sensitivity relative to previous missions. AMEGO provides breakthrough capabilities in three areas of MeV astrophysics: nuclear line spectroscopy will provide new insight into the currently topical area of element formation in dynamic environments; polarization capabilities will uniquely probe conditions and processes in astrophysical jets and in the magnetospheres and winds of compact objects; a wide field of view and broad energy range provide outstanding capability in time domain and multi-messenger astrophysics with excellent synergies with observations at other wavelengths.

Primary author: MCENERY, Julie (NASA)

Presenter: MCENERY, Julie (NASA)

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **46** Type: **Contributed**

Concept: Galactic Explorer with a Coded Aperture Mask Compton Telescope (GECCO)

Tuesday, April 13, 2021 3:45 PM (15 minutes)

We present a novel concept for a next-generation γ-ray telescope that will cover the hard X-ray - soft γ-ray region. Despite the progress made by the European Space Observatory INTEGRAL, this energy range is still under-explored. GECCO will conduct high-sensitivity measurements of the cosmic γ-radiation in the energy range from 100 keV to ~10 MeV and create intensity maps with high spectral and spatial resolution, focusing on sensitive separation of diffuse and point- source components. These observations will enable the following major objectives for GECCO:
a) understand the nature, composition and fine structure of the inner Galaxy
b) localize and discern the origin(s) of the positron annihilation 511 keV line,
c) resolve Galactic chemical evolution and sites of explosive element synthesis
d) provide identification and precise localization of gravitational wave and neutrino events
e) test as-yet unexplored candidates for the dark matter
The instrument is based on a novel CdZnTe Imaging calorimeter and a deployable coded aperture mask. The unique feature of GECCO is that it combines the advantages of two techniques –the high-angular resolution possible with coded mask imaging, and a Compton telescope mode providing high sensitivity measurements of diffuse radiation. Expected GECCO performance is as follows: energy resolution <1% at 0.5-5 MeV, angular resolution ~1 arcmin in the Mask mode (3-4 degree field-of-view, ~2,000 cm2 effective area), and 3-5 degrees in the Compton mode (~80 degree field-of-view, ~500 cm2 effective area). The sensitivity is expected to be ~ $10{-}6$MeV/cm2/s at 1 MeV. GECCO can be considered for a future NASA Explorer mission.

Primary author: MOISEEV, Alexander

Presenter: MOISEEV, Alexander

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **47** Type: **Contributed**

The GRAMS Project: Gamma-Ray and AntiMatter Survey

Tuesday, April 13, 2021 4:00 PM (15 minutes)

GRAMS (Gamma-Ray and AntiMatter Survey) is a next-generation balloon/satellite mission that will be the first to target both MeV gamma-ray observations and antimatter-based indirect dark matter searches with a LArTPC detector. Astrophysical observations at MeV energies have not yet been well-explored due to the complexity and difficulties of the event reconstruction of Compton scatterings. With a cost-effective, large-scale LArTPC, the GRAMS single LDB (Long-Duration Balloon) flight could provide an order of magnitude improved sensitivity compared to previous experiments. Additionally, GRAMS can uniquely explore dark matter parameter space via antimatter measurements. In particular, low-energy antideuterons can be background-free dark matter signatures. In this talk, I will discuss the overview of the GRAMS project and the detection concepts for MeV gamma rays and antiparticles.

Primary author: ARAMAKI, Tsuguo

Presenter: ARAMAKI, Tsuguo

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **48** Type: **Contributed**

SWGO: The next-generation ground-based wide field-of-view gamma-ray observatory in the southern hemisphere

Tuesday, April 13, 2021 4:15 PM (15 minutes)

Particle-detector arrays at high elevation, such as HAWC and LHAASO in the northern hemisphere, proved to be very effective instruments to perform surveys on a daily basis providing significant improvements on our knowledge about Very High Energy TeV gamma-ray sources. In this contribution, we will present an overview on the effort to realise a next generation gamma-ray survey observatory in the southern hemisphere, where the Galactic Center and most of the Galactic plane are observable from. We will discuss the unique science case for this observatory with particular emphasis on the multi-messenger and multi-wavelength connections.
In addition, we will introduce the international organisation formed in July 2019 that aims to realise this facility: The Southern Wide field-of-view Gamma-ray Observatory (SWGO) collaboration.

Primary author: LONGO, Francesco

Presenter: LONGO, Francesco

Session Classification: Exploring the MeV Sky

Track Classification: Future Missions/Instruments

Contribution ID: **49** Type: **Invited**

Fast Radio Bursts

Tuesday, April 13, 2021 4:45 PM (25 minutes)

Fast radio bursts (FRBs) are millisecond-duration radio flashes of unknown physical origin. We now know that they originate at cosmological distances and hence must be exceptionally luminous. As such, FRBs promise to provide a new view of extreme astrophysics in action. At the same time, FRBs also promise to be unique probes of the ionised material within and between galaxies. Though only a hundred FRBs have been published to date, their all-sky event rate is estimated to be in the thousands per day. A new generation of wide-field radio telescopes has started to detect FRBs in earnest, and distributed radio telescope arrays are providing the necessary localisation precision to identify host galaxies. Nonetheless, the FRBs remain enigmatic. While some sources produce repeat bursts, most have only been seen once. Could there be multiple types of FRB sources? I will present our current observational understanding in this rapidly evolving field, and comment on how we can differentiate between the dozens of proposed FRB models. Multi-wavelength characterisation of FRBs, including deep gamma-ray observations, can provide critical insight.

Primary author: HESSELS, Jason (University of Amsterdam)

Presenter: HESSELS, Jason (University of Amsterdam)

Session Classification: Fast Radio Bursts and Binaries

Track Classification: Binaries

Contribution ID: **50** Type: **Invited**

Stellar objects as gamma-ray sources: the Cygnus region

Tuesday, April 13, 2021 5:10 PM (25 minutes)

A good fraction of high-energy (HE) sources do not have confirmed counterparts at any of the other branches of the electromagnetic spectrum. In the extragalactic sky, most of those sources with counterparts are blazars, the AGN subclass. HE sources with identified counterparts in our Galaxy do have a wide range of categories, as supernovae remnants, pulsar wind nebulae, microquasars, etc. Additional scenarios, involving stars in alternate -or earlier- stages, have been modelled, although evidence of correlation has been rather elusive from the observational point of view.

I will present the results of unidentified HE source counterpart searches in the stellar objects universe, especially related to hot, massive stars with strong stellar winds, and pulsars. This long-standing investigation focus on the central region of the Cygnus constellation, crowded with stars, and it is based on radio observations of arcsec scale at low frequencies, where the non-thermal emission is expected to be paramount.

Primary author: BENAGLIA, Paula

Presenter: BENAGLIA, Paula

Session Classification: Fast Radio Bursts and Binaries

Track Classification: Binaries

Contribution ID: **51** Type: **Invited**

Optical observations of high-energy gamma-ray binaries

Tuesday, April 13, 2021 5:35 PM (25 minutes)

Gamma-ray binary stars are intriguing members of the X-ray binary population which exhibit radiation across the entire electromagnetic spectrum, allowing for the study of extreme astrophysical conditions. They are characterised by a feature in their spectral energy distributions that shows a peak above 1 MeV. To date, there are only eight known systems which display a wide range of observational parameters. These systems are composed of an early-type star (O/B spectral class) and compact object which, apart from two systems, is of unknown nature. In this talk I will give an overview of gamma-ray binaries, highlighting the observational aspects of these systems, in particular those made at optical wavelengths.

Primary author: MONAGENG, Itumeleng

Presenter: MONAGENG, Itumeleng

Session Classification: Fast Radio Bursts and Binaries

Track Classification: Binaries

Contribution ID: **52** Type: **Invited**

Gamma rays and multiwavelength astronomy with 3ML

Wednesday, April 14, 2021 3:00 PM (25 minutes)

In the last decade, the number of known gamma-ray sources has exploded and gamma-ray astronomy is reaching an era of precision measurements. Wide-field-of-view observatories like Fermi-LAT in the GeV range and HAWC in the TeV range, as well as IACTs like H.E.S.S., MAGIC, and VERITAS, have amassed a wealth of data. Some of these experiments have made data and analysis tools available to the public. To unlock the full potential of these data, we need to be able to combine them not just with data from other gamma-ray instruments, but also with data from other wavelengths. There are several current efforts to this end. In this presentation, I will focus on threeML, the multi-mission maximum likelihood framework. Its flexible, plugin-based structure enables the inclusion of data from many different observatories in their diverse native formats. ThreeML relies on astromodels, a flexible modeling framework, for the description of astronomical sources. Source modeling and data access are thus separate from likelihood optimization, and can be combined in a flexible manner. In addition to the (frequentist) maximum likelihood analysis, threeML also allows for Bayesian analysis via sampling of the posterior distribution. I will report on the current status of threeML and astromodels, and show some examples for joint likelihood fits using threeML.

Presenter: OMODEI, Nicola

Session Classification: Exploring Gamma-ray Data

Track Classification: Analysis Techniques

Contribution ID: **53** Type: **Contributed**

Incremental releases of the Fermi LAT source catalog

Wednesday, April 14, 2021 3:25 PM (15 minutes)

The latest Fermi-LAT source catalog constructed from scratch (4FGL: 5065 sources above 50 MeV) was based on eight years (2008 - 2016) of Pass 8 data. Since neither the event reconstruction (Pass 8) nor the interstellar emission model (gll_iem_v07) has evolved since then, we decided we will provide incremental 4FGL releases at regular intervals of two years, until one of those two key ingredients changes. The first of those incremental catalogs, 4FGL DR2 covering 10 years of LAT data, has been released in 2020.
The main goals of these releases are to go a little deeper, report transients that became active only recently and provide a reasonable model for background sources. I will describe what we mean precisely by incremental and what products are provided. I will then introduce the second incremental 4FGL catalog, DR3 covering 12 years of data, which benefits from a few new features.

Primary author: BALLET, Jean (CEA Saclay)

Presenter: BALLET, Jean (CEA Saclay)

Session Classification: Exploring Gamma-ray Data

Track Classification: Analysis Techniques

Contribution ID: **54** Type: **Contributed**

The Fermi GBM Data Tools and GSpec

Wednesday, April 14, 2021 3:40 PM (15 minutes)

The Fermi Gamma-ray Burst Monitor (GBM) observes a wide variety of high-energy phenomena, spanning astrophysics, heliophysics, and Earth science. Its all-sky monitoring, broad energy range, fine spectral resolution, and fine time resolution make GBM a promising instrument for many different investigations. The GBM Team developed spectral analysis software, RMfit, for the analysis of onboard triggered gamma-ray bursts (GRBs), and now an updated Python-based version is available, GSpec. However, the access to, and analysis of, the overall set of GBM data, including continuous data, is not straightforward for the interested community. To enable community science with GBM, we present the GBM Data Tools, a Python-based API that provides an interface to the GBM data files and catalogs. In addition to the data interface, the GBM Data Tools also provides standard plotting capabilities to quickly plot GBM data, simple reduction tools for binning data and background estimation, and functionality that allows GBM spectral data to be easily used with XSPEC. In fact, GSpec is developed using the GBM Data Tools, and community users will be able to use the Data Tools API to build their own scripts and analysis workflows using GBM data with minimal roadblocks. We will demonstrate some of the capabilities of the GBM Data Tools and GSpec and will receive feedback on future development of features.

Primary author: GOLDSTEIN, Adam

Presenter: GOLDSTEIN, Adam

Session Classification: Exploring Gamma-ray Data

Track Classification: Analysis Techniques

Contribution ID: **55** Type: **Contributed**

The Fermi-LAT Light Curve Repository

Wednesday, April 14, 2021 3:55 PM (15 minutes)

We present the Fermi LAT light curve repository, consisting of a public library of light curves for variable Fermi LAT sources on a variety of time scales. Based on the successful Fermi All-sky Variability Analysis data portal, the Fermi LAT light curve repository aims to provide publication quality light curves on time scales of days, weeks, and months for over 1500 sources deemed variable in the 4FGL DR2 catalog. Unlike FAVA, which focuses on efficient flare detection through photometric analysis, the repository will consist of light curves generated through a full likelihood analysis of the source and surrounding region, providing calibrated flux and photon index measurements for each time bin. Hosted at NASA's HEASARC, the library will provide users with on demand access to this light curve data, replacing a task that is currently time consuming to perform with high cadence over long intervals using traditional LAT analysis tools. Such a system will serve as a resource to the multi-messenger community by helping scientists monitor interesting LAT sources and alerting them of γ-ray flares in near real time.

Primary author: KOCEVSKI, Dan

Presenter: KOCEVSKI, Dan

Session Classification: Exploring Gamma-ray Data

Track Classification: Analysis Techniques

Contribution ID: **56** Type: **Contributed**

The First Fermi Masterclass Online Edition 2020

Wednesday, April 14, 2021 4:10 PM (15 minutes)

The Fermi Masterclass is an international outreach event designed to give high-school students the unique opportunity to discover the world of High-Energy Astrophysics. Since 2017, following analogous experiences previously proposed mostly in France, various Italian universities and research institutes, guided by the National Institute for Nuclear Physics (INFN), organized a "full immersion" day of dedicated lectures and exercises in which students analysed real data collected by the LAT experiment aboard the Fermi satellite. Over the years, foreign institutes from Slovenia, Sweden and the U.S. also joined the effort, giving the students the unique opportunity to interact with each other as in real international collaborations.

The 4th edition of the Fermi Masterclass was scheduled to take place in April 2020. However, due to the pandemic emergency, the Masterclass was initially postponed, and finally took place as an online edition on December 10th, 2020.

Here we present the structure and organization of this first virtual event, including an interactive part of exercises accessible to the students through dedicated web platforms.

Primary author: BISSALDI, Elisabetta

Presenter: BISSALDI, Elisabetta

Session Classification: Exploring Gamma-ray Data

Track Classification: Analysis Techniques

Contribution ID: **57** Type: **Invited**

The challenge of understanding AGNs through extensive multiwavelength observations

Wednesday, April 14, 2021 4:35 PM (25 minutes)

The Active Galactic Nuclei (AGN) are the most powerful persistent sources in the Universe, bringing information from extreme environments expected to accelerate particles to energies well above those at reach on Earth-based laboratories. In the last decade, the advent of novel instrumentation has boosted our capabilities to study these environments across the electromagnetic spectrum. Such technological improvement is largest in the gamma-ray domain, where the operation of Fermi-LAT and the new and/or upgraded generation of ground-based instruments like HAWC, H.E.S.S., MAGIC, and VERITAS has provided us with a wealth of possibilities that did not exist before. In the talk I will put into context the main challenges we are facing, I will review several exciting studies published in the last years, and will describe the prospects for the future observations.

Primary author: PANEQUE, David

Presenter: PANEQUE, David

Session Classification: Exploring Connections: Active Galactic Nuclei & Neutrinos

Track Classification: AGN

Contribution ID: **58** Type: **Invited**

EBL models and cosmology with gamma rays

Wednesday, April 14, 2021 5:00 PM (25 minutes)

Gamma-rays from cosmological gamma-ray sources, primarily blazars but also gamma-ray bursts, interact with the extragalactic background light (EBL) photons, and are absorbed. This allows one to use gamma-ray absorption to constrain the EBL, which depends strongly on a number of quantities that are interesting from an astrophysical and cosmological point of view. This includes the universe's history of star formation and heavy element production, and its expansion rate. I describe how combining results of gamma-ray absorption measurements with the Fermi-LAT with galaxy survey results can constrain these quantities.

Primary author: FINKE, Justin

Presenter: FINKE, Justin

Session Classification: Exploring Connections: Active Galactic Nuclei & Neutrinos

Track Classification: AGN

Contribution ID: **59** Type: **Invited**

High-Energy Neutrino Observations by IceCube

Wednesday, April 14, 2021 5:25 PM (25 minutes)

The IceCube neutrino observatory at the geographic South Pole has been operating at full capacity for the past ten years. In 2013, IceCube reported first evidence of an isotropic flux of astrophysical neutrinos in the TeV-PeV energy range. While the flux is by now observed with high significance, its astrophysical origin is unknown. Only recently, IceCube was able to report first compelling evidence of neutrino emission from the gamma-ray blazar TXS 0506+056. The present lack of neutrino point source detections indicates that the observed isotropic flux is dominated by relatively weak extragalactic sources. Most likely, the neutrino sky is complex and several source classes may contribute. I will summarize the status of IceCube's high-energy neutrino observations, highlight the strong role of multi-messenger astronomy for the identification of neutrino sources, and give an outlook on the scientific potential of future IceCube upgrades and extensions.

Presenter: AHLERS, Markus (Niels Bohr International Academy, Niels Bohr Institute)

Session Classification: Exploring Connections: Active Galactic Nuclei & Neutrinos

Track Classification: Neutrinos

Contribution ID: **60** Type: **Invited**

Theoretical perspectives on Multimessenger Astronomy with astrophysical neutrinos

Wednesday, April 14, 2021 5:50 PM (25 minutes)

Multi-messenger astrophysics experienced a tremendous boost, after the first detection of astrophysical neutrinos was reported eight years ago. Despite having uncovered a large variety of gamma-ray emitting source classes up to today, a firm identification of the dominant source population responsible for the detected high-energy neutrino all-sky flux is, however, still lacking.
In this presentation I will review our current theoretical understanding of neutrino production in various environments. I will further discuss the role high-energy cosmic neutrino signatures play in characterizing cosmic-ray accelerators, and comment on their link to gamma-ray astronomy. I will conclude on future prospects for multi-messenger astrophysics.

Primary author: REIMER, Anita (University of Innsbruck)

Presenter: REIMER, Anita (University of Innsbruck)

Session Classification: Exploring Connections: Active Galactic Nuclei & Neutrinos

Track Classification: Neutrinos

Contribution ID: **61** Type: **Contributed**

Multimessenger follow-up of high energy neutrino events using Fermi-GBM

Wednesday, April 14, 2021 6:15 PM (15 minutes)

The simultaneous detection of a high energy neutrino event during a gamma-ray flare from TXS 0506+056 played an essential role in its identification as an astrophysical neutrino source in 2017. This highlights the current importance of electromagnetic follow-up by gamma-ray instruments for finding new sources in the field of high-energy neutrino astronomy where many of the sources and source classes have yet to be discovered. The Fermi Gamma-ray Burst Monitor (GBM) is an ideal instrument for searching for new classes of high energy neutrino sources from short timescale transients given its all sky monitoring capabilities and sensitivity to photon energies from 8 keV to 40 MeV. We will present the current methods that Fermi-GBM uses to identify potential seconds-scale counterparts to high energy neutrino events, including subthreshold searches for weak candidates performed in high-time-resolution data that are sensitive to dim, potentially off-axis transients similar to GRB170817A/GW170817.

Primary author: WOOD, Joshua (University of Wisconsin, Madison)

Presenter: WOOD, Joshua (University of Wisconsin, Madison)

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Neutrinos

Contribution ID: **62** Type: **Contributed**

12.5 Years of Fermi LAT Flare Advocate Service

Wednesday, April 14, 2021 6:30 PM (15 minutes)

The Fermi Flare Advocate (also known as Gamma-ray Sky Watcher, FA-GSW) service provides for a quick look and review of the gamma-ray sky observed daily by the Fermi Large Area Telescope (LAT) through on-duty LAT Flare Advocates and high level software pipelines like the LAT Automatic Science Processing (ASP), the Fermi All-sky Variability Analysis (FAVA), a dedicated suite of software and, recently, by a quicklooks analysis for cosmic neutrino alerts.

The service provides alerts and communicates to the external scientific community potentially new gamma-ray sources, and interesting transients, flares, outbursts, particular flux trends and spectral hardenings of, mainly, extragalactric sources, in addition to a preliminary outlook to gamma-ray sky positions of cosmic neutrinos detected by IceCube.

From 2008 August 3, to 2021 February 1, 542 Astronomer's Telegrams reporting blazars, radiogalaxies, novae, microquasars, the Crab nebula, unidentified and new sources, and about 60 Gamma-ray Coordinates Network notes with LAT follow up of IceCube events have been published by the Fermi LAT Collaboration. Target of opportunity observing programs to other satellites and telescopes have also been triggered by Flare Advocates.

Primary author: CIPRINI, Stefano (INFN & University Perugia)

Presenter: CIPRINI, Stefano (INFN & University Perugia)

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Neutrinos

Contribution ID: **63** Type: **Contributed**

Patterns in the multi-wavelength behavior of neutrino emitting blazar candidates

Wednesday, April 14, 2021 6:45 PM (15 minutes)

The detection of the flaring gamma-ray blazar TXS 0506+056 in spatial and temporal coincidence with the high-energy neutrino IC-170922A represents a milestone for multi-messenger astronomy. This finding suggests that gamma rays represent an important tracer of neutrino production in blazars and the 11-year all-sky coverage of the Fermi-LAT provides unique opportunities for both long-term studies of sources as well as realtime follow-up. In this contribution we present an analysis of the temporal and spectral multi-wavelength behavior from radio to GeV gamma rays of blazars found in spatial coincidence with either high-energy neutrino alerts or historical neutrino flares. Our results suggest that high-energy single neutrino emission is correlated with the gamma-ray brightness of the source, which does not hold for neutrino flare-emitting candidates. We also discuss the case of the blazar PKS 1502+106 found in coincidence with the IceCube realtime alert IC-190730A. By numerically simulating cosmic-ray interactions taking place in the jet, we simultaneously explain the source's multi-wavelength signatures and predict the emission of high-energy neutrinos, consistent with the detected IceCube event.

Primary author: GARRAPPA, Simone

Presenter: GARRAPPA, Simone

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Neutrinos

Contribution ID: **64** Type: **Contributed**

Searching for the sources of high-energy astrophysical neutrinos with VERITAS

Wednesday, April 14, 2021 7:00 PM (15 minutes)

VERITAS, an array of atmospheric-Cherenkov telescopes sensitive to gamma rays in the very-high-energy range (VHE, E > 100 GeV), carries out an extensive multimessenger program focused on the search for electromagnetic counterparts to high-energy neutrinos and gravitational waves. As both neutrinos and gamma rays are expected to be produced in hadronic interactions near cosmic ray accelerators, the detection of a gamma-ray source in temporal and spatial coincidence with the arrival of astrophysical neutrinos could reveal cosmic ray sources and provide insights into their properties.
The first evidence for the detection of a high-energy astrophysical neutrino source was based on the observation of the high-energy neutrino event IC170922A by IceCube in coincidence with an extended gamma-ray flare of the blazar TXS 0506+056 detected by Fermi-LAT. The detection of this source in VHE gamma rays by MAGIC, and later by VERITAS, provides an opportunity to study potential hadronic emission scenarios combining observations over the entire electromagnetic spectrum.This talk will introduce the VERITAS multimessenger program with a focus on the search for neutrino counterparts and present recent results from the study of TXS 0506+056.

Presenter: JIN, Weidong (The University of Alabama)

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Gamma-ray Bursts

Contribution ID: **65** Type: **Contributed**

Multimessenger tests of high-energy neutrino production in blazars

Wednesday, April 14, 2021 7:15 PM (15 minutes)

Blazars host relativistic jets which are considered to be excellent sites for high-energy-cosmic-ray acceleration. In the vicinity of the supermassive black hole and inside the relativistic jet, there exist photon fields which are thought to facilitate high-energy neutrino production. Recently, a number of blazars have been tentatively associated with high-energy neutrinos detected by the IceCube Observatory. Motivated by these observations we have performed multimessenger modelling of these sources and calculated the expected neutrino emission. In this talk, I will present the results of these studies, focussing on PKS 1502+106, which is a flat-spectrum radio quasar at redshift z ~ 1.838 possibly associated with the high-energy muon neutrino IC-190730A.

Primary author: OIKONOMOU, Foteini

Presenter: OIKONOMOU, Foteini

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Neutrinos

Contribution ID: **66** Type: **Contributed**

Seeking the Link between IceCube High-Energy Neutrinos and the Unresolved Gamma-ray Background

Wednesday, April 14, 2021 7:30 PM (15 minutes)

The new era of the multi-messenger Astrophysics has begun. The first step required to enable this science is to identify the multimessenger sources. Of particular interest is the relation between the high-energy neutrino events detected by IceCube Observatory and the γ-ray emission from extra-galactic objects. Despite the effort devoted to finding a clear γ-ray counterpart to astrophysical neutrinos, and the recent evidence of a neutrino event counterpart found in the blazar TXS 0506+056, the connection is still uncertain. The studies carried out so far focus on sources resolved by the Fermi Large Area Telescope (LAT), neglecting the numerous sources too faint to be individually resolved. In our analysis we consider the Fermi LAT unresolved emission at high latitude, whose fluctuation field is known to be produced by blazars, to investigate the contribution of unresolved blazars to the astrophysical neutrino flux.

Primary author: NEGRO, Michela

Presenter: NEGRO, Michela

Session Classification: Exploring Connections: Neutrinos and Gamma Rays

Track Classification: Neutrinos

Contribution ID: **67** Type: **Contributed**

Search for new cosmic-ray acceleration sites within the 4FGL catalog sources

Wednesday, April 14, 2021 6:15 PM (15 minutes)

Cosmic rays are mostly composed by protons accelerated to relativistic speeds. When those protons encounter interstellar material, they produce neutral pions which in turn decay into gamma rays. This offers a compelling way to identify the acceleration sites of protons. A characteristic hadronic spectrum was detected in the gamma-ray spectra of four Supernovae Remnants (SNRs), IC 443, W44, W49B and W51C, with the Fermi Large Area Telescope. This detection provided direct evidence that cosmic-ray protons are (re-)accelerated in SNRs.

In this review, we present the results from a comprehensive search for low energy spectral breaks. We use 8 years of data from the Fermi Large Area Telescope
between 50 MeV and 1 GeV. This search is based on the 4FGL catalog from which we extracted the unidentified sources or those associated to SNRs with a significance above 3sigma at low energy in both cases. Several SNRs, binaries and one star forming region as well as a handful of unidentified sources are detected with our search. These best candidates will be presented, thus enlarging our view to potential new cosmic-ray acceleration sites.

Primary author: LEMOINE-GOUMARD, Marianne (CNRS)

Presenter: LEMOINE-GOUMARD, Marianne (CNRS)

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **68** Type: **Contributed**

Shell like Supernova Remnants observed with Fermi-LAT

Wednesday, April 14, 2021 6:30 PM (15 minutes)

Supernova Remnants (SNRs) emitting gamma rays in the GeV-TeV energy range are fundamental for identifying the accelerators of Galactic cosmic rays. In 2018 H.E.S.S. has revealed at TeV energies three extended shell-like sources: HESS J1534-571, HESS J1614-518 and HESS J1912+101. A radio Supernova Remnant (SNR) candidate has been identified as a counterpart to HESS J1534-571, therefore it is classified as a SNR, while the other two are still candidate SNRs. We will report on the Fermi-Large Area Telescope (LAT) analysis of all three sources using 10 years of Pass 8 data. We will focus mostly on the analysis of HESS J1912+101 for which we are going to present the results of a deep observation campaign with the MAGIC telescopes together with Fermi-LAT data. The Fermi-LAT observed morphology of this source is really complex and we will describe it in detail. The joint Fermi-MAGIC morphological and spectral analysis covers six decades in energy.

Primary author: DE PALMA, Francesco (INFN)

Presenter: DE PALMA, Francesco (INFN)

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **69** Type: **Contributed**

G150.3+4.5: a new dynamically young SNR seen with the Fermi-LAT

Wednesday, April 14, 2021 6:45 PM (15 minutes)

The supernova remnant (SNR) G150.3+4.5 was recently detected in radio and exhibits a shell-like morphology with an angular size of 3°, suggesting either an old or a nearby SNR. An extended Fermi-LAT source, spatially coincident with the radio SNR, was reported in the Fermi Galactic Extended Source Catalog. Using more than 10 years of Fermi-LAT data, we perform detailed morphological and spectral studies of the SNR G150.3+4.5. The gamma-ray emission is adequately described by an extended component, spatially coincident with the radio emission, and exhibits a hard spectrum extending up to hundreds of GeV. We also investigate the association between G150.3+4.5 and the point source 4FGL J0426.5+5434, which is located in the South part of the SNR and has a pulsar-like spectrum. Using radio and X-ray data, we estimate the distance and the surrounding density of the SNR to understand its evolutionary stage. We find that G150.3+4.5 is spectrally similar to the shell-type SNRs observed with the Fermi-LAT such as RX J1713-3946 or Vela Junior. The broadband nonthermal emission of G150.3+4.5 is explained by a leptonic scenario that implies particle acceleration up to TeV energies, making G150.3+4.5 a new dynamically young Fermi-LAT SNR.

Primary author: DEVIN, Justine

Presenter: DEVIN, Justine

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **70** Type: **Contributed**

SNR G39.2-0.3, an hadronic cosmic rays accelerator

Wednesday, April 14, 2021 7:00 PM (15 minutes)

Recent results obtained with gamma-ray satellites have established supernova remnants as accelerators of GeV hadronic cosmic rays. In such processes, CRs accelerated in SNR shocks interact with particles from gas clouds in their surrounding. In particular, the rich medium in which core-collapse SNRs explode provides a large target density to boost hadronic gamma-rays. SNR G39.2-0.3 is one of the brightest SNR in infrared wavelengths, and its broad multiwavelength coverage allows a detailed modelling of its radiation from radio to high energies. We reanalysed the Fermi-LAT data on this region and compare it with new radio observations from the MWISP survey. The modelling of the spectral energy distribution from radio to GeV energies favours a hadronic origin of the gamma-ray emission and constrains the SNR magnetic field to be at least ~100 μG. Despite the large magnetic field, the present acceleration of protons seems to be limited to ~10 GeV, which points to a drastic slow down of the shock velocity due to the dense wall traced by the CO observations, surrounding the remnant. Further investigation of the gamma-ray spectral shape points to a dynamically old remnant subjected to severe escape of CRs and a decrease of acceleration efficiency. The low-energy peak of the gamma-ray spectrum also suggests that that the composition of accelerated particles might be enriched by heavy nuclei which is certainly expected for a core-collapse SNR. Alternatively, the contribution of the compressed pre-existing Galactic cosmic rays is discussed, which is, however, found to not likely be the dominant process for gamma-ray production.

Primary author: DE ONA WILHELMI, Emma

Presenter: DE ONA WILHELMI, Emma

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **71** Type: **Contributed**

Cosmic-ray acceleration and escape from post-adiabatic Supernova remnants

Wednesday, April 14, 2021 7:15 PM (15 minutes)

Supernova remnants are known to accelerate cosmic rays on account of their non-thermal emission of radio waves, X-rays, and gamma rays. Although there are many models for the acceleration of cosmic rays in Supernova remnants, the escape of cosmic rays from these sources is yet understudied.
We use our time-dependent acceleration code RATPaC to study the acceleration of cosmic rays and their escape in post-adiabatic Supernova remnants and calculate the subsequent gamma-ray emission.
We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in the test-particle limit. Our simulations span 100,000 years, thus covering the free-expansion, the Sedov-Taylor, and the beginning of the post-adiabatic phase of the remnant's evolution.
At later stages of the evolution cosmic rays over a wide range of energy can reside outside of the remnant, creating spectra that are softer than predicted by standard diffusive shock acceleration and feature breaks in the 10-100 GeV-range. The total spectrum of cosmic rays released into the interstellar medium has a spectral index of s~2.4 above roughly 10 GeV which is close to that required by Galactic propagation models. We further find the gamma-ray luminosity to peak around an age of 4,000 years for inverse-Compton-dominated high-energy emission. Remnants expanding in low-density media emit generally more inverse-Compton radiation matching the fact that the brightest known supernova remnants - RCW86, Vela Jr, HESSJ1721-347 and RXJ1713.7-3946 - are all expanding in low density environments.

Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **72** Type: **Contributed**

Pulsar wind nebulae as probes of high energy astrophysics

Wednesday, April 14, 2021 7:30 PM (15 minutes)

Pulsar wind nebulae (PWNe) are created by the interaction between the highly relativistic winds from pulsars and their surroundings. When young, the PWN resides in the remnant produced by the supernova explosion, and confines the entire energy input of the pulsar. These PWNe also prove to be excellent particle accelerators. Hence, the properties of these systems can be used to study the formation of neutron stars, creation of particles in the pulsar magnetosphere, and their acceleration up to extreme energies in its wind. Fermi's spectral coverage of the GeV emission from these objects provides crucial information on the spectrum of both particles injected into the PWN, critical for understanding the underlying acceleration mechanism, and background photon fields, which provides important information on its surroundings. From modelling the radiative and dynamic evolution of a sample of PWNe we find a surprising variety in neutron star progenitors and, possibly, in particle acceleration mechanisms as well. I will present the initial results of this study and how they relate to our current understanding of core-collapse supernovae and particle acceleration up to extreme energies.

Primary author: STRAAL, Samayra

Presenter: STRAAL, Samayra

Session Classification: Exploring the Galaxy: Supernova Remnants & Pulsar Wind Nebulae

Track Classification: SNR/PWN

Contribution ID: **73** Type: **Contributed**

A Decade of Gamma-ray Bursts Observed by Fermi-GBM

Wednesday, April 14, 2021 6:15 PM (15 minutes)

With the completion of the first decade of operation, Fermi-GBM has been longer in orbit than its predecessor experiment BATSE on-board CGRO. It is capable to detect almost the same number of GRBs (~240 GBM GRBs compared ~300 BATSE GRBs per year) resulting in 2357 triggers on cosmic GRBs during the first ten years. The GBM GRB catalog series is now continued by the latest releases of the GBM Gamma-Ray Burst and Spectral Catalogs. They summarize the basic characteristics of the triggered GRBs, like sky location, duration, peak flux, fluences and spectral properties. The statistical analyses of these quantities of the entire ten year GRB sample will be presented.

Furthermore the relevance of the GBM data for multi-messenger astrophysics is emphasized by presenting a search for GRBs with characteristics similar to GRB 170817A, conducted for the full time period of the current GBM GRB catalog. A total of 13 candidates were identified from which it is predicted that Fermi-GBM will trigger on-board on about one burst similar to GRB 170817A per year.

Primary author: Dr VON KIENLIN, Andreas (MPE)

Presenter: Dr VON KIENLIN, Andreas (MPE)

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **74** Type: **Contributed**

Photospheric emission in GRBs observed by Fermi/GBM

Wednesday, April 14, 2021 6:30 PM (15 minutes)

A large fraction of gamma-ray burst (GRB) spectra are very hard below the peak which indicates that the emission comes from the photosphere. The size of this fraction is investigated in two different ways. First, we use the theoretical spectrum expected from a non-dissipative flow to make synthetic Fermi/GBM spectra which are then fitted by the cut off power law function to simulate real data analysis. These results are compared these with observations made by the Fermi/GBM. We find that more than a quarter of the bursts in the GBM catalogue have at least one time-resolved spectrum, which is consistent with a non-dissipative flow. Second, we reanalyse a sample of peak spectra from strong bursts observed by Fermi. In particular we perform a model comparison between a non-dissipative photospheric model and a slow cooled synchrotron model based on Bayesian evidences. We find that the photospheric spectral shape is preferred by a majority of the spectra. This allows us to draw the conclusion that GRB spectra are indeed very narrow. The fraction of spectra consistent with emission from the photosphere will increase even more if dissipation of kinetic energy in the flow occurs below the photosphere. We discuss these findings in context of alternative emission models such as synchrotron emission from optically-thin shock regions.

Primary author: RYDE, Felix

Presenter: RYDE, Felix

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **75** Type: **Contributed**

GRB 160625B: Evidence for a Gaussian-Shaped Jet

Wednesday, April 14, 2021 6:45 PM (15 minutes)

Gamma-ray bursts (GRBs) detected by the Large Area Telescope (LAT) on board Fermi tend to be extraordinarily bright, making them ideal candidates for exploring emission models beyond the traditional on-axis, top-hat jet model. In this talk I will discuss our recent work modeling GRB 160625B with alternative jet structure shapes and testing assumptions typically made regarding certain physical parameters of the burst (e.g., burst energy, circumburst density, and participation fraction of electrons). We find that GRB 160625B does in fact prefer a more complex jet structure similar to that of the short GRB 170817A, implying jet structure is not dependent on progenitor type but is rather a more universal physical process. We also present evidence to suggest that GRB 160625B may show a preference for a black hole collapsar origin as opposed to a magnetar origin. Finally, I will share some preliminary results found from our initial modeling of a larger population study of Fermi GRBs.

Primary author: CUNNINGHAM, Virginia

Presenter: CUNNINGHAM, Virginia

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **76** Type: **Contributed**

"Pulsar Wind" model of early GRB Afterglows

Wednesday, April 14, 2021 7:00 PM (15 minutes)

We develop a model of early GRB X-ray afterglows are dominated by emission from the reverse shock propagating in highly relativistic, highly magnetized wind of a long-lasting central engine, similar to the Pulsar Wind Nebulae. The model reproduces high conversion efficiency of the wind power into radiation (fast cooling regime), afterglow plateaus, flares and abrupt intensity drops. The reverse shock emission in the X-rays and combined forwards and reverse shock emission in the optical explain many puzzling properties of early GRB afterglows.

Primary author: LYUTIKOV, Maxim

Presenter: LYUTIKOV, Maxim

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **77** Type: **Contributed**

Magnetar Giant Flares as Gamma-Ray Bursts

Wednesday, April 14, 2021 7:15 PM (15 minutes)

Cosmological Gamma-Ray Bursts (GRBs) are known to arise from neutron star mergers and collapsars. We have identified 4 GRBs within 5 Mpc which are inconsistent with such an origin: they appear to be extragalactic Magnetar Giant Flares (MGFs). These are the closest known GRBs, the signals from the most distant known magnetars, and suggest a broadly morphology of MGFs than previously known. They require an intrinsic rate higher than any previously detected extragalactic high energy transient, which further suggests magnetars as sources of repeating GRBs and that common core-collapse supernovae are the dominant progenitors of magnetars.

Primary author: HAMBURG, Rachel

Presenter: HAMBURG, Rachel

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **78** Type: **Contributed**

High-Energy Emission from a Magnetar Giant Flare in the Sculptor Galaxy

Wednesday, April 14, 2021 7:30 PM (15 minutes)

Magnetars are neutron stars with the strongest-known magnetic fields in the Universe, up to a thousand times stronger than typical neutron stars. Rarely, magnetars can produce enormous eruptions, called giant flares, consisting of a highly luminous sub-second initial spike of hard X-rays and soft gamma rays, followed by a softer and much dimmer pulsating tale lasting a few hundred seconds.

In this talk, we present the recent discovery of the first GeV emission from a magnetar giant flare (MGF) performed by the Fermi Large Area Telescope (LAT). On April 15 2020, the LAT detected GeV gamma rays in temporal coincidence with GRB 200415A, which was detected at MeV and localized by the InterPlanetary Network (IPN). Our detailed analysis shows that the GeV signal is consistent with the IPN localization and spatially associated with the nearby Sculptor galaxy. Thus, we infer that gamma rays likely originated with the MGF in Sculptor, and not from a from a cosmological gamma-ray burst, and we suggest that the GeV signal is generated by an ultra-relativistic outflow that first radiates the prompt MeV-band photons.

Primary author: DI LALLA, Niccolo'

Presenter: DI LALLA, Niccolo'

Session Classification: Exploring the Cosmos: GRB-1

Track Classification: Gamma-ray Bursts

Contribution ID: **79** Type: **Contributed**

The unique role of Fermi-LAT in GRB science

Thursday, April 15, 2021 7:00 AM (15 minutes)

Since their discovery over 50 years ago, Gamma-Ray Bursts (GRBs) have mainly been observed up to a few MeV. In recent years, several detections have been made in the very high-energy domain by ground-based Cherenkov Telescopes, providing new input and raising new questions regarding the emission mechanisms of these powerful events. The Fermi-LAT, spanning the energy range from tens of MeV to several hundreds GeV, carries unique capabilites to bridge these two energy ranges.

The LAT 10-year catalog (2FLGC) was completed in 2019, comprising a systematic study of 186 detections made from launch until August 2018. In this talk we present this work, revealing the characteristics of the GRB population at high energy with unprecedented sensitivity, and cover aspects such as temporal properties, energetics and spectral index of the high-energy emission. Our results confirm Fermi-LAT being a key instrument to understand GRB physics, and underscore the importance of both present and future observations in this energy range.

Primary author: AXELSSON, Magnus

Presenter: AXELSSON, Magnus

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **80** Type: **Contributed**

Fermi and Swift Observations of GRB 190114C: Tracing the Evolution of High-Energy Emission from Prompt to Afterglow

Thursday, April 15, 2021 7:15 AM (15 minutes)

We report on the observations by Fermi and Swift of gamma-ray burst (GRB) 190114C detected at very high energy by MAGIC. The prompt gamma-ray emission was detected by the Fermi/GBM, the Fermi/LAT, and the Swift/BAT and the long-lived afterglow emission was subsequently observed by the GBM, LAT, Swift/XRT, and Swift/UVOT. The early-time observations reveal multiple emission components that evolve independently, with a delayed power-law component that exhibits significant spectral attenuation above 40 MeV in the first few seconds of the burst, which enables us to estimate the initial bulk Lorentz factor. This power-law component transitions to a harder spectrum that is consistent with the afterglow emission observed by the XRT at later times. As a result, we are able to observe the transition from internal shock to external shock dominated emission. We find that the temporal and spectral evolution of the broadband afterglow emission can be well modeled as synchrotron emission from a forward shock propagating into a wind-like circumstellar environment. Considering the onset of the afterglow component, we estimate the maximum synchrotron energy as a function of time. We find that even in the LAT energy range, there exist high-energy photons that are in tension with the theoretical maximum energy that can be achieved through synchrotron emission.

Primary author: ARIMOTO, Makoto (Kanazawa University)

Presenter: ARIMOTO, Makoto (Kanazawa University)

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **81** Type: **Contributed**

Exploring the late-time gamma-ray burst afterglow at Very High Energies with H.E.S.S.

Thursday, April 15, 2021 7:30 AM (15 minutes)

The field of gamma-ray bursts (GRBs) is often advanced by detections of spectacular individual events. Most recently, H.E.S.S. detected VHE emission from GRB 190829A for three consecutive nights, up to 56 hours after the burst began, providing an unprecedented opportunity to study the late-time VHE afterglow spectrum. By combining the simultaneous Swift-XRT and H.E.S.S. observations, some curious similarities of the temporal and spectral behavior of the X-ray and VHE emission can be seen. We will discuss the questions that GRB 190829A raises, that challenge the standard models for VHE afterglow modelling and GRB physics.

Primary author: ZHU, Sylvia

Presenter: ZHU, Sylvia

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **82** Type: **Contributed**

VHE emission from GRBs: does it require a peculiar host environment?

Thursday, April 15, 2021 7:45 AM (15 minutes)

GRB 190114C was the first gamma-ray burst (GRB) for which a secure detection of very high-energy (VHE) photons by MAGIC has been announced. By now, at least another two GRBs have confirmed VHE detections. One of the still unsolved questions is whether all GRBs show VHE emission (and we were just lucky to observe it) or whether they actually require special conditions for this VHE emission to occur at sufficient strength to be observable. In the case of GRB 190114C, optical spectroscopy from X-shooter a few hours after the burst hints at a peculiar environment: We detect excited lines of Titanium never seen before in any GRB (nor in any other astrophysical object!) and we have further evidence for a very dense environment in the data. At least one of the other VHE detected GRBs, 190829A, share some of these properties. Both GRBs furthermore show a high extinction in their sightline. The location of GRB 190114C in its host was also peculiar: It occurred in the central region of its host, which itself shows a high molecular gas content, as seen in ALMA CO imaging, and is part of an closely interacting galaxy pair. All these observations support our claim of a particularly dense environment, not commonly observed in GRBs. We therefore believe that a dense environment is key to produce the VHE emission, similar to the dense central star clusters where VHE emission in low redshift starburst galaxies has been observed (without hosting a GRB).

Primary author: THÖNE, Christina

Presenter: THÖNE, Christina

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **83** Type: **Contributed**

The connection between GRB prompt emission physics and high energy cosmic rays: new constraints using Fermi data

Thursday, April 15, 2021 8:00 AM (15 minutes)

The acceleration site of ultra-high energy cosmic rays is still an open question despite extended research.
Over 20 years ago it was proposed that gamma-ray bursts (GRBs) are good candidates. This idea can now better be tested using recent Fermi data of GRB prompt emission spectra, that can be used to put strong constraints on the physical conditions of the outflow.

I will critically discuss the different emission models in GRBs, in particular the synchrotron and photosphere in view of current observational status. I will then show that the physical conditions during the GRB prompt emission in fact do not enable the acceleration of particles to ultra-high energies, both within the frames of the synchrotron and the photospheric emission models. I will show that this is the case also for low luminosity (ll) GRBs, such as GRB060218.

Primary author: PE'ER, Asaf

Presenter: PE'ER, Asaf

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **84** Type: **Contributed**

Spatiotemporal correlation between gamma-ray bursts and ultra-high energy neutrinos

Thursday, April 15, 2021 8:15 AM (15 minutes)

We searched for coincident arrivals of photons from gamma-ray bursts (GRBs) and ultra-high energy neutrinos (UHENs) from the IceCube Observatory. A spatiotemporal cross-match of the compiled datasets that contained 164 UHENs and 3221 GRBs was conducted. As a result, 20 GRB-UHEN matches were obtained within a time window of 4 days after the GRBs. Statistical analysis of the results was conducted using mock data, and imply that the resulting number of matches is in perfect agreement with random associations.

Primary author: TARNOPOLSKI, Mariusz

Presenter: TARNOPOLSKI, Mariusz

Session Classification: Exploring the Cosmos: GRB-2

Track Classification: Gamma-ray Bursts

Contribution ID: **85** Type: **Contributed**

Einstein @ Home Discovery of Two Spiders Pulsars

Thursday, April 15, 2021 7:00 AM (15 minutes)

Fermi gamma-ray source lists have led to the discovery of many "spider" pulsars, tight binary systems in which the pulsars are evaporating their companions. Most of these have been found in radio searches targeting the Fermi sources, because the computational effort to find the pulsations by directly searching the gamma-ray data is tremendous. Using novel search methods, optical observations of the companion and the volunteer computing project Einstein@Home, this challenge has been overcome with the discovery of two spider pulsars, PSR J1653-0158 and PSR J2039-5617. In this talk, I will describe the properties of these remarkable pulsars and their companions, which were found in a multiwavelength effort. One of these is in an extremely tight orbit with a low-mass companion and remains undetected in radio despite extensive searches. The other experiences strong variations in the orbital period and the radio pulsations, discovered in a follow-up search, are eclipsed for large parts of the orbit.

Primary author: NIEDER, Lars

Presenter: NIEDER, Lars

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **86** Type: **Contributed**

Searching for a population of soft gamma-ray pulsars

Thursday, April 15, 2021 7:15 AM (15 minutes)

The Fermi Large Area Telescope (LAT) has detected ~250 gamma-ray pulsars in its > 10 years of operation. The gamma-ray emission from most of these pulsars peaks in the GeV range, where the LAT is most sensitive; perhaps not surprisingly, only a handful of them fall in the "soft" gamma-ray category. While Fermi pulsars are teaching us much about the pulsar mechanism, the full picture is still incomplete. Soft gamma-ray pulsars appear to be an interesting and distinct population: typically single-pulsed, very young, extremely energetic, and with strong magnetic fields, these pulsars populate a part of the parameter space not probed extensively by Fermi. Indeed, even the archetypal example of a soft gamma-ray pulsar, PSR B1509-58, detected with COMPTEL over 20 years ago, remains challenging to study with Fermi LAT. Using LAT data in conjunction with X-ray observations (Chandra, XMM, Swift, and NuSTAR), I will describe our attempts to find additional soft gamma-ray pulsars with Fermi and will discuss the prospects of planned space missions in the MeV domain to uncover a larger population of these MeV pulsars in the future.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **87** Type: **Contributed**

Energy-dependent Light Curve Modeling of the Vela Pulsar

Thursday, April 15, 2021 7:30 AM (15 minutes)

The ground-based discovery of pulsed γ-ray emission from four pulsars has marked the beginning of a new era in pulsar science. Recent kinetic simulations sparked a debate regarding the emission mechanism responsible for pulsed γ-ray emission from pulsars. Detection of the Vela pulsar up to $\sim$~100 GeV by H.E.S.S.\ and Fermi Large Area Telescope (LAT) provides evidence for a curved spectrum. We interpret this to be the result of curvature radiation due to primary particles in the pulsar magnetosphere and current sheet. We present predictions of energy-dependent light curves and spectra using a slot gap and current sheet model in a force-free magnetosphere, invoking a step function for the accelerating electric field as motivated by kinetic simulations. We include a refined calculation of the curvature radius of particle trajectories, which has a significant impact on the transport, predicted light curves, and spectra. Upon obtaining reasonable fits for the energy-dependent light curves and spectra, we isolate the distribution of Lorentz factors and curvature radii of trajectories associated with the first and second γ-ray light curve peaks. The median values of these quantities are slightly larger for the second peak, leading to larger cutoffs and explaining the decrease in ratio of first to second peak intensity as energy increases. However, an unknown azimuthal dependence of the electric field as well as uncertainty in the precise spatial origin of the emission preclude a simplistic discrimination of emission mechanisms.

Primary author: BARNARD, Monica

Presenter: BARNARD, Monica

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **88** Type: **Contributed**

Modelling the optical polarized emission of AR Scorpii white dwarf pulsar

Thursday, April 15, 2021 7:45 AM (15 minutes)

We report the modelling of the optical polarized emission of the white dwarf pulsar in the binary system AR Scorpii (AR Sco) in the framework of the striped pulsar wind model constrained by optical photopolarimetric data. One of the main goals of this work is to constrain the parameters, which describe the white dwarf pulsar magnetic field geometry. Besides, we determine the location of the emitting region, inclination of the line of sight (LOS) with respect to the white dwarf pulsar spin axis, and the Lorentz factor Doppler boosting of the wind for a given particle density distribution and a finite thickness of the current sheet. We assume that the observed polarized emissions emanate from the wind synchrotron radiation produced within the sheets outside the light cylinder. We compute the Stokes parameters of the linearly polarized radiation and fit the total counts, linear counts, and polarization angle of the electric field to the photopolarimetric data folded on the spin phase of the white dwarf pulsar. We find that the model can reproduce the observed light curves main trends. An observer's viewing angle of [35 , 60] degree and a magnetic field inclination (relative to the rotation axis of the white dwarf) of [50 , 80] degree with synchrotron emission produced at a radial distance 1.6r L ≤ r ≤ 4.6r L (where r L denotes the light cylinder radius) can reasonably fit the observed pulse profiles at different orbital phases. This provides clear evidence of a pulsar-like particle acceleration process resulting from a striped magnetohydrodynamic wind produced by the white dwarf pulsar in AR Sco.

Primary author: RAMAMONJISOA, Fidy Andriamanankasina

Presenter: RAMAMONJISOA, Fidy Andriamanankasina

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **89** Type: **Contributed**

Phase-resolved polarimetry constraints for the white dwarf pulsar AR Sco

Thursday, April 15, 2021 8:00 AM (15 minutes)

Marsh et al. (2016; M16) detected radio and optical pulsations from the binary system AR Scorpii (AR Sco). This system, with an orbital period of 3.55h, is composed of a cool, low-mass star and a white dwarf with a spin period of 1.95min. X-ray pulsations have also been detected from this source (Takata et al. 2018). Optical observations by Buckley et al. (2017) showed that optical pulsations from the white dwarf are strongly linearly polarised (up to 40%). These pulsations are thought to be powered by the spinning down of the highly magnetised (5×10^8G) white dwarf. We fitted a standard rotating vector model to the polarisation emission angle data, and found a magnetic inclination angle $\alpha \sim 90^\circ$ and the observer angle to $\sim 60^\circ$.Using zeta and the mass function from M16, we constrained the mass of the white dwarf to $M_{\rm WD} = 1.00^{+0.19}_{-0.13}$. From the timescales of different radiation processes and the observed spectral cutoffs in the spectral energy distribution from M16, we determine that synchrotron radiation dominates as long as the pitch angles of the particles can be maintained; otherwise curvature radiation would dominate. Lastly we applied our model to the orbitally phase-resolved polarisation position angle data from Potter and Buckley (2018b) and obtained a $\sim 10^\circ$ variation in α and $\sim 30^\circ$ variation in ζ over the orbital period. We speculate that the observer is detecting radiation from a non-uniform emission region that is a stable structure over several orbital periods.

Primary author: DU PLESSIS, Louis

Presenter: DU PLESSIS, Louis

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **90** Type: **Contributed**

Studying the importance of possible oscillations of photons into axion-like particles in pulsars

Thursday, April 15, 2021 8:15 AM (15 minutes)

Axion-like particles (ALPs) are hypothetical very light neutral spin-zero bosons predicted by superstring theory which can oscillate into photons in the presence of external magnetic fields. ALPs are attracting increasing interest in the high- and very-high-energy (VHE) astrophysics, since they can explain several issues: they mitigate Universe transparency at VHE, explain why flat spectrum radio quasars emit above 20 GeV (first hint for ALP existence), solve for the redshift dependence of blazar spectra (second hint for ALP existence). Since pulsars are characterized by a very strong magnetic field (10^{11} –10^{13} G at the neutron star (NS) surface and even much greater than the critical magnetic field (4.41*10^{13} G) in the case of magnetars), a natural question arises: is the magnetosphere of NSs and/or their outer region such as the pulsar wind nebula a good environment for photon-ALP oscillations? The very strong magnetic field could suggest a positive answer, since the strength of the photon-ALP interaction is linked to the intensity of the magnetic field. Yet, quantum one-loop vacuum polarization effects –which become very important and even dominant in the presence of very strong magnetic fields –can drastically reduce the photon-ALP conversion efficiency. Thus, we want to study for which kind of NSs and in which regions of their magnetosphere photon-ALP oscillations can possibly lead to measurable effects by modifying the observed pulsar spectra and/or their light curves.

Primary author: Dr GALANTI, Giorgio (INAF, Osservatorio Astronomico di Brera)

Presenter: Dr GALANTI, Giorgio (INAF, Osservatorio Astronomico di Brera)

Session Classification: Exploring the Galaxy: Pulsars and Pulsar Wind Nebulae

Track Classification: Pulsar

Contribution ID: **91** Type: **Contributed**

12 years of quasi-periodic gamma-ray oscillations of PG 1553+113 seen by Fermi LAT

Thursday, April 15, 2021 7:00 AM (15 minutes)

We present the results of twelve years of Fermi Large Area Telescope (LAT) monitoring observations of the high-energy peaked BL Lac object PG 1553+113. The Fermi-LAT (E>100 MeV) results are complemented by simultaneous, multi-wavelength data at lower energy bands, including the optical band. Our previous work published in 2015 revealed the presence of a ~2 years periodic modulation in the observed source flux. The newly acquired dataset that will be presented here accounts for five additional years of observations, including a dedicated monitoring campaign at X-ray energies performed by the Neil Geherls Swift Observatory, and new optical polarization data. The temporal and cross-correlation analysis of this rich multifrequency dataset confirms the previous findings, i.e., a ~2-year, nearly periodic flux oscillation, that modulates the light curves and flares of PG 1553+113. Energy-dependent features were found, which confirm the modulation with higher significance at higher energies. Our findings provide further support that the periodicity is intrinsic to the blazar, and could be caused by e.g., a gravitationally bound system of binary supermassive black holes or the influence of massive stellar-sized objects on the central black hole, among other scenarios.

Primary author: LARSSON, Stefan

Presenter: LARSSON, Stefan

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **92** Type: **Contributed**

Building a robust sample of Fermi-LAT blazars that exhibit periodic gamma-ray emission

Thursday, April 15, 2021 7:15 AM (15 minutes)

Blazars can show variability on a wide range of timescales. However, the search for periodicity in the gamma-ray emission of blazars remains an on-going challenge. This contribution will show the results obtained when a systematic pipeline is used to implement ten well-established methods for searching for periodicity. We analyze the most promising candidates selected from our previous work, extending the Fermi-LAT light curves over three more years, for a total telescope time of twelve years. These improvements have allowed us to build the first sample of blazars that display a periodicity detected at a significance >5sigma. Finally, we will discuss the potential origins for the periodic behavior observed in blazars.

Primary author: PEÑIL, Pablo (Universidad Complutense de Madrid)

Presenter: PEÑIL, Pablo (Universidad Complutense de Madrid)

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **93** Type: **Contributed**

A new approach to search for binary black holes with Fermi/LAT

Thursday, April 15, 2021 7:30 AM (15 minutes)

Blazars are powered by super-massive black holes in their centers and are known for extreme variability on time scales from minutes to years. In case of a binary black hole system, this duality is traceable as periodic modulation of their gamma-ray emission. So far, high-significance periodicity has been reported for a very few blazars with standard approaches.
We developed a method to search for periodic patterns in Fermi/LAT light curves, using information field theory (IFT). IFT is a formulation of Bayesian statistics in terms of fields. Bayesian statistics is ideal for the problem at hand since the data is incomplete, irregularly sampled and obeys non-Gaussian statistics such that common least-squares methods do not apply. Simulated Fermi/LAT light-curves are used for significance testing and to provide a proof of the used method.
We present first results, analyzing a sample of promising binary black hole candidates like PG 1553+113 and Mrk 501.

Primary author: KRETER, Michael

Presenter: KRETER, Michael

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **94** Type: **Contributed**

Pinpointing the sources of the Fermi Isotropic Gamma-ray Background using Swift

Thursday, April 15, 2021 7:45 AM (15 minutes)

The origin of the diffuse isotropic gamma-ray back- ground measured by the Fermi gamma-ray satellite at energies between 100 MeV and 820 GeV remains largely uncertain. Population studies indicate that most of the emission originates in a large number of extragalactic objects such as active galactic nuclei, star-forming galaxies, or radio galaxies too faint to be resolved as individual sources. A detailed knowledge of how each population contributes to the overall observed flux is of key importance to understand the density and evolution of these sources with redshift, set constraints on a potential dark matter contribution, and study the link between the Isotropic Gamma-Ray Background (IGRB) and other cosmic backgrounds such as the diffuse neutrino flux discovered by the IceCube observatory. We present preliminary results from a Swift program of follow-up observations of unassociated Fermi-LAT very-high-energy photons observed at high Galactic latitudes. The purpose of this pilot program is to pinpoint the origin of individual VHE high-energy photons contributing to the IGRB to help identify X-ray and optical sources responsible for this flux. Apart from resolving new sources, these observations would be valuable in the identification of candidate VHE gamma-ray sources that could be further studied with ground-based VHE observatories.

Presenter: SHARPE, RIleyAnne

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **95** Type: **Contributed**

The GLEAM 4-Jy (G4Jy) Sample: the ‘brightest’ radio-sources in the southern sky

Thursday, April 15, 2021 8:00 AM (15 minutes)

Powerful radio-galaxies feature heavily in our understanding of galaxy evolution. However, when it comes to studying their properties as a function of redshift and/or environment, the most-detailed studies tend to be limited by small-number statistics. In this talk, I will present a new sample of ~2,000 of the ‘brightest’radio-sources in the southern sky (Dec. < 30 deg). These were observed at low radio-frequencies as part of the GaLactic and Extragalactic All-sky MWA (GLEAM) survey, conducted using the Murchison Widefield Array (MWA). This instrument is the precursor telescope for the low-frequency component of the Square Kilometre Array, and allows us to select radio galaxies in an orientation-independent way (i.e. minimising the bias caused by Doppler boosting, inherent in high-frequency surveys). Having an integrated flux-density > 4 Jy at 151 MHz, we refer to these objects as the GLEAM 4-Jy (G4Jy) Sample (White et al., 2020a, 2020b). Thanks to the location of the MWA in a protected, radio-quiet zone, we have excellent spectral coverage for these sources, with 20 radio flux-densities spanning a frequency range of 72-231 MHz. Following repeated visual inspection and thorough checks against the literature, the G4Jy catalogue is public and includes mid-infrared identifications for 86% of the sources. With over 10 times as many sources as the best-studied, low-frequency radio-source sample that is optically complete (the revised Third Cambridge Catalogue of Radio Sources; 3CRR), the G4Jy Sample will allow models of powerful active galactic nuclei (including blazars) to be tested more robustly.

Primary author: WHITE, Sarah

Presenter: WHITE, Sarah

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **96** Type: **Contributed**

Kinematics of Parsec-Scale Jets of Gamma-Ray Blazars: Ten Years of the 43GHz VLBA-BU-BLAZAR Program

Thursday, April 15, 2021 8:15 AM (15 minutes)

We analyze the parsec-scale jet kinematics of a sample of gamma-ray bright blazars monitored roughly monthly with the Very Long Baseline Array at 43 GHz from 2007 to 2018. We implement a novel piece-wise linear fit to the trajectories of over 500 distinct emission features (knots) in the jets of 23 quasars, 12 BL Lacertae objects, and 3 radio galaxies. The apparent speeds range from < 1c to ~50 c; ~25% of the knots are quasi-stationary. We assess the stability of the jet direction of each source; 9 sources show a change in the jet position angle over time. Approximately 20% of moving knots exhibit non-ballistic motion, defined as deviations from a pure linear trajectory using a chi-square test. These deviations take the form of discrete regions of acceleration, with a net positive acceleration along the jet direction within 3 pc (projected) of the mm-wave "core" and deceleration farther down the jet. Acceleration perpendicular to the average jet direction only occurs within the first 2 pc of the mm-wave core. We also show that the regions of acceleration are associated with the locations of the quasi-stationary features. We derive the physical parameters of over 450 superluminal motion segments using the apparent speeds and timescales of flux variability. These parameters include variability Doppler factors, Lorentz factors, and viewing angles - crucial for modeling the gamma-ray emission in blazars. This research is supported by NASA through the Fermi Guest Investigator Program grants 80NSSC17K0649 and 80NSSC20K1567, and the NRAO Student Observing Support Program.

Primary author: WEAVER, Zachary

Presenter: WEAVER, Zachary

Session Classification: Exploring the Cosmos: AGN-2

Track Classification: AGN

Contribution ID: **97** Type: **Invited**

Current constraints on WIMP dark matter

Thursday, April 15, 2021 3:00 PM (25 minutes)

With gamma-ray observations from Fermi-LAT, cosmic-ray observations from the Alpha Magnetic Spectrometer 02 on board the International Space Station, and with collider data at the LHC and direct detection underground experiments, we are at last probing WIMP dark matter candidates masses and cross-sections. I will discuss the current status of constraints on WIMP scale dark matter from collider, direct and indirect searches. Moreover, I will show that there is still a compelling case for continuing indirect studies of the Fermi-LAT data. Current advances of dark matter searches in gamma rays include both analyses of observations towards the galactic center and inner galaxy and also of close-by dwarf galaxies.

Primary author: CHOLIS, Ilias

Presenter: CHOLIS, Ilias

Session Classification: Dark Matter Constraints & Diffuse Emission

Track Classification: Dark Matter

Contribution ID: **98** Type: **Contributed**

Constraining the Dark Matter annihilation cross section with a combined analysis of dwarf spheroidal galaxy observations from Fermi-LAT, HAWC, H.E.S.S., MAGIC, and VERITAS

Thursday, April 15, 2021 3:25 PM (15 minutes)

The nature of Dark Matter (DM) is still an open question for modern Physics. In the particle DM paradigm, this elusive kind of matter cannot be made of any of the known particles of the Standard Model (SM) of particle physics. Many efforts have been made in order to model the nature of the DM. Among others, weakly interacting massive particles (WIMPs) are one of the most favored candidates for DM. Ground-based and space-based gamma-ray telescopes could potentially detect DM indirectly, by observing secondary products of its annihilation into SM particles. In the past years, limits on the DM self-annihilation cross section have been produced independently by the Fermi-LAT, HAWC, H.E.S.S., MAGIC, and VERITAS collaborations from a variety of DM targets. In this contribution, we will focus on the combination of observations from these five experiments in order to maximize the sensitivity of DM searches in dwarf spheroidal galaxies (dSphs), using a joint maximum likelihood approach. dSphs are one of the most promising targets for indirect DM searches, due to their proximity and their negligible contamination by astrophysical background. The obtained limits to the DM self-annihilation cross section are presented as a function of the DM particle mass, ranging from 10 GeV to 100 TeV.

Primary author: MIENER, Tjark

Presenter: MIENER, Tjark

Session Classification: Dark Matter Constraints & Diffuse Emission

Track Classification: Dark Matter

Contribution ID: **99** Type: **Invited**

Galactic Centre gamma-ray excesses

Thursday, April 15, 2021 3:40 PM (25 minutes)

The Galactic Centre region is noteworthy for its massive black hole, bursts of star formation, network of highly magnetised filaments, and bipolar outflow to the halo. This region is of high interest to characterise the nuclei of spiral galaxies and the interstellar medium in starburst galaxies, but its study is hampered by confusion with Galactic activity along the 8.15 kpc-long sightlines to the centre. I will review the series of extraplanar lobes, chimneys, and bubbles seen from the radio to the gamma rays. They highlight the intense activity of the region over the past few million years, but we do not know their spatial relation to the centre and to each other, and their spectral properties are often biased by foreground absorption or contamination. In gamma rays, the Fermi Bubbles and an excess of GeV emission towards the centre could shed important light on past eruptions from Sgr A*, on the launch of the Galactic wind, on cosmic-ray production and transport in the starburst nucleus, and on the dynamical history of millisecond pulsars in the bulge. Determining the spatial and spectral distribution of the base of the Fermi Bubbles and of the central GeV excess is, however, extremely challenging because of the unknown distribution of the intense foreground emission. I will discuss the systematic biases that currently limit the characterisation of these important features, thereby limiting tests of their origin, as well as a conclusive assessment of the potential level of dark-matter annihilation.

Primary author: GRENIER, Isabelle

Presenter: GRENIER, Isabelle

Session Classification: Dark Matter Constraints & Diffuse Emission

Track Classification: Diffuse

Contribution ID: **100** Type: **Contributed**

Measuring the Mass of the Missing Baryons in the Halo of Andromeda Galaxy with Gamma-Ray Observations

Thursday, April 15, 2021 4:05 PM (15 minutes)

It has been suggested that a huge amount of baryons resides in the circumgalactic medium (CGM) extending out to the virial radii of galaxies. In this work we attempt to measure the baryon mass in CGM with a novel method based on the gamma-ray observations of the extended halo of the Andromeda Galaxy Messier 31 (M31). Since cosmic-ray particles generated inside the galaxy will eventually escape to the CGM, they will produce gamma-ray emission via the proton-proton collision with CGM and produce gamma rays. Different from some traditional measurements which are sensitive to certain metallic ions in specific temperature range, the
hadronic gamma-ray flux is sensitive to baryonic gases in all phases and does not rely on the metallicity in the halo, hence the measured gamma-ray flux from the galaxy's halo can be used to constrain the mass of CGM. By dealing with the cosmic-ray transport in the halo and calculating the hadronic gamma-ray intensity, we find that the total baryon mass contained within the virial radius is less than (1.4-5)e10 M_sun according to the gamma-ray observation. It implies that the CGM of Andromeda Galaxy may not account for more than 30% of the missing baryons, but the result is subject to uncertainties from the diffusion coefficient of the CRs in
the halo as well as the stellar mass and dark matter halo mass of the galaxy. This method will become more constraining provided better understandings on these issues and more sensitive gamma-ray telescopes in the future.

Primary author: ZHANG, Yi

Presenter: ZHANG, Yi

Session Classification: Dark Matter Constraints & Diffuse Emission

Track Classification: Diffuse

Contribution ID: **101** Type: **Invited**

Fermi-LAT Solar Flare Catalog: Observations of Solar Flares at High Energy During Solar Cycle 24th

Thursday, April 15, 2021 4:35 PM (25 minutes)

The Fermi Large Area Telescope (LAT) observations of the active Sun provide the largest sample of solar flares with emission greater than 30 MeV to date. These include detections of impulsive emission coincident with hard X-rays and hours-long sustained emission associated with GOES soft X-ray flares as well as very fast Coronal Mass Ejections (CME). Of particular interest is the first detection of >100 MeV gamma-ray emission from three solar flares whose positions behind the limb were confirmed by the STEREO spacecrafts and the 2017 September 10 X8.2 flare associated with Ground Level Enhancement 72. Fermi-LAT detections of solar flares at high energy present a unique opportunity to explore the mechanisms of high-energy emission and particle acceleration and transport in solar flares. We will present the Fermi-LAT Solar Flare (FLSF) Catalog, which includes observation of 45 solar flares during Solar Cycle 24. We will discuss correlation studies with Solar Energetic Particles (SEP) and CMEs, and highlight future prospects.

Primary author: OMODEI, Nicola

Presenter: OMODEI, Nicola

Session Classification: Gamma Rays in the Solar System

Track Classification: Solar System

Contribution ID: **102** Type: **Invited**

Probing the Puzzle of Fermi Long-Duration Gamma-Ray Flares by Data-driven Global MHD Simulations

Thursday, April 15, 2021 5:00 PM (25 minutes)

With the increasing number of long-duration gamma-ray solar flares >100 MeV observed by Fermi/LAT, it poses a puzzle on the particle acceleration and transport mechanisms. The recent detections of behind-the-limb (BTL) solar flares (e.g., 2014 September 1 event), in which the gamma-ray emission region is located away from the BTL flare site by up to tens of degrees in heliographic longitude, and on-disk flares with migration of gamma-ray emission centroid hours past the impulsive phase (e.g., 2012 March 7 event), present further new challenges on the theoretical models for interpreting the observations. Since most of the long-duration events are associated with fast CMEs, it is therefore intriguing to understand the role of CMEs and CME-driven shocks in these events. To probe this puzzle, we perform data-driven, global magnetohydrodynamics simulations of the CMEs associated with the long-duration gamma-ray flares and investigate the magnetic connectivity and evolution of the CME-driven shock, and their relationship, in both space and time, with the observed gamma-ray emission. Specifically, we derive and track the time-varying shock parameters over the area that is magnetically connected to gamma-ray emission region. Based on the modeling results, we discuss the causes and implications of Fermi long-duration gamma-ray events, in the framework of a potential shift of paradigm on particle acceleration in solar flares and CMEs.

Primary author: JIN, Meng

Presenter: JIN, Meng

Session Classification: Gamma Rays in the Solar System

Track Classification: Solar System

Contribution ID: **103** Type: **Contributed**

Free time

Thursday, April 15, 2021 5:25 PM (15 minutes)

Session Classification: Gamma Rays in the Solar System

Track Classification: Solar System

Contribution ID: **104** Type: **Contributed**

Study of Earth's Stratospheric Gamma-Ray Emission in Geographical Coordinates with Fermi LAT

Thursday, April 15, 2021 5:40 PM (15 minutes)

The Earth's upper atmosphere is constantly bombarded by cosmic rays (CRs). The interactions produce cascades of secondary particles including gamma rays. In any particular region of the upper atmosphere, CRs with insufficient rigidity (momentum per charge) are excluded because they are deflected by the Earth's magnetic field. Therefore, CR fluxes vary with geographical location, being highest near the poles and lowest near the equator. Here we analyze the Earth's gamma-ray data between 0.2 –20 GeV from the Fermi Large Area Telescope (LAT) and verify the inverse association between the photon intensity and the direction-dependent geomagnetic cutoff rigidity. The emission from the Earth's stratosphere is mapped in geographical coordinates, creating the first images of the Earth in gamma rays. We confirm and quantify the solar modulation effects on the Earth's gamma- ray spectrum. Utilizing the geomagnetic field as a spectrometer, we also report the stratospheric gamma-ray yield per CR proton as a function of CR rigidity as observed at the LAT altitude. This research project is partly supported by Thailand Science Research and Innovation (RTA6280002) and Research Grant for New Scholar (MRG6280155).

Primary author: MITTHUMSIRI, Warit

Presenter: MITTHUMSIRI, Warit

Session Classification: Gamma Rays in the Solar System

Track Classification: Solar System

Contribution ID: **105** Type: **Contributed**

Search for gamma-ray emission from interstellar visitors 1I/ʻOumuamua and 2I/Borisov with Fermi-LAT data

Thursday, April 15, 2021 5:55 PM (15 minutes)

The asteroid 1I/'Oumuamua (A/2017 U1) and the cometary-like object 2I/Borisov (C/2019 Q4) are the first two objects of interstellar origin discovered in our Solar system. They approached the Earth in October 2017 and in December 2019 respectively.

We searched for gamma-ray emission with the Fermi Large Area Telescope (LAT) data for energies above 56 MeV, focusing on the period before and after the minimum distance from the Earth. Such gamma-ray emission could originate from the interaction of cosmic rays (CRs) with their surfaces or from more exotic gamma-ray production due to accelerated particles or dark matter annihilation.

We analyzed the data with two independent methods, based on a maximum likelihood analysis with different methods for background estimation. No significant signal was found and upper limits on the gamma-ray flux were derived. A physical model based on CR interaction was also applied, providing information on the physical size of the two objects.

Presenter: DI VENERE, Leonardo (Universita e INFN, Bari (IT))

Session Classification: Gamma Rays in the Solar System

Track Classification: Solar System

Contribution ID: **106** Type: **Invited**

Very-High-Energy Observations of Pulsar Wind Nebulae and Supernova Remnants

Friday, April 16, 2021 3:00 PM (25 minutes)

The High Energy Stereoscopic System (H.E.S.S.) has conducted a survey of the Milky Way, discovering 78 sources of very-high-energy (VHE, E > 100 GeV) gamma-ray emission. A total of 28 sources are firmly identified as being Pulsar Wind Nebulae (PWNe), Supernova Remnants (SNRs) or composite SNRs. Correlating the H.E.S.S. sources with other catalogues shows that 21 objects are firmly or plausibly associated with SNRs, 20 with composites and 16 with PWNe. This makes SNRs and PWNe the largest population of Galactic VHE sources.

PWNe and SNRs are powered by the remains of stellar explosions. The rotational energy of the stellar core fuels, in the form of a pulsar, a nebula of relativistic electrons. The material ejected in the supernova explosion shocks the interstellar medium and accelerates protons and electrons. Protons may escape the SNR and interact in nearby molecular clouds. Ground-based observations of VHE gamma rays probe the electron population in the sources through inverse Compton scattering and the proton population through inelastic proton-proton scattering and subsequent gamma-ray production in pion decay. The good angular resolution of the instruments allow detailed morphological studies of the sources.

In this talk I present the current status of VHE observations of PWNe and SNRs. The results are put into context with the proposed emission mechanisms. I will show how the particle transport in PWNe can be measured with gamma-ray observations and why SNRs are very good candidates for Cosmic-Ray acceleration. I will conclude with an outlook on future observations.

Primary author: KOMIN, Nukri (Wits University)

Presenter: KOMIN, Nukri (Wits University)

Session Classification: Exploring the Galaxy: Pulsars, Pulsar Wind Nebulae and Supernova Remnants

Track Classification: SNR/PWN

Contribution ID: **107** Type: **Contributed**

Free time

Friday, April 16, 2021 4:05 PM (15 minutes)

Session Classification: Exploring the Galaxy: Pulsars, Pulsar Wind Nebulae and Supernova Remnants

Track Classification: SNR/PWN

Contribution ID: **108** Type: **Invited**

What have we learned from Fermi Pulsar Light Curve Modelling?

Friday, April 16, 2021 3:25 PM (25 minutes)

The Fermi Large Area Telescope (LAT) has caused a revolution in the field of high-energy pulsar science. The number of known pulsars has sky-rocketed from a mere handful prior to its launch to more than 250, and the accumulation of statistics has yielded superior quality light curves in some cases. These developments have stimulated and enabled a flurry of theoretical activity, substantially increasing our understanding of the pulsar phenomenon. While phase-averaged spectra may constrain the radiation energetics, light curves may probe the spatial emissivity distribution and Special Relativistic effects in the pulsar magnetosphere. Low-altitude and extended gap models provided a first framework in which to interpret multi-band light curves, and it was quickly appreciated that by adding data from multiple energy bands, stronger constraints could be derived if a robust statistical method is available to fully exploit such heterogeneous data. Models with extended, high-altitude emission for the bulk of the pulsar population are now unanimously favored, although the GeV emission mechanism is still being debated. Moreover, Fermi's extended energy range enabled the study of multi-band high-energy light curves, while recent ground-based detections of very-high-energy light curves from a few pulsars provide additional energetics and emissivity constraints. Sophisticated MHD and kinetic models indicate that near-force-free magnetospheres (separatrix and current sheet emission) predict light curves that best describe the rich phenomenology of Fermi light curves. In this talk, I will survey the recent theoretical work that has been done on pulsar light curve modelling, and also provide an overview of open problems and new developments in this area of research.

Primary author: VENTER, Christo (North-West University Potchefstroom Campus)

Presenter: VENTER, Christo (North-West University Potchefstroom Campus)

Session Classification: Exploring the Galaxy: Pulsars, Pulsar Wind Nebulae and Supernova Remnants

Track Classification: Pulsar

Contribution ID: **109** Type: **Contributed**

The Third Fermi-LAT Pulsar Catalog

Friday, April 16, 2021 3:50 PM (15 minutes)

The Third Fermi Pulsar Catalog (3PC) is nearing completion and will provide timing solutions, pulse profiles, spectra, and ancillary data for about 250 gamma-ray detected pulsars. It is a tremendous undertaking, as it continues the geometric increase in source count established by 1PC (46 pulsars) and 2PC (117 pulsars). This large population reflects the application of ever-more-sophisticated search techniques that turn up very gamma-faint radio pulsars and a surprising number of radio-eclipsing binary systems (black widows, redbacks, tiddarens, and huntsmen!) Because radio emission in young pulsars is thought to identify the polar cap, the radio-loud population is particularly useful in constraining pulsar emission models. Indeed, the capability of finite-resistivity MHD models to produce the observed trends in 2PC data provided the first strong evidence for emission from the current sheet, beyond the light cylinder. We will present analogous results from 3PC for a much larger sample, as well as general properties of the population and further highlights from the analysis.

Primary author: KERR, Matthew

Presenter: KERR, Matthew

Session Classification: Exploring the Galaxy: Pulsars, Pulsar Wind Nebulae and Supernova Remnants

Track Classification: Pulsar

Contribution ID: **110** Type: **Invited**

eROSITA –The new X-ray all-sky survey

Friday, April 16, 2021 4:35 PM (25 minutes)

Primary author: PREDEHL, Peter

Presenter: PREDEHL, Peter

Session Classification: Exploring Connections: The Multiwavelength Sky

Track Classification: Future Missions/Instruments

Contribution ID: **111** Type: **Invited**

The Square Kilometre Array: Big Telescope, Big Science, Big Data

Friday, April 16, 2021 5:00 PM (25 minutes)

The first decades of this century has seen a tremendous advance in information and digital technologies impacting scientific inquiry. Data being created by global projects in science and engineering, by the ubiquitous sensors tracking the state of the planet, by the connected internet of things, and by vast and complex collections of meta data that trace the patterns and trends in human behaviour are beginning to be creatively mined in ways that fundamentally change our perception of the world and empower global change.

The Square Kilometre Array, one of the largest scientific projects ever undertaken, has harnessed these advances to create one of the biggest data challenges in science of the coming decades. Under development by an international consortium of thirteen countries, it is one of a suite of future global flagship projects designed in consort to answer our biggest questions about the universe, The SKA is coming to Africa to be hosted by an eight-country African partnership. The MeerKAT telescope just completed in the Great Karoo is the first element of the SKA and marks the beginning of the new era big data in African astronomy. A new generation of researchers working at the forefront of data science and multi-wavelength astronomy will be critical to African leadership in the SKA science enterprise.

Presenter: TAYLOR, Russ

Session Classification: Exploring Connections: The Multiwavelength Sky

Track Classification: Future Missions/Instruments

Contribution ID: **112** Type: **Invited**

Science with Fermi and the Cherenkov Telescope Array

Friday, April 16, 2021 5:25 PM (25 minutes)

The Cherenkov Telescope Array (CTA) is a next generation facility for ground-based gamma-ray astronomy operating in the very high energy (20 GeV to 300 TeV) range. It will consist of two telescope arrays, one on the island of La Palma in the Canary Islands, and the other near Paranal, Chile. CTA will provide order of magnitude improvements in sensitivity over current instruments, together with enhanced angular resolution, energy resolution and energy range. The CTA Consortium, consisting of over 1500 members from around the world, has proposed a core program of observations to address a selection of key science goals for the observatory. I will summarize these goals, and highlight links with the Fermi mission.

Primary author: HOLDER, Jamie (University of Delaware)

Presenter: HOLDER, Jamie (University of Delaware)

Session Classification: Exploring Connections: The Multiwavelength Sky

Track Classification: Future Missions/Instruments

Contribution ID: **113** Type: **Contributed**

High-Energy Astrophysics in Namibia

Friday, April 16, 2021 5:50 PM (15 minutes)

Astronomy plays a major role in the scientific landscape of Namibia and Southern Africa. Considerable progress has been achieved scientifically as well as in terms of human capacity development in the field. In all wavelength regimes accessible with ground-based instruments, the largest of those instruments are situated in Southern Africa: MeerKAT, the Southern African Large Telescope, and the High Energy Stereoscopic System (H.E.S.S.). Because of the excellent observing conditions from Namibian soil, further large-scale projects such as the Cherenkov Telescope Array (CTA) considered sites in Namibia and the Africa Millimetre Telescope (AMT) is planned to be built there.
Against this background, the current situation of high-energy astrophysics research and education in Namibia is reviewed:
From characterization of electronics for the new cameras for the H.E.S.S. and CTA telescopes over optical spectroscopy of blazars with SALT in the context of CTA, up to theoretical modelling of high-energy emitters and site testing and project planning for the AMT.
Further, the role of astronomy, with particular focus on developmental aspects in the African context is outlined and the progress in human capacity development is summarized.

Primary author: Dr BACKES, Michael (University of Namibia)

Presenter: Dr BACKES, Michael (University of Namibia)

Session Classification: Exploring Connections: The Multiwavelength Sky

Track Classification: Future Missions/Instruments

Contribution ID: **114** Type: **Contributed**

Recent highlights from VERITAS

Friday, April 16, 2021 6:05 PM (15 minutes)

VERITAS (Very Energetic Radiation Imaging Telescope Array System) is one of the world's most sensitive very-high-energy (VHE; E > 100 GeV) gamma-ray detectors. It consists of four 12-m imaging atmospheric Cherenkov telescopes and has been operating continuously in a full-array mode since 2007. In fourteen years of operation, VERITAS has made a remarkable contribution to the development of gamma-ray astronomy by detecting numerous sources both within and beyond our Galaxy. Its role remains crucial in the new era of multimessenger astrophysics with observations of sources of astrophysical neutrinos and gravitational waves. Recent highlights from the rich VERITAS observation program covering a broad range of scientific topics will be shown and discussed here.

Primary author: CHROMEY, Alisha

Presenter: CHROMEY, Alisha

Session Classification: Exploring Connections: The Multiwavelength Sky

Track Classification: Future Missions/Instruments

Contribution ID: **115** Type: **Contributed**

Point source location and classification at GeV energies using image segmentation and classification neural networks

Saturday, April 17, 2021 3:00 PM (15 minutes)

At GeV energies, the sky is dominated by the interstellar emission from the Galaxy. With limited statistics and spatial resolution, accurate separation of point sources is therefore challenging. In this presentation I will describe the first application of deep learning based algorithms to detect and classify point sources from raw gamma-ray data. To detect point sources we utilise U-shaped convolutional networks for image segmentation and k-means for source clustering and localisation. We also explore the Centroid-Net algorithm, which is designed to find and count objects. The training data is based on 9.5 years of Fermi-LAT exposure and we use source properties of active galactic nuclei (AGNs) and pulsars (PSRs) from the fourth Fermi-LAT source catalog (4FGL) in addition to several models of background interstellar emission. We demonstrate that the source localization algorithms are robust to modifications to the background emission models by using a series of different models. This gives them an important advantage with respect to the more traditional, likelihood based, catalogue derivation techniques. In terms of the source classification, we show that the network is capable of distinguishing between the three general source classes we trained it on (AGNs, PSRs and FAKE) with global accuracy of ~70%, as long as balanced data sets are used in classification training. I will also describe the data challenge that we introduce with this work, inviting the community to participate with the clear scope to address the question: How can we best locate and classify gamma-ray point sources?

Primary author: PANES, Boris

Co-authors: ECKNER, Christopher; ZAHARIJAS, Gabrijela; JOHANNESSON, Gudlaugur; DIJKSTRA, Klaas; HENDRIKS, Luc; RUIZ DE AUSTRI, Roberto; CARON, Sascha

Presenters: PANES, Boris; ECKNER, Christopher; ZAHARIJAS, Gabrijela; JOHANNESSON, Gudlaugur; DIJKSTRA, Klaas; HENDRIKS, Luc; RUIZ DE AUSTRI, Roberto; CARON, Sascha

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **116** Type: **Contributed**

A comprehensive power spectral density analysis of astronomical time series: the gamma-ray light curves of selected Fermi blazars

Saturday, April 17, 2021 3:15 PM (15 minutes)

We present results of Fermi-Large Area Telescope (LAT) light curve (LC) modelling of selected Fermi blazars. All objects possess densely sampled and long-term LCs. For each blazar we generated three LCs with 7, 10, and 14 days binning, using the latest 4FGL catalogue and binned analysis provided within the fermipy package.
The LCs were modelled with several tools: the Fourier transformation, the Lomb-Scargle periodogram (LSP), the autoregressive moving average (ARMA), the fractional autoregressive integrated moving average, the continuous-time autoregressive moving average (CARMA) processes, the Hurst exponents (H), the A-T plane, and the wavelet scalogram.
Power law indices β calculated from the Fourier and LSP modelling are consistent with each other. Many objects yield β≈1, with PKS 2155-304 even flatter, but some are significantly steeper, e.g. Mrk 501 and B2 1520+31. A power law power spectral density (PSD) is indicative of a self-affine stochastic process characterised by H, underlying the observed variability. Several algorithms for the H estimation are employed. For some objects we observe H>0.5, indicating long-term memory. The ARMA results give in general higher orders for 7 days binned LCs and lower orders for 10 and 14 days binned LCs, implying temporal variations in the LCs are consistently captured by the fitted models. CARMA fits lead to featureless PSDs. The recently introduced A-T plane allows to successfully classify the PSDs based on the LCs alone.

Primary author: ZYWUCKA, Natalia

Presenter: ZYWUCKA, Natalia

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **117** Type: **Contributed**

Eliminating single-band dominance in dual-band pulsar light curve fitting

Saturday, April 17, 2021 3:30 PM (15 minutes)

The wealth of multiwavelength pulsar data has stimulated the development of emission models that predict light curves (LCs) over multiple wavebands, most notably radio and gamma-ray. Using established statistical methods to fit these model LCs to data can prove ineffectual if the data from one waveband are substantially more precise. This waveband—typically radio—dominates the fit and biases inferred parameters. We re-examine the use of Pearson's chi-squared statistic for joint fits, and introduce a new, derived statistic. The core insight that this statistic encodes is that the component single-band chi-squared values implicitly express goodness of fit in units of the respective LC uncertainties. The resulting implicit weighting the dual-band chi-squared carries is eliminated by expressing these values in a shared unit before calculating their sum, derived by effectively standardizing the scaled pulsar-associated flux across the two wavebands. Importantly, chi-squared and our new statistic converge to the same constraints as the precision disparity dissipates. As a first test, we fit two amalgamated dual-band models to 23 Fermi LAT pulsars and compare the resulting constraints to earlier results derived using the same data and similar models. Our fits consistently show no radio dominance, and our constraints more strongly correlate with those derived by eye.

Primary author: SEYFFERT, Albertus

Presenter: SEYFFERT, Albertus

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **118** Type: **Contributed**

Assessment of the data-model agreement in Fermi-LAT data analysis

Saturday, April 17, 2021 3:45 PM (15 minutes)

An important step of a Fermi-LAT data analysis of a Region of Interest consists in performing a binned likelihood fit to find the sky model that, after convolution with the instrument response, best predicts the number of observed counts. The data and model counts are binned in a 3d grid, with two spatial and one spectral dimensions. Checking the goodness-of-fit is not straightforward because of the 3d nature of the data/model representation. The usual solution to this problem is to compute a so-called TS map by testing the presence of an additional source at each pixel of the RoI. While this solution is optimal to detect data/model positive deviations, it is not sensitive to negative deviations and it is furthermore very CPU expensive. We propose a new method which provides a map of the deviation probabilities. This method is by construction sensitive to both positive and negative deviations and is much faster than the TS map computation.

Primary author: BRUEL, Philippe

Presenter: BRUEL, Philippe

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **119** Type: **Contributed**

An observational determination of the extragalactic background light from the HST/CANDELS survey in the Fermi and CTA era

Saturday, April 17, 2021 4:00 PM (15 minutes)

The diffuse extragalactic background light (EBL) is formed by ultraviolet (UV), optical, and infrared (IR) photons mainly produced by star formation processes over the history of the Universe, and contains essential information about galaxy evolution and cosmology. In this talk, we present a new determination of the evolving EBL spectral energy distribution using a novel approach purely based on galaxy data aiming to reduce current uncertainties on the higher redshifts and IR intensities. Our calculations use multiwavelength observations from the UV to the far-IR of a sample of approximately 150,000 galaxies detected up to z~6 in the five fields of the Cosmic Assembly Near-Infrared Deep Extragalactic Legacy Survey (CANDELS) from the Hubble Space Telescope. This is one of the most comprehensive and deepest multi-wavelength galaxy datasets ever obtained. These unprecedented resources allow us to derive the overall EBL evolution up to z~6 and its uncertainties. Our results agree with cosmic observables estimated from galaxy surveys and gamma-ray attenuation such as monochromatic luminosity densities, including those in the far-IR, and star formation rate densities, also at the highest redshifts. We will also discuss about the gamma-ray optical depths that are derived from our EBL approximation and how we can measure the expansion of the Universe using very high energy observations of blazars with Fermi-LAT and imaging atmospheric Cherenkov telescopes.

Primary author: SALDANA-LOPEZ, Alberto

Presenter: SALDANA-LOPEZ, Alberto

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **120** Type: **Contributed**

What Racing Distant Fermi GRB Photons Can Tell Us About our Universe

Saturday, April 17, 2021 4:15 PM (15 minutes)

Do photons of different energies disperse as they race across the universe? Potential reasons for dispersion include violations of Lorentz invariance, violations of the weak equivalence principle, and electromagnetic interactions with the intervening matter. Which parameters make GRBs the most sensitive to these potential differences: their great distance, being seen over such a wide range of energies, or their fast time scale of variation? Also, how can we find a fair race where GRB photons were emitted at nearly the same time? Are higher or lower energy photons expected to win the race? Could racing distant GRB gravitational waves tell us something different from photons? Which Fermi GRBs, so far, have probed the universe the best – and why? A review of these Fermi GRBs and the limits they impose on fundamental physics is reviewed, along with a comparison of similar limits from other – and likely future – GRB detectors.

Primary author: NEMIROFF, Robert

Presenter: NEMIROFF, Robert

Session Classification: Exploring Data Analysis

Track Classification: Analysis Techniques

Contribution ID: **121** Type: **Contributed**

Investigating the radio and high-energy connection in a sample of gamma-ray emitting radio-loud AGN

Saturday, April 17, 2021 3:00 PM (15 minutes)

Relativistic jets are among the most variable objects in the Universe. Their variability is observed at all energy bands, from radio wavelengths to gamma rays. Despite decades of efforts, many aspects of the physics of relativistic jets remain elusive. In particular, the location and the mechanisms responsible for the high-energy emission and the connection with the variability at different wavelengths are among the greatest challenges in the study of AGN. High resolution Very Long Baseline Interferometry observations point out the emergence of superluminal jet components close in time with some strong gamma-ray flares. However, this is not a one-to-one relation. Neither all the gamma-ray flares are associated with a new superluminal component, like in the case of PKS 1510-089, nor any ejection of new jet knots occurs during a high activity period at high energy, like for SBS 0846+513.

In this contribution we discuss the gamma-ray properties of radio-loud AGN for which high resolution observations pointed out the ejection of a new superluminal component during the period the Large Area Telescope on board the Fermi satellite has been surveying the sky. In particular, we study the incidence of gamma-ray flares and changes in the radio structure of the relativistic jets.

Primary author: ORIENTI, Monica

Presenter: ORIENTI, Monica

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **122** Type: **Contributed**

Gamma-ray bright AGN: a decade of joint MOJAVE-Fermi monitoring

Saturday, April 17, 2021 3:15 PM (15 minutes)

Within the MOJAVE VLBA program (Monitoring of Jets in AGN with VLBA Experiments) we accumulated observational data at 15 GHz for hundreds of gamma-ray bright active galactic nuclei jets since the beginning of the Fermi observations. We investigated a time delay between flux density of AGN parsec-scale radio emission at 15 GHz and 0.1-100 GeV Fermi LAT photon flux, taken from constructed light curves using weekly and adaptive binning. The correlation analysis based on the ZDCF shows that radio is lagging gamma-ray radiation by up to a few months in the observer's frame, while in the source frame the typical delay is about one month. If the jet radio emission excluding the opaque core is considered, no significant correlation is found. This, along with the estimation of the distance between the radio and the gamma-ray emission regions obtained from the kinematics data, strongly suggests that the dominant high-energy production zone is typically located at a distance of several parsecs from the central nucleus.

Primary author: KRAMARENKO, Ivan

Presenter: KRAMARENKO, Ivan

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **123** Type: **Contributed**

Gamma-ray observations of low-luminosity AGNs

Saturday, April 17, 2021 3:30 PM (15 minutes)

Primary author: DE MENEZES, Raniere

Presenter: DE MENEZES, Raniere

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **124** Type: **Contributed**

Locating the gamma-ray emission in Flat Spectrum Radio Quasars

Saturday, April 17, 2021 3:45 PM (15 minutes)

We present a study of the gamma-ray emission from the 9 brightest flat spectrum radio quasars (FSRQs) detected with the Fermi Large Area Telescope (LAT) during its first eight years of operation, with the aim of constraining the location of the gamma-ray emission from these objects.
Using the brightest flares, we find the shortest variability timescales for our sources, which we then use to constrain the size and location of the emission region assuming a simple one zone emission model. The emission was found to be predominantly from the broad line region (BLR). The flares were also studied in more detail to look for for evidence of spectral cut-off as well as searching for energy dependence of cooling timescales. We found evidence of gamma-ray absorption which further supports the argument of BLR emission, although the study of energy-dependent cooling is limited by the large uncertainties in both the fluxes and decay timescales for these objects.
Finally, we use simulations to compare the expected onset of the intrinsic cut-off in our sample due to Lyman alpha absorption and compare this with the highest energy photons observed from these bright FSRQs. For most objects, the results are compatible with a BLR origin for the gamma-ray emission, with the exceptions of CTA 102 and PKS 0454-234, suggesting that atleast in these objects a more sophisticated emission model is required

Primary author: ACHARYYA, Atreya

Presenter: ACHARYYA, Atreya

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **125** Type: **Contributed**

Modeling the Spectral Energy Distributions and Spectropolarimetry of Blazars

Saturday, April 17, 2021 4:00 PM (15 minutes)

The magnetic field strengths and topologies in blazar jets are not yet well understood. The low-frequency (radio through UV / X-rays) emission from blazars is likely dominated by non-thermal synchrotron emission from relativistic electrons in the jets and is therefore highly polarised, while in the optical through X-ray regime, unpolarised thermal radiation components, e.g., from the accretion disk, the host galaxy, or emission lines from the Broad Line Region, contribute. The accretion disk is not visible for some blazars as it is outshone by the synchrotron emission. Spectropolarimetry observations provide an indication on the frequency regime in the EM spectrum, wherein the unpolarised accretion disk dilutes the synchrotron polarisation, which is visible in a decrease in the total degree of polarisation observed. A Southern African Large Telescope target-of-opportunity, Large Science Program, provides spectropolarimetry of flaring blazars with co-ordinated multi-wavelength observations from the Las Cumbres Observatory, Swift-XRT and Fermi-LAT. A model is presented that simultaneously fits the spectral energy distributions and spectropolarimetry observations for the flat spectrum radio quasar 4C+01.02 (z = 2.1). This enabled constraining its black hole mass to 4 x 10^8 M_sol and gives us a characterizing order of how tangled its magnetic field is in the emission region. Considering a leptonic model, the high energy X-ray and gamma-ray radiation can be modelled with Compton scattering of the synchrotron radiation (polarised), and external radiation fields of the broad line region and accretion disk (unpolarised). Preliminary results are presented of the high-energy (X-ray - gamma-ray) polarisation of 4C+01.02.

Primary author: SCHUTTE, Hester

Presenter: SCHUTTE, Hester

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **126** Type: **Contributed**

Monte-Carlo Simulations of Compton Polarization for Blazars

Saturday, April 17, 2021 4:15 PM (15 minutes)

The spectral energy distributions (SEDs) of some blazars exhibit an ultraviolet (UV) and/or soft Xray excess, which can be modelled with different radiation mechanisms. Polarization measurements of the UV/X-ray emission from blazars may provide new and unique information about the astrophysical environment of blazar jets and could thus help to distinguish between different emission scenarios. I will present a new Monte-Carlo code –MAPPIES (Monte-Carlo Applications for Partially Polarized Inverse External-Compton Scattering) –for polarization-dependent Compton scattering. I will present the code by showing results of the polarization signatures in a model where the UV/soft X-ray excess arises from the bulk Compton process. Predictions of the expected polarization signatures of Compton emission from the soft X-ray excess in the SED of AO 0235+164, and the UV excess in the SED of 3C 279 are made for upcoming and proposed polarimetry missions.

Primary author: DREYER, Lente

Presenter: DREYER, Lente

Session Classification: Exploring the Cosmos: AGN-3

Track Classification: AGN

Contribution ID: **127** Type: **Contributed**

Using The Fermi Treasure Map To Find Pulsars With MeerKAT

Saturday, April 17, 2021 3:00 PM (15 minutes)

Spider pulsars refer to the general class of millisecond pulsar binaries comprising a low-mass companion in a tight-enough orbit for the latter to be strongly affected by the energetic pulsar wind. In the radio regime multiple spider systems present extended eclipses which has made them challenging to discover in typical radio surveys. Fermi LAT has considerably changed this picture as gamma-ray point sources with no identified counterpart often prove to be associated with energetic pulsars, many of which are spider binaries. This treasure map provides a reliable way of performing targeted radio survey for pulsars. In fact, they have been so successful that the number of confirmed/solid candidate spiders is now on par with the number of known pulsars in globular clusters with similar spin periods. They also make up around half of the fastest pulsars in the galactic field (i.e. Ps < 5 ms), which is a stark contrast to the handful known in the pre-Fermi era. With the MeerKAT radio telescope in its early days of operation, the TRAPUM consortium is conducting an extensive survey of the remaining ~1000 unidentified Fermi-LAT sources. We aim to perform the most uniform and complete survey so far in terms of addressing biases related to observing frequency, sky area coverage, instantaneous sensitivity and binary selection effects, possibly targeting up to a third of the remaining sources. In this talk, we present the early results from this survey and prospects it will offer to understand the underlying population of spider binaries.

Primary author: BRETON, Rene

Presenter: BRETON, Rene

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Pulsar

Contribution ID: **128** Type: **Contributed**

Modeling Very-High-Energy Emission from Pulsars

Saturday, April 17, 2021 4:00 PM (15 minutes)

Ground-based Air-Cherenkov telescopes have detected pulsations at energies above 50 GeV from a growing number of Fermi pulsars. These include the Crab, Vela, PSR B1706-44 and Geminga, with the first two having pulsed detections above 1 TeV. There appears to be VHE emission that is an extension of the Fermi spectra to high energies as well as additional higher-energy components that require a separate emission mechanism. We will present results of broad-band spectral modeling using global magnetosphere fields and multiple emission mechanisms that include synchro-curvature, synchrotron self-Compton (SSC) and inverse Compton (IC) radiation from both accelerated particles and power-energy pairs. Our models predict two VHE components: SSC from pairs that can extend to several TeV and IC from particles accelerated in the current sheet that appears beyond 10 TeV. Model spectra show a wide range of VHE emission, with detectable SSC and IC components expected for Crab-like pulsars and some millisecond pulsars but only an IC component for Vela. We argue that the IC component above 10 TeV from Vela has been seen by H.E.S.S. Detection of this emission component from the Crab and other pulsars is possible with HAWC and CTA and directly measures the maximum particle energy in pulsars.

Primary author: HARDING, Alice

Presenter: HARDING, Alice

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Pulsar

Contribution ID: **129** Type: **Contributed**

Understanding the Pulsar Multipolar Field Structure through NICER and Fermi data

Saturday, April 17, 2021 3:30 PM (15 minutes)

Modeling of the NICER X-ray waveform of the pulsar PSR J0030+0451 aimed to constrain the neutron star mass and radius has inferred surface hot spots (i.e., the magnetic polar caps) that imply significantly non-dipolar magnetic fields. We investigate magnetic field configurations that comprise offset dipole plus quadrupole components using static vacuum field and force-free global magnetosphere models and their inferred hot spots (polar caps). To this end, we compute geodesics from the observer plane to the polar caps to compute the resulting X-ray light curve. Through Markov chain Monte Carlo techniques, we explore the detailed magnetic field configurations that can reproduce the observed X-ray light curve and have discovered degeneracies. Having obtained the force-free field structures, we then compute the corresponding synchronous gamma-ray light curves based on dissipative pulsar magnetosphere models, and we compare these to those obtained by Fermi-LAT to lift the degeneracies and provide models consistent with both the X-ray and the gamma-ray data, thereby restricting further the multipole field parameters. An essential aspect of this approach is the proper computation of the relative phase between the synchronous X- and gamma-ray light curves. The next steps and the broader implications of this study will be discussed.

Primary author: KALAPOTHARAKOS, Constantinos (UMCP CRESST / NASA GSFC)

Presenter: KALAPOTHARAKOS, Constantinos (UMCP CRESST / NASA GSFC)

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Pulsar

Contribution ID: **130** Type: **Contributed**

Constraining the Average Pair Physics of Pulsars Embedded in Terzan 5 through Multi-component Spectral Modelling

Saturday, April 17, 2021 3:45 PM (15 minutes)

Our Galaxy hosts around 160 globular clusters (GCs). The Fermi Large Area Telescope (LAT) has detected about two dozen of them in the GeV band, including Terzan 5. However, only Terzan 5 has plausibly been detected in the very-high-energy range. This unique cluster has also been detected in the radio and X-ray bands. We model the updated broadband spectral energy distribution, attributing this to cumulative pulsed emission from a population of embedded millisecond pulsars, as well as to unpulsed emission resulting from the interaction of the escaping pulsar leptonic winds with the ambient magnetic and soft-photon fields. Using both pulsed and unpulsed spectral components to consistently fit the available data yields strong constraints on the average spatial distribution of currents within the pulsar magnetospheres. We show that a good fit requires increased pair production for particles emitting keV and GeV emission, with a lower multiplicity required to fit the unpulsed components.

Primary author: DAVIDS, Hambeleleni

Presenter: DAVIDS, Hambeleleni

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Pulsar

Contribution ID: **131** Type: **Contributed**

Predicting Broadband Emission from Spider Binaries

Saturday, April 17, 2021 3:15 PM (15 minutes)

Black widow (BW) and redback (RB) systems are compact binaries in which the pulsar heats or ablates its low-mass companion by its intense wind of relativistic particles and emission. Radio, optical and X-ray follow-up of unidentified Fermi Large Area Telescope (LAT) sources has expanded the number of these systems from four to nearly 30. Orbital modulation in X-rays suggests that in many systems, an intrabinary pulsar shock exists as a site for particle acceleration, which in some cases may wrap around the pulsar. We model the X-ray and γ-ray spectral components from nearby spider binaries', including diffusion, convection and radiative energy losses in an axially-symmetric, steady-state approach. The code simultaneously yields energy-dependent light curves and orbital phase-resolved spectra. We constrain certain model parameters and estimate the broadband flux for various systems via data fitting, enabling us to identify the effect that different system conditions (e.g. shock orientation or stand-off distance) have on the expected emission from the two subclasses. Two sources, J1723-2837 (RB) and J1311-3430 (BW), have been observed by Fermi-LAT, leading to constraints on the maximum particle energy and particle acceleration. We find that nearby binaries in aflaring state'are promising targets for H.E.S.S. and the future Cherenkov Telescope Array (CTA), and that GeV photons (in the off-peak phases of the pulsar light curve) may be detectable by Fermi-LAT for optimistic parameter choices. Moreover, some of these systems will be excellent targets for future MeV missions such as AMEGO.

Primary author: Dr WADIASINGH, Zorawar (NASA GSFC)

Presenter: Dr WADIASINGH, Zorawar (NASA GSFC)

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Pulsar

Contribution ID: **132** Type: **Contributed**

A search for new TeV sources with HAWC

Saturday, April 17, 2021 4:15 PM (15 minutes)

We will present our follow-up studies of candidate TeV sources. Instead of a blind scan, we searched for significant multi-TeV emission from previously identified targets. Using data from the most recent HAWC sky map (1132 days), we followed up two lists of proposed sources: the sources flagged as good TeV candidates in the Third Catalog of Hard Fermi-LAT Sources (3FHL); and the unassociated sources in the first HAWC catalog (508 days) of TeV gamma-ray sources (2HWC).

Primary author: Prof. MOSTAFA, Miguel (Penn State University)

Presenter: Prof. MOSTAFA, Miguel (Penn State University)

Session Classification: Exploring the Galaxy: Models and Maps

Track Classification: Future Missions/Instruments

Contribution ID: **133** Type: **Contributed**

GECAM, a new GW Counterpart All-sky Monitor in 2020's

Saturday, April 17, 2021 4:30 PM (15 minutes)

GECAM (Gravitational wave high-energy Electromagnetic Counterpart All-sky Monitor) is an ALL-TIME ALL-SKY monitor for GW EM. It consists of two small satellites in the same Low Earth Orbit (~600 km, 29°) with opposite orbital phase, monitoring instantaneous 100% all-sky from 6 keV to 5 MeV, without a turned-off during the SAA passage.
GECAM shall detect several GW GRBs per year jointly with LIGO/Virgo, as one of the best high-energy monitors in the multi-messenger and multi-wavelength era in the early 2020s

Primary author: ZHENG, Shijie

Presenter: ZHENG, Shijie

Session Classification: New Instruments and Opportunities

Track Classification: Future Missions/Instruments

Contribution ID: **134** Type: **Contributed**

BurstCube: A CubeSat for Gravitational Wave Counterparts

Saturday, April 17, 2021 4:45 PM (15 minutes)

Joint detections between gravitational waves and gamma-ray bursts (GRBs) enable multi-messenger science and allows for constraints on the neutron star equation of state, tests of fundamental physics, and insight into the origin of the prompt emission. To increase the likelihood of these coincident detections, full sky coverage in the gamma-ray regime is needed. BurstCube aims to expand sky coverage in order to detect and localize GRBs. BurstCube will be comprised of 4 Cesium Iodide scintillators coupled to arrays of silicon photo-multipliers (SiPMs) and will be sensitive to gamma-rays between 50 keV and 1 MeV, the ideal energy range for GRB prompt emission. BurstCube will assist current observatories, such as Swift and Fermi, in the detection of GRBs as well as provide astronomical context to gravitational wave events detected by LIGO, Virgo, and KAGRA. BurstCube is currently in its development phase and will reach launch readiness in the spring of 2022. I present the mission concept, preliminary performance, and current status.

Primary author: JOENS, Alyson

Presenter: JOENS, Alyson

Session Classification: New Instruments and Opportunities

Track Classification: Future Missions/Instruments

Contribution ID: **135** Type: **Contributed**

The Transient High-Energy Sky and Early Universe Surveyor (THESEUS)

Saturday, April 17, 2021 5:00 PM (15 minutes)

The Transient High-Energy Sky and Early Universe Surveyor (THESEUS) is a space mission concept currently under Phase A study by ESA as candidate M5 mission, aiming at exploiting Gamma-Ray Bursts for investigating the early Universe and at providing a substantial advancement of multi-messenger and time-domain astrophysics. Through an unprecedented combination of X-/gamma-rays monitors, an on-board IR telescope and automated fast slewing
capabilities, THESEUS will be a wonderful machine for the detection, characterization and redshift measurement of any kind of GRBs and many classes of X-ray transients. In addition to the full exploitaiton of high-redshift GRBs for cosmology (pop-III stars, cosmic re-ionization, SFR and metallicity evolution up to the "cosmic dawn"), THESEUS will allow the identification and study of the electromagnetic counterparts to sources of gravitational waves which will be routinely detected in the late '20s / early '30s by next generation facilities like aLIGO/aVirgo, LISA, KAGRA, and Einstein Telescope (ET), as well
as of most classes of transient sources, thus providing an ideal sinergy with the large e.m. facilities of the near future like LSST, ELT, TMT, SKA, CTA, ATHENA.

Primary author: Dr AMATI, Lorenzo (INAF - OAS Bologna)

Presenter: Dr AMATI, Lorenzo (INAF - OAS Bologna)

Session Classification: New Instruments and Opportunities

Track Classification: Future Missions/Instruments

Contribution ID: **136** Type: **Contributed**

X-ray counterparts of gravitational waves

Saturday, April 17, 2021 5:15 PM (15 minutes)

The discovery of the joint GRB/GW 170817 events opened a new window into the multi-messenger astronomy. The Advanced gravitational wave detectors of second and third generation will observe larger and larger volume of the Universe. While the current optical surveys will suffer of the faint kilonova emission and many contaminants within the gravitational-wave poor sky-localization, and the gamma-rays of rare detectable events, the X-ray band could play a key role for joint detections. The future wide-field X-rays missions are expected to detect these sources while the usual GRB prompt emission would be most probably missing. I will present the advantages of the X-ray domain for the potential increase of the number of GW-GRB associations with respect to the gamma-rays. I will discuss several classes of soft X-ray counterparts expected from the prompt and the afterglow phases for off-axis observers, and robust observational strategies to detect them.

Primary author: OGANESYAN, Gor

Presenter: OGANESYAN, Gor

Session Classification: New Instruments and Opportunities

Track Classification: Future Missions/Instruments

Contribution ID: **137** Type: **Contributed**

Polarimetry of gamma rays converting to e+e- pairs: performance of silicon strip detectors-based telescopes

Saturday, April 17, 2021 5:30 PM (15 minutes)

The polarimetry of gamma rays converting to an e+e- pair would open a new window on the high-energy sky with, among other things, providing insight into the radiation mechanism in young pulsars (curvature or synchrotron) or deciphering the composition of the gamma-ray emitting jets in blazars (leptonic or lepto-hadronic).

The performance of polarimeters based on homogeneous active targets (gas detectors (MeV, HARPO) or emulsions (GeV, GRAINE)) has been studied both with simulation and by the analysis of data collected with telescope prototypes on linearly-polarized gamma-ray beams, and found to be excellent, but the present (Fermi-LAT, AGILE) and project (AMEGO, ASTROGAM) gamma-ray missions are using active targets based on silicon strip detectors (SSD). After past attempts to demonstrate a non-zero effective polarization asymmetry with SSDs failed, be it only with simulated data, published sensitivity estimations had to be obtained from an assumed value of the effective polarization asymmetry.

I will present a characterization of the potential of SSD-based active targets for polarimetry with gamma ray conversions to pairs, and the development of various methods to improve on the sensitivity. These results were obtained using data simulated with my home-made, exact, five-dimensional, event generator and a dedicated event-reconstruction method. This work could pave the way to providing the polarimetry of the brightest gamma-ray sources of the sky from the decade of data collected by by the Fermi-LAT and by AGILE, and to guiding the design of future missions.

Primary author: BERNARD, Denis Robert Leon (Centre National de la Recherche Scientifique (FR))

Presenter: BERNARD, Denis Robert Leon (Centre National de la Recherche Scientifique (FR))

Session Classification: New Instruments and Opportunities

Track Classification: Future Missions/Instruments

Contribution ID: **138** Type: **Contributed**

Concluding remarks

Saturday, April 17, 2021 5:45 PM (15 minutes)

Primary authors: HAYS, Elizabeth (NASA GSFC); RACUSIN, Judith; BOETTCHER, Markus (North-West University); RAZZAQUE, Soebur (University of Johannesburg)

Presenters: HAYS, Elizabeth (NASA GSFC); RACUSIN, Judith; BOETTCHER, Markus (North-West University); RAZZAQUE, Soebur (University of Johannesburg)

Session Classification: New Instruments and Opportunities

Contribution ID: **139** Type: **Poster**

Absorption spectroscopy of GRB160410A: First complete study of the ISM of a short GRB

Tuesday, April 13, 2021 6:24 PM (4 minutes)

Short gamma-ray burst are, as we now know, produced as the result of the coalescence of two compact objects. These objects are also known to release large amounts of energy in gravitational waves during the merger. We present our first results on the study of GRB 160410A, an undoubtedly short GRB at z=1.717, making it one of the farthest short GRBs to date. We observed the afterglow emission starting just 8.2 minutes after the detection with Neil Gehrels Swift Observatory using the Rapid Response Mode from X-Shooter spectrograph mounted in VLT at Paranal Observatory. Our fast reaction gave us high-quality data that show a large number of absorption lines as well as Lyman α. This allows us the first ever detailed study of chemical properties in the sight-line of a short GRB and the first metallicity measurement for a short GRB in absorption. The environment seems to have an unusually low ionization state compared to long GRBs with all high ionization states such as CIV and SiIV being completely absent while they are frequently observed in long GRBs. The low ionization is consistent with the idea of a neutron star binary coalescence with a long delay time, where the host galaxy would no longer have the very active star formation that is normally seen in long GRB hosts. In addition to the host galaxy features we find several intervening absorbers at lower redshifts. Our spectra is the first ever complete study of the ISM in the host of a short GRB.

Primary author: AGÜÍ FERNÁNDEZ, José Feliciano

Presenter: AGÜÍ FERNÁNDEZ, José Feliciano

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **140** Type: **Poster**

Temporal and Spectral Modelling of Intermediate Luminosity type Ib Supernova SN2015ap.

Tuesday, April 13, 2021 6:40 PM (4 minutes)

In this paper,we present the observed photo metric and spectroscopic properties of a type Ib supernova (SN) SN2015ap. Our aim in this paper is to model a reliable progenitor for SN2015ap, which can undergo core-collapse and explain the observed properties of this SN. Initially, this SN shows some broad-lined features like SN2008D and later it shows features matching with normal type Ib supernovae (SNe). We tried to synthetically reproduce the explosion. For this purpose, we modelled a 12 M zero-age main sequence star and evolved it until the onset of core-collapse using the stellar evolution code MESA. Thereafter a synthetic explosion is produced using SNEC, which provides properties such as observed bolometric luminosity, black body radius, temperature and velocity evolution of the photo-sphere. We compare the observed parameters of SN2015ap with those produced by synthetic explosion and find satisfactory agreement with each other supporting a 12 M progenitor for SN2015ap.

Primary author: ARYAN, Amar

Presenter: ARYAN, Amar

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: SN

Contribution ID: **141** Type: **Poster**

Double-dipping for dark matter with gamma-rays

Tuesday, April 13, 2021 7:42 AM (7 minutes)

Gamma-ray probes have historically been a gold-standard in indirect dark matter detection due to their smaller set of complicating factors and generally lower backgrounds. However, they are most optimally sensitive to the traditional supersymmetric WIMP annihilation channels and leptophilic channels (particularly for larger masses) are much harder to probe effectively in this manner. However, these channels do produce strong neutrino emissions but this has been complicated by lack of neutrino telescope sensitivity. In this work we display a method for inferring neutrino fluxes from gamma-ray data and using this to achieve superior constraints on the leptophilic channels of WIMP annihilation. This allows us to 'double-dip' re-using the same gamma-ray data sets to get a wider range of robust WIMP and stringent annihilation constraints. We demonstrate this approach with data from HESS and Fermi-LAT and use it to probe dark matter models suggested to explain recently reported cosmic-ray excesses.

Primary author: BECK, Geoff

Presenter: BECK, Geoff

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Dark Matter

Contribution ID: **142** Type: **Poster**

Constraining the intergalactic magnetic field with Fermi-LAT observations of seven ultra-high-frequency peaked BL Lac sources.

Tuesday, April 13, 2021 8:03 AM (6 minutes)

Galaxies and galaxy clusters are separated by large distances of nearly empty
space called the intergalactic space. In these large, nearly empty regions a weak magnetic field of strength < 10 nG is present that is predicted to be of primordial (early universe) origin. This is called the intergalactic magnetic field (IGMF) and knowledge about its strength, coherence length, origin etc. is limited. Understanding the origin of the IGMF is crucial because of the impact it may have had on early star and galaxy formations. Gamma-ray observations of very high energy emitting blazars provide one method to indirectly probe the IGMF. The gamma ray photons emitted from the blazars will undergo gamma-gamma absorption due to their interaction with the extragalactic background light (EBL), producing electrons-positrons pairs. These electron-positron pairs can then upscatter photons from the cosmic microwave background (CMB) to produce a secondary cascade component at lower energies ($\approx 0.1 - 10$ GeV). However the IGMF can scatter the electron-positron pairs away and thus attenuating the emission that will be superimposed on the blazars intrinsic spectrum. This attenuation is highly dependent on the IGMF strength and the coherence length. Seven hard and non-variable sources were selected to be re-analysed, using the Fermi Science Tools package (version 1.0.5 released on 05/21/2019) with the improved Pass 8 analysis pipeline. Using previous IACT observations results, the secondary cascade component was modelled using the Monte Carlo code of Kachelrieß et al. and the primary and total spectrum components were compared to the Fermi-LAT spectrum, allowing constraints to be placed on the strength of the IGMF.

Primary author: BISSCHOFF, Brandon

Presenter: BISSCHOFF, Brandon

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **143** Type: **Poster**

Ultrahigh-energy cosmic-ray interactions as the origin of very high-energy gamma-rays from BL Lacertae objects

Tuesday, April 13, 2021 8:00 AM (3 minutes)

We explain the observed multiwavelength photon spectrum of some high energy BL Lac objects, using a lepto-hadronic model. The one-zone leptonic emission is employed to fit the synchrotron peak. Subsequently, the SSC spectrum is calculated, such that it extends up to the highest energy possible for the jet parameters considered. The data points beyond this and also in the entire VHE range (E>30 GeV) are well explained using a hadronic origin. The UHECRs escaping from the source interacts with the EBL background during propagation over cosmological distances to initiate electromagnetic cascade down to GeV energies. The resulting photon spectrum peaks at ~ TeV energies. We consider a random turbulent EGMF with a Kolmogorov power spectrum to find the survival rate of UHECRs within 0.1 degrees of the direction of propagation in which the observer is situated. We restrict ourselves to an RMS value of EGMF ~ 10^-5 nG for a significant contribution to the photon SED from UHECR interactions. The kinetic power in UHECRs required in this scenario is estimated and compared with the Eddington luminosity of the sources. We discuss the possibility of UHECR detection from these sources and find the neutrino fluxes produced from each source. The uncertainties posed due to the choice of EBL models are also presented.

Primary author: DAS, Saikat

Presenter: DAS, Saikat

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **144** Type: **Poster**

GRB 171205A/SN2017iuk as a reference for GRB studies

Tuesday, April 13, 2021 6:28 PM (4 minutes)

GRB 171205A was one of the closest GRBs that we have ever detected and one of the best-followed events. In this talk I will present the result of several studies of this event, its afterglow, associated supernova SN2017iuk, and host galaxy. Optical spectroscopy ranges from one hour after the event to more than 7 months later. These data served to identify cocoon signatures during the first 3 days, with material expanding at speeds that reached 0.3c (Izzo, de Ugarte Postigo et al. 2019, Nature 565, 324), and study the supernova evolution into the nebular phase. The interaction of the jet that emerged from the collapsing star with the interstellar medium generated a weak afterglow. In spite of its intrinsic faintness, thanks to the proximity of the GRB, we have been able to follow the radio emission for over 2 years now, obtaining a detailed insight on the physics involved in this event. Finally the data are complemented with a very detailed study of the host galaxy in which this GRB happened, thanks to high-resolution HST imaging, resolved molecular spectroscopy from ALMA and optical integrated field spectroscopy from VLT/MUSE. The GRB is located in the outskirts of a barred grand-design spiral galaxy, a very unique environment for a long GBR.

Primary author: DE UGARTE POSTIGO, Antonio

Presenter: DE UGARTE POSTIGO, Antonio

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **145** Type: **Poster**

M@TE - Extending the Coverage of TeV Monitoring

Tuesday, April 13, 2021 6:16 PM (4 minutes)

Blazars are extremely variable sources showing flux variations on time scales from minutes to years. To study typical variability time scales of few hours to one day, continuous observations are crucial. Furthermore, studying the temporal evolution of the spectral energy distribution is a key to discriminate between different theoretical models for the emission mechanisms and processes underlying the
observed variability.

Monitoring at TeV Energies (M@TE) is a project aiming at long-term observations of blazars in gamma rays. Combining these observations with the long-term monitoring carried out by FACT the continuous coverage will be extended to 12 hours. For this, a small imaging air Cherenkov telescope is being installed in Mexico. A mount from a previous experiment is being refurbished and will be equipped with a new SiPM camera. Providing an excellent and stable performance, these semi-conductor photo sensors are ideal for long-term monitoring. The mount, a new drive system and new mirrors are already available. The new SiPMs
purchased provide an improved photon detection efficiency. Different options for the production of the light guides are under investigation. Simulations of the different detector components are being implemented. With the observatory of San Pedro Martir, an excellent site has been chosen.

In the presentation, an overview of the project will be given and its status discussed.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Instrumentation

Contribution ID: **146** Type: **Poster**

X-ray luminosity function of FSRQ with BAT 105 month catalog and contribution to cosmic MeV gamma-ray background

Tuesday, April 13, 2021 7:18 AM (3 minutes)

FSRQs are important to study cosmic evolution of AGN jet and also interesting how they contribute to the cosmic MeV gamma-ray background. Past studies with hard X-ray (Swift/BAT 22 month catalog) and GeV gamma-ray (Fermi/LAT) reported the X-ray and gamma-ray luminosity function, but predicts a different evolution between X-ray and GeV gamma-ray. Here we used the Swift/BAT 105 month catalog to double the number of sample FSRQs and derived a X-ray luminosity function with luminosity-dependent density evolution model as used in the GeV gamma-ray study. Then we found that the X-ray luminosity function is consistent with that of GeV gamma-ray within uncertainties. Also we calculated the contribution of FSRQs to the cosmic MeV gamma-ray background and found that their contribution is minor. Interestingly, half of our sample FSRQs are not detected by Fermi/LAT, indicating many MeV-peak FRRQs

Primary author: FUKAZAWA, Yasushi

Presenter: FUKAZAWA, Yasushi

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **147** Type: **Poster**

The first gamma-ray flare of the peculiar source PKS 2004-447

Tuesday, April 13, 2021 7:00 AM (3 minutes)

While blazars are abundant in the gamma-ray sky, there is only a handful of narrow-line Seyfert 1 galaxies that Fermi/LAT detected in more than 10 years of observation. Flares from this elusive source class are among the rarest events that Fermi has seen so far.
One of them is the radio- and gamma-ray loud source PKS 2004-447. It exhibits blazar-like features, i.e., a flat featureless X-ray spectrum and a core-dominated, one-sided parsec-scale jet with indications for relativistic beaming.
However, the spectrum also shows properties atypical for blazars, such as a steep radio spectrum and large-scale size consistent with compact-steep-spectrum objects, which are usually associated with young radio galaxies. Such characteristics are unique among all gamma-loud NLS1s and extremely rare among gamma-loud AGN.
Very recently, PKS 2004-447 showed its first bright gamma-ray flare since the beginning of the Fermi Mission, for which optical/UV, X-ray and radio follow-up observations took place.
We will present results on the multi-wavelength analysis, focusing on the source classification based on the X-ray spectra and the construction of the spectral energy distribution with a quasi-simultaneous dataset.

Primary author: GOKUS, Andrea

Presenter: GOKUS, Andrea

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **148** Type: **Poster**

Automated classification of X-rays sources within the extent of Fermi-LAT sources

Tuesday, April 13, 2021 7:56 AM (13 minutes)

The release of the Fermi-LAT 4FGL catalog includes over 1,000 unidentified Fermi-LAT sources (roughly 25% of sources). One of the most successful ways to uncover their counterparts are through X-ray observations. Over their ~20 year lifetimes XMM-Newton and Chandra have observed a large number of Galactic fields, many of which contain unidentified Galactic Fermi-LAT sources. Often these fields can contain 10s to 100s of X-ray sources, most of which need to be vetted as potential GeV counterparts owing to the large positional uncertainties of the Fermi-LAT sources. Studying each individual X-ray source manually is a tedious and time consuming task. However, machine learning methods can substantially speed up this task. Here we present a systematic study of archival X-ray observations of fields containing these unidentified 4FGL Fermi-LAT sources, using our multi-wavelength machine learning pipeline (MUWCLASS). We will discuss the most interesting sources and present results from their IR to GeV spectral and timing analyses. Additionally, new high cadence optical surveys (e.g., ZTF, TESS, ASAS-SN), when combined with X-ray variability information, provide a new window to help identify and classify highly variable sources, such as high-mass gamma-ray binaries, spider millisecond pulsars, and AGN. We will also discuss the ongoing implementation of this information into our pipeline.

Primary author: HARE, Jeremy

Presenter: HARE, Jeremy

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Catalogs

Contribution ID: **149** Type: **Poster**

A Fundamental Plane of Gamma-Ray Pulsars: Observations and Kinetic PIC Models

Tuesday, April 13, 2021 7:15 PM (5 minutes)

The Fermi data imply that the gamma-ray observables, i.e., the gamma-ray luminosity, spectral cut-off energy, stellar surface magnetic field, and spin-down power obey a relation that represents a 3D plane in the 4D log-space. This observed fundamental plane (FP) is remarkably close to the theoretical relation that is obtained, assuming that the pulsar gamma-ray emission is due to curvature radiation. We present advanced kinetic particle-in-cell (PIC) models that reproduce both the shapes of the gamma-ray light curves and the FP. Our modeling predicts also that the cutoff energies decrease toward low spin-down powers for both young and millisecond pulsars implying that the observed death line of gamma-ray pulsars is due to cutoff energies dropping below the Fermi band.

Presenter: KALAPOTHARAKOS, Constantinos (UMCP CRESST / NASA GSFC)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **150** Type: **Poster**

SN 2010kd: Photometric and Spectroscopic Analysis of a Slow-Decaying Superluminous Supernova.

Tuesday, April 13, 2021 6:36 PM (4 minutes)

This poster presents data and analysis of SN 2010kd, a low-redshift (z = 0.101) H-deficient superluminous supernova (SLSN), based on ultraviolet/optical photometry and optical spectroscopy spanning between −28 and +193 days relative to B band maximum light. The B band light curve comparison of SN 2010kd with a subset of well-studied SLSNe at comparable redshifts indicates that it is a slow-decaying but less luminous SLSN. Analytical light-curve modeling using the Minim code suggests that the bolometric light curve of SN
2010kd favors models having combined circumstellar matter interaction and heating from radioactive decay for the powering mechanism. SYNAPPS modeling of the early-phase spectra does not identify broad H or He lines, whereas the photospheric-phase spectra are dominated by O I, O II, C II, C IV and Si II, particularly, presence of both low and high-velocity components of O II and Si II lines. The nebular-phase spectra of SN 2010kd are
dominated by O I and Ca II emission lines similar to those seen in other SLSNe I. The line velocities in SN 2010kd exhibit flatter evolution curves similar to SN 2015bn but with comparatively higher values. SN 2010kd shows a higher single-zone local thermodynamic equilibrium temperature in comparison to PTF12dam and SN 2015bn, and it has an upper O I ejected mass limit of ~ 10 M. The host of SN 2010kd is a dwarf galaxy with a high star-formation rate (~ 0.18 ± 0.04 M yr−1) and extreme emission lines.

Primary author: KUMAR, Amit

Presenter: KUMAR, Amit

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: SN

Contribution ID: **151** Type: **Poster**

Extragalactic Radio Background from Synchrotron Emission of Radio and Normal Galaxies

Tuesday, April 13, 2021 7:03 AM (3 minutes)

The extragalactic radio background in the universe is mainly due to emission from the radio galaxies and normal galaxies. This emission is synchrotron radiation by relativistic electrons gyrating in the magnetic field of the galaxies. Synchrotron self-absorption and free-free absorptions by hot ionised gas in the interstellar medium play an important role to modify radio emission. In this study, we calculate the radio spectra of the radio and normal galaxies. Thereafter, we develop a model for the intensity of extragalactic radio background by using the resulting radio spectra and by integrating over the observed luminosity functions according to cosmological evolution. We compare our model with the latest radio source count data.

Primary author: MOTHA, Nomthendeleko

Presenter: MOTHA, Nomthendeleko

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **152** Type: **Poster**

Hadronic synchrotron mirror model for blazars- Application to 3C279

Tuesday, April 13, 2021 7:06 AM (3 minutes)

On the 28th of January, an orphan very-high-energy γ-ray flare from 3C279 was detected, not accompanied by flaring in the adjacent GeV gamma-ray regime. Orphan flares have to be caused by different processes than normal γ-ray flares. Specifically, the Hadronic Synchrotron Mirror Model has been proposed to provide a consistent explanation of this flare. The expected target photon densities have been calculated analytically using the cloud/mirror model. The results suggest that the Hadronic Synchrotron Mirror Model may provide a plausible explanation. A semi-analytical model has been developed to represent the Hadronic Synchrotron Mirror Model in a realistic fashion. Our analytical estimates are confirmed by detailed numerical simulations of the Hadronic Synchrotron Mirror scenario, predicting snap-shot SEDs and light curves as well as neutrino emission.

Primary author: OBERHOLZER, Laenita

Presenter: OBERHOLZER, Laenita

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **153** Type: **Poster**

High energy face of Gamma-ray bursts

Tuesday, April 13, 2021 6:48 PM (4 minutes)

TeV emissions from Gamma-ray bursts (GRBs) are very important to study the origin and the radiation mechanisms in detail. Recent discoveries of TeV photons in some of the GRBs are challenging to be explained by Synchrotron mechanism. In this work, we present the results of a detailed investigation of the prompt and afterglow emission of recently discovered TeV GRBs (GRB 180720B, GRB 190114C and GRB 190829A) based on the publicly available prompt and afterglow data. We studied the time-resolved spectroscopy of their prompt emission data to understand their emission mechanisms and to search for spectral parameter correlations based on various binning methods such as Bayesian blocks and signal to noise (SNR). GRB 190829A is a peculiar low luminous burst and it could have shock- breakout origin. We analyzed the late time Fermi-LAT emission that encapsulates the H.E.S.S. and MAGIC detection. Some of the LAT photons are likely to be associated with the GRBs and they could have Inverse Compton mechanism origin.

Primary author: PANDEY, Shashi Bhushan

Presenter: PANDEY, Shashi Bhushan

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **154** Type: **Poster**

Constraining TeV emission regions in gamma-ray binaries with gamma-gamma absorption

Tuesday, April 13, 2021 7:10 PM (5 minutes)

Gamma-ray binaries are a class of high-mass binary systems which are distinguished by their spectral energy distributions peaking above 1 MeV. Gamma-ray binaries consist of an O or B type companion and an orbiting compact object which is either a neutron star or a black hole. Generally in these systems the nature of the compact object is unknown except for two cases, namely PSR B1259-63 and PSR J2032+4127, where the compact objects have been identified to be pulsars. For a neutron star compact object the non-thermal emission is believed to originate from the interaction between the stellar and pulsar winds. It has been suggested that there are multiple regions of emission in these systems with the GeV and TeV emission potentially originating from different locations. The influence of gamma-gamma absorption on the gamma-ray emission may, therefore, be a tool in constraining the location of the TeV emission region. We have calculated the gamma-gamma absorption expected around six of the seven known gamma-ray binaries and are studying the influence on the observed spectrum. With this we plan to place constraints on the TeV production location. The results of this study will be used for predictions based on the upcoming Cherenkov Telescope Array (CTA).

Primary author: PLOOY, Drikus

Presenter: PLOOY, Drikus

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Binaries

Contribution ID: **155** Type: **Poster**

Measure the weighted cross correlation between GeV and MeV fluxes of Blazars

Tuesday, April 13, 2021 7:21 AM (3 minutes)

An active galactic nucleus with a relativistic jet pointing within 10o of the line of the sight of the earth is known as a Blazar. Normally a Blazar has two relativistic jets. These jets are linear features instigating very close to the super massive black hole (SMBH) at the center of an Active Galactic Nucleus (AGN). A broad region of energies consist in these jets from radio rays to gamma rays. Blazars emitting energies due to non-thermal processes called the inverse Compton Effect and Synchrotron radiation. The model for blazers were proposed in 1978 by Blandford and Rees. Even though it has taken almost 40 years still the model is incomplete. This research is an effort to complete the model of Blazars. In this research a weighted cross correlation was calculated using a python script. Mrk421 and Mrk501 was selected as sources for this research. Three day bin analysis has been used for 22 months. Data was taken for two energy ranges, 100MeV −1000MeV for MeV file and 1GeV to 100GeV for GeV file. Then weighted cross correlation was taken. As the results of this project two weighted cross correlation graphs were plotted. First graph was plotted to Mrk501 and second graph was plotted to Mrk421. Mrk501 was showed nothing but the plot of Mrk421 had a six day lag between GeV and MeV fluxes. There are three possibilities to explain this kind of lag. First one is there might be two different places for triggering MeV and GeV fluxes, second one is there might be different triggering mechanisms and the third one is the possibility of having Lorentz Invariant Violation (LIV).

Primary author: RANDU, Mithun

Presenter: RANDU, Mithun

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **156** Type: **Poster**

GRB 190114C: from prompt to afterglow?

Tuesday, April 13, 2021 6:20 PM (4 minutes)

I will present the interesting case of GRB 190114C, the first GRB ever detected by MAGIC at Very High Energy (VHE). We analyzed the spectral evolution of its gamma-ray emission as detected by the Fermi Gamma-Ray Burst Monitor (GBM) up to~60 s. We revealed the presence of an extra component starting on ~4 s post-trigger. This extra component rises and decays quickly (peaking at~6 s) and it is characterized by a non-thermal spectrum that can be fit by a power law. We interpret this additional component as due to the afterglow of the burst. The onset time allows us to estimate the initial jet bulk Lorentz factor Gamma0 which is ~ 130-700, depending on the assumed circum-burst density profile.

Primary author: RAVASIO, Maria Edvige

Presenter: RAVASIO, Maria Edvige

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **157** Type: **Poster**

The impact of the circumstellar magnetic field on the observed gamma-ray spectrum from supernova remnants

Tuesday, April 13, 2021 7:00 PM (5 minutes)

Supernova remnants (SNRs) are widely believed to be one of the main candidates for the origin of Galactic cosmic rays. Very-high-energy gamma-ray emission observed from a number of SNRs suggests that particles are indeed accelerated to high energies by shock in remnants. However, it is extremely difficult to discriminate which particles are responsible for this emission as both protons (through hadronic interactions and subsequent pion decay) and electrons (through inverse Compton scattering on ambient photon fields) can potentially generate gamma-ray photons. The recent detection of the abrupt cut-off at lower energies in the gamma-ray spectra of two SNRs, IC 443 and W44, with the Fermi-LAT provided strong evidence that cosmic-ray protons are indeed accelerated in SNRs based on the interpretation of this cutoff as a characteristic pion-decay feature. However, it can be shown that certain spatial or temporal variability of the ambient medium can result in similar spectral features in the leptonic scenario adding another uncertainty to the determination of the emitting process. SNRs created in core-collapse explosions expand inside the stellar wind bubble blown up by a progenitor star. The magnetic field in the wind medium follows a 1/r profile with high values at the surface of the star, e.g. 1-10 G for red supergiants. This means that at the early stages of its evolution the remnant interacts with a very strong magnetic field, which results in a synchrotron cooling feature in the electron spectrum, which in turn shows up in the gamma-ray spectrum as a break at similar energies as a pion-decay signature. In this work, we study how the circumstellar magnetic field might modify the resulting spectrum of electrons and subsequent gamma-ray spectrum.

Primary author: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Presenter: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: SNR

Contribution ID: **158** Type: **Poster**

Characterizing long-term leptonic variability in blazars

Tuesday, April 13, 2021 7:09 AM (3 minutes)

Most research on blazar variability focuses on individual flares to explain acceleration and radiation mechanisms and improve on current models. These short-time events (being minutes, hours, or days) might not be representative of the underlying mechanisms causing small-amplitude variability and/or continuous emission which is present most of the time. We will therefore investigate long-term (months to years) variability of blazar emission in the framework of current leptonic blazar models. For this purpose, we introduce generated time-dependent parameter variations which are based on typical Power Spectral Densities (PSDs) associated with the variability of accretion flows. The PSDs from the resulting light curves are analyzed and compared to one another, as well as the PSD of the input variation. Correlations between light curves are also investigated to aid identification of characteristic variation patterns associated with leptonic models. The resulting multi-wavelength PSDs were found to follow the input variation PSD trend closely, however, it presented no clear distinctions between the varied parameters. The multi-wavelength cross-correlations showed significant difference among the varied parameters. We therefore conclude that the PSDs are plausible candidates for extracting the variational trends of variability progenitors while multi-wavelength cross-correlations would be a plausible diagnostic for identifying radiative mechanism characteristics as well as the varying quantity in the emission region.

Primary author: THIERSEN, Hannes

Presenter: THIERSEN, Hannes

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **159** Type: **Poster**

Systematic physical characterization of the gamma-ray spectra of 2FHL blazars

Tuesday, April 13, 2021 7:24 AM (3 minutes)

We test different physically motivated models for the spectral shape of the gamma-ray emission in a sample of 128 blazars with known redshifts detected by Fermi-LAT at energies above 50 GeV. The first nine years of LAT data in the energy range from 300 MeV to 2 TeV are analyzed in order to extend the spectral energy coverage of the 2FHL blazars in our sample. We compare these spectral data to four leptonic models for the production of gamma-rays through Compton scattering by a population of electrons with different spectral shapes. In the first three models we consider Compton scattering in the Thomson regime with different acceleration mechanisms for the electrons. In the fourth model we consider Compton scattering by a pure power law distribution of electrons with spectral curvature due to scattering in the Klein-Nishina regime. The majority of blazar gamma-ray spectra are preferentially fit with either a power law with exponential cut-off in the Thomson regime or a power law electron distribution with Compton scattering in the Klein-Nishina regime, while a log-parabola with a low-energy power-law and broken power-law spectral shape in the Thomson regime appear systematically disfavoured, which is likely a consequence of the restriction to pure Thomson scattering which we imposed on those models. This finding may be an indication that the gamma-ray emission from FSRQs in the 2FHL catalog is dominated by Compton scattering of radiation from the dusty torus, while in the case of bL Lac objects, it is dominated by synchrotron self-Compton radiation.

Primary author: VAN DEN BERG, Jacobus

Presenter: VAN DEN BERG, Jacobus

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **160** Type: **Poster**

The ablation of gas clouds by blazar jets and the long-lasting flare in CTA 102

Tuesday, April 13, 2021 7:12 AM (3 minutes)

The FSRQ CTA 102 (z=1.032) has been tremendously active over the last few years. During its peak activity lasting several months in late 2016 and early 2017, the gamma-ray and optical fluxes rose by up to a factor 100 above the quiescence level. We have interpreted the peak activity as the ablation of a gas cloud by the relativistic jet, which can nicely account for the months-long lightcurve in 2016 and 2017. The peak activity was in the middle of a 2-year-long high-state, which was characterized by increased fluxes and increased rms variability compared to the previous low-states, and which was flanked by two bright flares. In this presentation, we put the cloud-ablation scenario into the broader context of the 2-year-long high-state.

Primary author: MICHAEL, Zacharias

Presenter: MICHAEL, Zacharias

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **161** Type: **Poster**

An association of a Fermi-LAT flaring activity with a blazar candidate behind the Large Magellanic Cloud

Tuesday, April 13, 2021 7:15 AM (3 minutes)

We present the results of a preliminary investigation of a potential association of a blazar candidate behind the Large Magellanic Cloud (LMC) and a gamma-ray transient object.
The hint of flaring activity appeared at the position (RA,dec)~(86.60 deg,-69.02 deg), while the J0545-6846 blazar candidate is located at (RA,dec)=(86.47 deg,-68.77 deg). J0545-6846 is characterised by a particularly large radio flux of 176.3 mJy at 843 MHz, a high value of the radio-loudness parameter R=6900, and an integrated gamma-ray flux >1 GeV of ~9.6 × 10-12 erg cm-2 s-1.
We have analysed the Fermi-Large Area Telescope (LAT) data from the LMC region in order to verify the flaring activity detected in July/August 2008 and later in April 2015 in MeV and GeV energies, using the latest Fermi-LAT point source catalogue. The performed unbinned maximum likelihood analysis took into account the positions of all known point-like sources, diffuse emission as well as the advanced gas modelling from the investigated region.
Our preliminary analyses indicate positional consistency between J0545-6846 and the flaring activity in both periods. This suggests that the observed transient activities are related to the same blazar.

Primary author: ZYWUCKA, Natalia

Presenter: ZYWUCKA, Natalia

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **162** Type: **Poster**

Cherenkov Telescope Array sensitivity to branon dark matter models

Tuesday, April 13, 2021 7:49 AM (7 minutes)

TeV DM candidates are gradually earning more and more attention within the community. Among others, extra-dimensional brane-world models may produce thermal DM candidates with masses up to 100 TeV, which could be detected with the next generation of very-high-energy gamma-ray observatories such as the Cherenkov Telescope Array (CTA).
In this work, we study the sensitivity of CTA to branon DM via the observation of dwarf spheroidal galaxies.
We computed annihilation cross section values needed to reach a 5σ detection as a function of the branon mass. Additionally, in the absence of a predicted DM signal, we obtained 2σ upper limits on the annihilation cross section.
These limits lie 1.5-2 orders of magnitude above the thermal relic cross section value.
Yet, CTA will allow to exclude a significant portion of the brane tension-mass parameter space in the 0.1-60 TeV branon mass range, and up to tensions of ~10 TeV. More importantly, CTA will significantly enlarge the region already excluded by AMS and CMS, and will provide valuable complementary information to future SKA radio observations.

Primary author: AGUIRRE-SANTAELLA, Alejandra

Presenter: AGUIRRE-SANTAELLA, Alejandra

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Dark Matter

Contribution ID: **163** Type: **Poster**

The Gamma-ray Emission of Ultra-Fast Outflows

Tuesday, April 13, 2021 7:27 AM (3 minutes)

Massive black holes at the centers of galaxies can launch powerful wide-angle winds, which if sustained over time can unbind the gas from the stellar bulges of galaxies. Propagating through the galaxy, the wind should interact with the interstellar medium creating a strong shock, similar to those observed in supernovae explosions, which is able to accelerate charged particles to high energies. Here we report the Fermi Large Area Telescope detection of gamma-ray emission from these shocks in a small sample of galaxies exhibiting ultra-fast outflows. The detection implies that energetic black-hole winds transfer ~0.04 % of their mechanical power to gamma rays and that the gamma-ray emission may represent the onset of the wind-host interaction.

Primary author: AJELLO, Marco

Presenter: AJELLO, Marco

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **164** Type: **Poster**

GeV emission from protostellar jets

Tuesday, April 13, 2021 7:05 PM (5 minutes)

Synchrotron radio emission from non-relativistic jets powered by massive protostars has been reported, indicating the presence of relativistic electrons and mG magnetic fields. We study diffusive shock acceleration and magnetic field amplification in protostellar jets with speeds between 300 and 1000 km/s. We show that the magnetic field in the synchrotron emitter can be amplified by the non-resonant hybrid (Bell) instability excited by the cosmic-ray streaming. By combining the synchrotron data with basic theory of Bell instability we estimate the magnetic field in the synchrotron emitter and the maximum energy of protons. Protons can achieve maximum energies of about 0.1 TeV and emit GeV gamma rays in their interaction with matter fields. We predict that Fermi can detect gamma rays in IRAS 16547-5247 and IRAS 16848-4603. The detection of this radiation by the Fermi satellite in the GeV domain may open a new window to study the formation of massive stars, as well as diffusive acceleration and magnetic field amplification in shocks with velocities of about 1000 km/s.

Primary author: ARAUDO, Anabella

Presenter: ARAUDO, Anabella

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Galactic

Contribution ID: **165** Type: **Poster**

Morphology of SNRs and their halos

Tuesday, April 13, 2021 6:55 PM (5 minutes)

Supernova remnants are known to accelerate particles to relativistic energies on account of their non-thermal emission. The observational progress from radio to gamma-ray observations reveals more and more morphological features that need to be accounted for when modeling the emission from those objects.
We use our time-dependent acceleration code RATPaC to study the formation of extended gamma-ray halos around supernova remnants and the morphological implications that arise when the high-energetic particles start to escape from the remnant.
We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in a volume large enough to keep all cosmic rays in the simulation.
We find strong difference in the morphology of the gamma-ray emission in supernova remnants at later stages dependent on the emission process. At early times both - the inverse-Compton and the Pion-decay morphology - are shell-like. However, as soon as the maximum-energy of the freshly accelerated particles starts to fall, the inverse-Compton morphology starts to become center-filled whereas the Pion-decay morphology keeps its shell-like structure. Escaping high-energy electrons start to form an emission halo around the remnant at this time. There are good prospects for detecting this hard emission-spectra with the future Cerenkov Telescope Array as there are for detecting variation of the gamma-ray spectral index across the interior of the remnant. Due to the projection effects there is no significant variation of the spectral index expected with current-generation gamma-ray observatories.

Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: SNR

Contribution ID: **166** Type: **Poster**

Gamma-rays from young SNRs in dense circumstellar environments

Tuesday, April 13, 2021 6:50 PM (5 minutes)

Supernova remnants are known to accelerate cosmic rays on account of their non-thermal emission of radio waves, X-rays, and gamma rays. However, the ability to accelerate cosmic-rays up to PeV-energies has yet to be demonstrated. The presence of cut-offs in the gamma-ray spectra of several young SNRs led to the idea that PeV-energies might only be achieved during the very initial stages of a remnant's evolution.
We use our time-dependent acceleration code RATPaC to study the acceleration of cosmic rays in dense environments around massive stars where the plenty target material might offer a path to the detection of gamma-rays by current and future experiments.
We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in the test-particle limit. We investigated typical CSM-parameters expected around RSG and LBV-stars expected for free-expanding winds as well as structured ambient media due to photoionization-confined shells or episodes of enhanced mass-loss prior to the SN-explosion.
We show that potentially detectable gamma-ray signals can be expected in the Fermi-Lat band weeks to months after the explosion for free expanding wind-zones. Likewise does the interaction with dense shells enhance the gamma-ray luminosity which is accompanied by a re-brightening in thermal X-rays that might be used as trigger for dedicated gamma-ray observations. The maximum achievable might be limited due to the strong magnetic fields close to the progenitor star that enhances turbulence-damping due to cascading.

Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: SNR

Contribution ID: **167** Type: **Poster**

Searching for misaligned active galactic nuclei among blazar candidates in the Fourth Fermi-LAT catalog

Tuesday, April 13, 2021 7:57 AM (3 minutes)

Radio-loud sources with blazar-like properties, but having a jet that does not directly point in the direction of the observer are among the most interesting classes of gamma-ray emitters. These sources are known as Misaligned Active Galactic Nuclei (MAGN). We searched for new MAGN candidates among the remaining blazars of uncertain type detected by the Fermi Large Area Telescope (LAT) using a methodology based on characterizing their radio morphology. We identified 10 new candidates associated with gamma-ray sources. Their features are consistent with a source with a misaligned relativistic jet consistent with the definition of MAGN.

Primary author: CHIARO, Graziano

Presenter: CHIARO, Graziano

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **169** Type: **Poster**

Gamma-ray Eclipses from Redback and Black Widow Pulsars

Tuesday, April 13, 2021 6:45 PM (5 minutes)

The ability of the Fermi Large Area Telescope to identify pulsar-like gamma-ray sources has sparked a huge increase in discoveries of "Spider" millisecond pulsar binaries (Black Widows and Redbacks). These systems are characterised by long radio eclipses due to scattering and absorption by diffuse intra-binary material that has been evaporated from the companion star's surface. Unlike radio emission, gamma-ray pulsations cannot be absorbed or scattered by this diffuse intra-binary material, and therefore the presence of a gamma-ray eclipse provides conclusive evidence that the pulsar passes directly behind the companion star. These subtle gamma-ray eclipses are only just becoming detectable thanks to the duration of the Fermi mission. I will present the results of our searches for gamma-ray eclipses from Spider MSPs, including the discovery of significant gamma-ray eclipses from several systems. I will describe how the detection, or significant exclusion, of a gamma-ray eclipse provides a crucial independent diagnostic for pulsar emission models and Spider optical light curve models, and how the new constraints on Spider binary inclination angles lead to robust constraints on their otherwise elusive pulsar masses.

Primary author: CLARK, Colin

Presenter: CLARK, Colin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **170** Type: **Poster**

Investigating Superorbital Modulation in the X-ray Binary 4U 1538-52 with the BAT and GBM

Tuesday, April 13, 2021 6:40 PM (5 minutes)

Superorbital periods in Roche-lobe overflowing X-ray binaries such as Her X-1 have been known for some time. These can be understood as being related to the presence of an accretion disk. However, more recently a number of HMXBs accreting from the wind of their supergiant companion, where the presence of a persistent accretion disk is unlikely, have also been found to show superorbital modulation. Swift BAT observations now reveal superorbital modulation in the wind-accreting supergiant high-mass X-ray binary (HMXB) 4U 1538-52 at a period of 14.9130 +/- 0.0026 days that is consistent with four times the 3.73 day orbital period. These periods agree with a previously suggested correlation between superorbital and orbital periods in similar HMXBs. During the ~14 years of observations the superorbital modulation changes amplitude, and since ~MJD 57,650 it was no longer detected in the power spectrum, although a peak near the second harmonic of this was present for some time. Measurements of the spin period of the neutron star in the system with the Fermi Gamma-ray Burst Monitor show a long-term spin-down trend which halted towards the end of the light curve, suggesting a connection between dP(spin)/dt and superorbital modulation, as proposed for 2S 0114+650. However, an earlier torque reversal from INTEGRAL observations was not associated with superorbital modulation changes. B and V band photometry from the Las Cumbres Observatory reveals orbital ellipsoidal photometric variability, but no superorbital optical modulation. However the photometry was obtained when the 14.9130 day period was no longer detected in the BAT power spectrum. We consider superorbital modulation mechanisms, and suggest that the Corotating Interaction Region model, with small deviations from orbital synchronization, appears promising. Since the start of 2020 (MJD ~58,850), 4U 1538-52 has been exhibiting a spin-up trend and we have been monitoring the system to determine whether the superorbital modulation has reappeared.

Primary author: CORBET, Robin

Presenter: CORBET, Robin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Binaries

Contribution ID: **171** Type: **Poster**

A study of super-luminous stars with the Fermi Large Area Telescope

Tuesday, April 13, 2021 6:35 PM (5 minutes)

The gamma-ray emission from stars is induced by the interaction of cosmic rays with stellar atmospheres and photon fields. This emission is expected to come in two components: a stellar disk emission, where gamma-rays are mainly produced in atmospheric showers generated by hadronic cosmic rays, and an extended halo emission, where the high density of soft photons in the surroundings of stars create a suitable environment for gamma-ray production via inverse Compton (IC) scattering by cosmic ray leptons. Besides the Sun, no other isolated star has ever been detected in gamma-rays. However, by assuming a cosmic ray distribution similar to that observed on Earth, the predicted gamma-ray emission of super-luminous stars, like e.g. Betelgeuse and Rigel, should be high enough to be detected by the Fermi Large Area Telescope (LAT) after its first decade of operations. In this work, we use 12 years of Fermi-LAT observations along with IC models to study 9 luminous nearby stars, both individually and via stacking analysis. Our results show no significant gamma-ray emission from any of the targets, but allow us to derive gamma-ray flux upper limits and to use them to constrain the local density of electrons in different places of the Galaxy.

Primary author: MENEZES, Raniere (Universidade de São Paulo)

Presenter: MENEZES, Raniere (Universidade de São Paulo)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Galactic

Contribution ID: **172** Type: **Poster**

Discovery of 100 TeV gamma-rays from HESS J1702-420: a new PeVatron candidate

Tuesday, April 13, 2021 7:28 AM (7 minutes)

The identification of active PeVatrons, hadronic particle accelerators reaching the knee (at the energy of few PeV), is crucial to understand the origin of cosmic rays in the Galaxy. In this context, we report on new H.E.S.S. observations of the PeVatron candidate HESSJ1702-420, close to the source 2FHL J1703.4-4145, that have revealed the presence of gamma-rays up to 100 TeV at 5 sigma confidence level. This is the first time in H.E.S.S. history that photons with such high energy are clearly detected. Remarkably, the new deep observations allowed the discovery of a new gamma-ray source component, called HESS J1702-420A, that was previously hidden under the bulk emission traditionally associated with HESSJ1702-420. This new object has a power-law spectral slope < 2 and a gamma-ray spectrum that, extending with no sign of curvature up to 100 TeV, makes it an excellent candidate site for the presence of extremely high-energy cosmic rays. This discovery brings new information to the open debates on the nature of the unidentified source HESSJ1702-420, one of the most compelling PeVatron candidates in the gamma-ray sky, and on the origin of Galactic cosmic rays.

Primary author: GIUNTI, Luca

Presenter: GIUNTI, Luca

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: CR

Contribution ID: **173** Type: **Poster**

GRB 131014A: A Laboratory for Studying the Thermal-like and Non-thermal Emissions in Gamma-Ray Bursts

Tuesday, April 13, 2021 6:12 PM (4 minutes)

Over the past few years, evidence has been accumulated in support of the existence of a thermal-like component during the GRB prompt phase. This component–often associated with the GRB jet's photosphere–is usually subdominant compared to a much stronger non-thermal one. The prompt emission of GRB 131014A detected by Fermi provides a unique opportunity to trace the history of this thermal-like component. In this GRB, the thermal emission is much more intense than in other bursts and a pure thermal episode is observed at early times. The intensity of the non-thermal component progressively increases until being energetically dominant at late times, similar to what is typically observed. GRB 131014A is a case study to disentangle the thermal component from the non-thermal component. Using this analysis, we derived fundamental physical quantities describing the GRB relativistic jet such as the evolution of (i) the bulk Lorentz Factor of the outflow, (ii) the photospheric radius, (iii) the injection radius, and (iv) the injected power.

Primary author: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Presenter: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **174** Type: **Poster**

Variability of the Mg II 2798λ Emission Line during the 2017 Nonthermal Outburst in the Gamma-Ray Bright Quasar 1156+295

Tuesday, April 13, 2021 7:30 AM (3 minutes)

The quasar 1156+295 (4C 29.45, Ton599) underwent a dramatic nonthermal outburst in late 2017, with detection at energies > 100 GeV. The outburst was essentially simultaneous at gamma-ray and optical bands, indicating co-spatiality of the emission regions. We present multi-epoch optical spectra of 1156+295 obtained with the 4.3 m Lowell Discovery Telescope at various times, including the outburst period. We find that the flux of the Mg II 2798-Angstrom emission line, as well as blended Fe II lines at shorter wavelengths, increased with the optical synchrotron continuum with a delay less than 2 weeks. We interpret such a correlation within a scenario that the line-emitting clouds lie alongside the jet, well outside the canonical broad-line region. These extended polar clouds have the properties needed to be the source of seed photons that are scattered to gamma-ray energies.
This research was supported in part by NASA Fermi guest investigator program grants 80NSSC19K1504 and 80NSSC20K1565.

Primary author: HALLUM, Melissa

Presenter: HALLUM, Melissa

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **175** Type: **Poster**

Relativistic Fluid Modeling of the Gamma-Ray Binary LS5039

Tuesday, April 13, 2021 6:30 PM (5 minutes)

LS 5039 is one of the best-observed gamma-ray binaries with non-thermal emission ranging from soft X-rays to VHE gamma-ray. Explaining the observed anti-correlation between the X-ray/VHE and the HE gamma-ray bands, while accounting for its complex spectral features, has become a challenge for current modelling efforts.
We investigate this system in a wind-driven context, where non-thermal leptons are thought to be accelerated in the interaction of the stellar and pulsar wind. Numerical simulations have shown that neither the shock structure nor the downstream flow are stationary but depend on the orbital phase. They are subject to the combined effects of orbital motion and dynamical turbulence arising in the wind collision. This has an impact on the system's radiative output that was largely neglected or simplified in previous models.
We investigate this dynamical behavior with a recently developed relativistic extension to the CRONOS code. The transport of accelerated leptons is thereby solved simultaneously alongside a three-dimensional, relativistic hydrodynamic simulation of the wind-interaction. This consistent treatment allows us to fully capture the effects of fluid dynamics on the particle evolution and the subsequent phase-dependent emission of gamma-rays. Relativistic boosting and gamma-gamma absorption can be included consistently for the extended emission region.
Our model successfully reproduces the main spectral features of the LS 5039 system, further supporting the applicability of wind-driven models for LS 5039. Furthermore, we provide first insights into the impact of fluid dynamics on the radiative output of gamma-ray binaries.

Primary author: HUBER, David

Presenter: HUBER, David

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Binaries

Contribution ID: **176** Type: **Poster**

Investigation of gamma rays at an altitude of 3340 meters above sea level on a complex installation HADRON-55

Tuesday, April 13, 2021 6:52 PM (4 minutes)

For research, our group uses an installation with an area of 55 m2, consisting of two recording levels, gamma and hadron blocks, separated by a two-meter gap, located at the Tien Shan high-altitude scientific station. The main idea is to select interactions that are only observed in the gamma block, and not observed in the hadron block.
The upgraded ionization calorimeter with a field of scintillation detectors will be used for research in the field of high-energy gamma astronomy. The ionization calorimeter consists of two parts - the upper gamma-block and the lower hadron block, separated by a two-meter gap. The gamma block registers, i.e. absorbs the electron-photon component (EPC) of cosmic rays, the hadronic component, due to the small thickness of the gamma block, passes through the gamma block without interactions and begins to interact and generate particles in the hadron block.

Primary author: IDRISSOVA, Tynik

Presenter: IDRISSOVA, Tynik

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Instrumentation

Contribution ID: **177** Type: **Poster**

Constraints on Lorentz Invariance Violation from MAGIC observation of GRB 190114C

Tuesday, April 13, 2021 7:08 PM (4 minutes)

On January 14th 2019, MAGIC, a stereoscopic system of two 17m diameter Imaging Atmospheric Cherenkov Telescopes located on the Canary island of La Palma, observed for the first time a gamma-ray burst (GRB) at TeV energies, namely GRB 190114C. MAGIC measurements started ~60s after the onset of GRB 190114C, predominantly in the featureless smooth afterglow phase. Nevertheless, in the first 30s of MAGIC observation the gamma-ray intensity from GRB 190114C reached the unprecedented level of around 130 times the Crab nebula flux. Such GRB observations are regarded as one of the best targets to test quantum gravity models, several of them predicting an energy dependence of the speed of light that can be probed thanks to the cosmological distances traveled by the emitted photons and the time variability of the emission. In this talk, we will report on the search of such LIV effect using a maximum likelihood analysis of the GRB 190114C observation by MAGIC.

Primary author: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Presenter: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **178** Type: **Poster**

Multiwavelength monitoring of gravitationally lensed blazar QSO B0218+357 between 2016 and 2020

Tuesday, April 13, 2021 7:33 AM (3 minutes)

QSO B0218+357 is currently the only gravitationally lensed source from which both high-energy (HE, >~100 MeV) and very-high-energy (VHE,>~100GeV) gamma-ray emission has been detected.

We report the Fermi/LAT and multiwavelength monitoring observations of this source in radio interferometry, optical and X-rays performed between 2016 and 2020. During the monitoring, individual flares in the optical, X-ray and HE bands were observed.

We analysed the MAGIC telescopes data during the flaring states to search for the associated VHE emission, constraining the VHE gamma-ray duty cycle of the source.

We model the quiescent emission in which the high-energy bump is explained as a combination of Synchrotron-Self-Compton and External Compton processes. The bulk of the low-energy emission is explained as originating from a tens of parsecs scale jet.

Primary author: LONGO, Francesco

Presenter: LONGO, Francesco

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **179** Type: **Poster**

Optical spectroscopic classification of a selection of Southern Hemisphere 3FHL unclassified blazar candidates

Tuesday, April 13, 2021 7:54 AM (3 minutes)

The Fermi-LAT has detected more than 5000 gamma-ray sources which show emission above 50 MeV of which 58 per cent belong to the blazar class. However, the Fourth Fermi-LAT catalogue (4FGL) lists 1312 of these as blazar candidates of uncertain type (BCU). Increasing the number of classified Fermi-LAT sources is important for improving our understanding of extra-galactic gamma-ray sources and can be used to search for new classes of very high energy sources. We report on the optical spectroscopy of thirteen unclassified BCUs with hard photon indices included in the Third Catalogue of Hard Fermi-LAT Sources (3FHL) during 2016 and 2017 using the SAAO 1.9-m telescope. We were able to classify all the sources observed as BL Lac objects, and were able to calculate the redshift for three sources and potential redshift for a further three. Additionally we were able to calculate redshifts to four previously observed BL Lacs without a confirmed redshift.

Primary author: MARAIS, JP

Presenter: MARAIS, JP

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **180** Type: **Poster**

Gamma-ray Emission from Molecular Outflows

Tuesday, April 13, 2021 7:36 AM (3 minutes)

Many star-forming galaxies and those hosting active galactic nuclei (AGN) show evidence of massive outflows of material in a variety of phases including ionized, neutral atomic, and molecular outflows. Molecular outflows in particular have been the focus of recent interest as they may be responsible for removing gas from the galaxy, thereby suppressing star formation. As the material is ejected from the core of the galaxies, interactions of accelerated cosmic rays with the interstellar medium can produce high-energy gamma rays. However, the gamma-ray emission from these individual objects is expected to be below the threshold for LAT detection and has yet to be directly observed. In order to search for this faint gamma-ray signal we conduct a stacked analysis of a sample of molecular outflows in the nearby universe using 11 years of Fermi-LAT data and present preliminary evidence of a detection. Confirmed observations of gamma-ray emission from these sources can have significant implications for our understanding of AGN feedback mechanisms and the extragalactic gamma-ray background.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **181** Type: **Poster**

Stacked Analysis of Galactic Wolf-Rayet Stars

Tuesday, April 13, 2021 6:25 PM (5 minutes)

Wolf-Rayet (WR) stars are massive evolved stars undergoing advanced nuclear burning in their cores and possess strong stellar winds. WR stars – and in particular WR binary systems – are also predicted to be potential emitters of gamma rays. Although details of the high-energy emission mechanisms are not well-understood, a majority of the emission is likely due to strong shocks produced by the colliding winds of WR binary systems. The shocked winds accelerate cosmic rays via diffusive shock acceleration, which subsequently produce X rays and gamma rays through inverse Compton processes, as well as producing neutral pions that quickly decay into gamma-ray photons. To date, only one WR system (WR11) has been detected in both X rays and gamma rays, and typically the WR gamma-ray emission is expected to be below the detection threshold of the Fermi-LAT. We conduct the first comprehensive analysis of the entire population of Galactic WR stars, including both isolated and binary systems. Since the gamma-ray emission from any one of these systems is expected to be faint, we employ a stacking technique. In this talk I will detail the motivation for our analysis, outline the analysis procedure, and present preliminary results.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Galactic

Contribution ID: **182** Type: **Poster**

3D magnetised jet break-out from neutron-star binary merger ejecta: afterglow emission from the jet and the ejecta

Tuesday, April 13, 2021 7:04 PM (4 minutes)

We perform three-dimensional (3D) general-relativistic magnetohydrodynamic simulations to model the jet break-out from the ejecta expected to be produced in a binary neutron-star merger. The structure of the relativistic outflow from the 3D simulation confirms our previous results from 2D simulations, namely, that a relativistic magnetized outflow breaking out from the merger ejecta exhibits a hollow core of $\theta_{core} \approx 4^{\circ}$, an opening angle of $\theta_{jet} > 10^{\circ}$, and is accompanied by a wind of ejected matter that will contribute to the kilonova emission. We also compute the non-thermal afterglow emission of the relativistic outflow and fit it to the panchromatic afterglow from GRB170817A, together with the superluminal motion reported from VLBI observations. In this way, we deduce an observer angle of $\theta_{obs} = 35.7^{\circ}{}^{+1.8}_{-2.2}$. We further compute the afterglow emission from the ejected matter and constrain the parameter space for a scenario in which the matter responsible for the thermal kilonova emission will also lead to a non-thermal emission yet to be observed.

Primary author: NATHANAIL, Antonios

Presenter: NATHANAIL, Antonios

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **183** Type: **Poster**

Spectral analysis of S5 1803+784 BL Lacs Blazar

Tuesday, April 13, 2021 7:51 AM (3 minutes)

Phenomenological spectral analysis of S5 1803+784 was done in both the high state and the low state using leptonic jet models. The jet energetic and spectral properties using single zone synchrotron-self Compton (SSC) and SSC with external photons (SSC+EC) jet models are presented. S5 1803+784 is a low synchrotron peak (LSP) blazar with the characteristics weak emission lines (EW < 5A). Data obtained from NED and Fermi-LAT was used for the analysis and the spectral energy distribution (SED) of the best-fit model is used to constraint the emission process of the blazar.

Primary author: OMOJOLA, Joseph

Presenter: OMOJOLA, Joseph

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **184** Type: **Poster**

StellarICS: Inverse Compton Emission from the Quiet Sun and Stars from keV to TeV

Tuesday, April 13, 2021 6:20 PM (5 minutes)

Gamma rays from the quiet Sun are produced by Cosmic Rays (CRs) interacting with its surface (disk component) and with its photon field (spatially extended inverse-Compton component, IC). IC is maximum close to the Sun and it extends over the whole sky. Monitoring the IC component with Fermi-LAT allows to obtain information on CR electrons close to the Sun and in the heliosphere for different solar activity and polarity. The detection of IC emission from stars allows to learn about CR electrons in their photosphere. Fermi-LAT data analyses are usually model-driven. Hence advances in model calculations and constraints from precise CR measurements are timely and needed.

We present our StellarICS code to compute the gamma-ray IC emission from the Sun and also from single stars. The code is publicly available and it is extensively used by the scientific community to analyze Fermi-LAT data. It has been used by the Fermi-LAT collaboration to produce the solar models released with the FSSC Fermi Tools. Our modeling provides the basis for analyzing and interpreting high-energy data of the Sun and of stars. After presenting examples of updated solar IC models in the Fermi-LAT energy range that account for the various CR measurements, we extend the models to keV, MeV, and TeV energies for predictions for future possible telescopes such as AMEGO, GECCO, e-ASTROGAM, HAWC, LHAASO, SWGO, and present X-ray telescopes. We also present predictions for some of the closest and most luminous stars. Work based on arXiv:2012.13126, JCAP submitted.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Solar

Contribution ID: **185** Type: **Poster**

Population Studies of Fermi LAT sources

Tuesday, April 13, 2021 7:21 AM (7 minutes)

The Fermi Large Area Telescope (LAT) has been detecting hundreds of Galactic sources, most of which are pulsars. Many Galactic sources are still undetected or unresolved due to their low flux, below the Fermi LAT sensitivity, or because of foreground and source confusion. Moreover, among the many unassociated sources, which are one third of the detected sources, a large amount may have Galactic origin.
We present our method of source population synthesis studies for characterizing the general properties of Fermi LAT Galactic gamma-ray sources and for estimating the number of Galactic sources below the Fermi LAT flux sensitivity threshold.
Source density distribution and luminosity function of our Monte-Carlo simulation are constrained by the Galactic sources detected by Fermi LAT. Then, the number of unresolved sources and their contribution to the diffuse emission are estimated by our best model.

This is a long-term project on analyzing the point source catalog and performing theoretical studies of gamma-ray sources. Apart from being interesting on its own, characterizing the general properties of detected sources will also allow to estimate the contribution to the diffuse emission from undetected and unresolved sources. In turn this will help their detection, impacting also other studies of diffuse gamma rays including studies of the interstellar emission and dark matter. Finally, it will also help in the characterization of unassociated sources.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Catalogs

Contribution ID: **186** Type: **Poster**

Two-component model of gamma-ray emission for Fermi/LAT-blazars

Tuesday, April 13, 2021 7:39 AM (3 minutes)

In this talk, we will present a two-component model of the γ-ray emission which assumes that the total γ-ray output of blazars consists of relativistically beamed and unbeamed components. 584 Fermi/LAT-blazars are listed in our compiled catalogue. This idea leverages the correlation between the radio core-dominance parameter and the γ-ray beaming factor. We firstly propose a so-called "γ-ray core-dominance parameter" and we successful divide the γ-ray emission into beamed and unbeamed contributions theoretically for those 584 sources. Our analysis confirms that the γ-ray emission in blazars is mainly from the beamed component.

Primary author: PEI, Zhiyuan

Presenter: PEI, Zhiyuan

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **187** Type: **Poster**

The gamma-ray emission of young radio galaxies and quasars

Tuesday, April 13, 2021 7:42 AM (3 minutes)

According to radiative models, radio galaxies are predicted to produce gamma rays since the first stages of their evolution. The study of the high-energy emission from young radio sources is crucial for providing information on the most energetic processes associated with these sources, the actual region responsible for this emission, as well as the structure of the newly born radio jets.
Despite systematic searches for young radio sources at gamma-ray energies, only a handful of detections have been reported so far. Taking advantage of more than 11 years of Fermi-LAT data, we investigate the gamma-ray emission of 162 young radio sources (103 galaxies and 59 quasars), the largest sample of young radio sources used so far for a gamma-ray study. We analyse the Fermi-LAT data of each individual source separately to search for a significant detection. In addition, we perform the first stacking analysis of this class of sources in order to investigate the gamma-ray emission of the young radio sources that are undetected at high energies.
We report the detection of significant gamma-ray emission from 11 young radio sources, including the discovery of significant gamma-ray emission by the compact radio galaxy PKS 1007+142.
Although, the stacking analysis of below-threshold young radio sources does not result in a significant detection, it provides stringent upper limits to constrain the gamma-ray emission from these objects.
In this talk we present the results of our study and we discuss their implications for the predictions of gamma-ray emission from this class of sources.

Primary author: PRINCIPE, Giacomo

Presenter: PRINCIPE, Giacomo

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **188** Type: **Poster**

Are we seeing magnetic reconnection generated gamma-ray flares in 3C 84

Tuesday, April 13, 2021 7:48 AM (3 minutes)

Magnetic reconnection - relinking of magnetic field lines - has been proposed as a possible mechanism to power the high-energy flares in gamma-ray bright Active Galactic Nuclei but has not been confirmed via observations. Our study found observational evidence of magnetic reconnection generated gamma-ray flares in a radio galaxy, 3C 84. In a sequence of radio images, the radio-emitting region (plasma blob) gets brighter and larger, then splits into two, and finally dissipates. A gamma-ray flare is observed shortly before the split. This 'split-flare-dissipate'behavior - detected for three gamma-ray events - provides an indication of magnetic reconnection in the source.

Primary author: RANI, Bindu

Presenter: RANI, Bindu

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **189** Type: **Poster**

Unveiling the origin of steep decay in gamma-ray bursts

Tuesday, April 13, 2021 6:08 PM (4 minutes)

γ-ray bursts (GRBs) are cataclysmic events, whose role became central in the new multi-messenger era. GRBs are thought to originate from internal dissipation of the energy carried by ultra-relativistic jets launched by the remnant of a massive star's death or a compact binary coalescence. In the present work I propose a novel investigation of the GRB emission mechanism, via time-resolved spectral analysis of the X-ray tails of bright GRB pulses, discovering a unique relation between the spectral index and the flux. The investigation of the spectral evolution is the ideal diagnostic to understand the connection between the emission processes and the outflow. I thoroughly discuss possible interpretations in relation to current available models and I show the incompatibility of our results with the high latitude emission of efficiently cooled particles. Our results for the first time show evidence of adiabatic cooling of the emitting particles, shedding light on fundamental physics of relativistic outflows in GRBs.

Primary author: RONCHINI, Samuele (Gran Sasso Science Institute)

Presenter: RONCHINI, Samuele (Gran Sasso Science Institute)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **190** Type: **Poster**

Identifying Black Hole Central Engines in Gamma-Ray Bursts

Tuesday, April 13, 2021 7:16 PM (4 minutes)

The nature of the gamma-ray burst (GRB) central engine remains an enigma. Entities widely considered to be capable of powering the extreme jets are: (i) a hyper-accreting stellar-mass black hole, and (ii) a rapidly spinning, highly magnetized, neutron star (NS) or fast magnetar. The maximum rotational energy that is feasible in a millisecond magnetar to form a jet is ~10^52 erg and hence presents an upper limit on energy budget available for the magnetar model. In this paper, analysing the jet-opening angle-corrected energetics of the prompt emission of gamma-ray bursts detected by the Fermi gamma-ray space telescope for the last eleven years, we identify eight long GRBs whose central engines are black holes. The majority of these GRBs exhibit significant emission in the sub-GeV energy range. Their X-ray light curves also lack the 'plateau'feature often attributed to magnetars; however, a few cases exhibit flares and multiple breaks. By considering the Blandford–Znajek mechanism of jet formation, we estimate the masses of these black holes to range between ~2 and 60 Msun. Interestingly, some of the lighter black holes formed in these catastrophic events are likely candidates to lie in the mass-gap region (2–5 Msun).

Primary author: SHARMA, Vidushi

Presenter: SHARMA, Vidushi

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **191** Type: **Poster**

Search for VHE emission from PSR J0218+4232

Tuesday, April 13, 2021 6:15 PM (5 minutes)

PSR J0218+4232 is one of the most energetic millisecond pulsars (MSP) known and has been considered as one of the best candidates for very high energy (>100 GeV) γ-ray emission. It has a period of 2.3 ms in a 2-day orbit with a ~ 0.2M⊙ white dwarf companion. With a characteristic age τ <0.5 Gyr it is one of the youngest MSPs known, with an extremely strong magnetic field at the light cylinder (BLC ~ 3.2 × 105 G), only slightly weaker than young Crab-like pulsars. PSR J0218+4232 is in the Third Fermi-LAT Catalog of High-Energy Sources and was shown to have pulsations above 10 and 25 GeV.
Using 11.5 years of Fermi Large Area Telescope (LAT) data (2008-2020) and ~90 hours of MAGIC observations (from 2018 November 2 to 2019 November 4), we have searched for high energy gamma-ray pulsed emission from PSR J0218+4232. The MAGIC data were collected in stereoscopic mode with the Sum-Trigger-II system, designed to improve the performance of the telescopes in the sub-100 GeV energy range.
In this contribution we will show the results of our searches for gamma-ray emission, together with our theoretical modeling.

Primary author: SPOLON, Alessia

Presenter: SPOLON, Alessia

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **192** Type: **Poster**

A MeerKAT Pulsar Survey of Fermi Unidentified Sources

Tuesday, April 13, 2021 6:10 PM (5 minutes)

In the last decade, Fermi LAT has provided an amazing roadmap to assist with pulsar searches conducted in other parts of the electromagnetic system. Indeed, multiple surveys have used Fermi unidentified sources with pulsar-like structures as their targets. Following this strategy, we present in this poster a survey conducted using the MeerKAT telescope to find energetic new pulsars associated with gamma-ray sources. MeerKAT's expected performances have been compared to those achieved in previous surveys (conducted with Parkes, GBT, Arecibo and Effelsberg) in order to determine the required integration time to reach comparable sensitivity. As a result, we concluded that a 10-minute observation for each source would be sufficient, thus enabling us to perform a relatively swift survey of a large number of targets. We also investigated other observing parameters such as the optimal de-dispersion and acceleration search strategy that would maximise our chance of finding new pulsars. Lastly, we carefully selected sources from the latest Fermi LAT 4FGL catalogue for the first phase of our survey based on criteria such as declination, Galactic latitude, gamma-ray emission characteristics and localisation. After applying these criteria, 79 targets were selected for a two-pass survey.

Primary author: THONGMEEARKOM, Tinn

Presenter: THONGMEEARKOM, Tinn

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **193** Type: **Poster**

Cross-match between the latest Swift/BAT and Fermi/LAT catalogs toward MeV all sky simulation

Tuesday, April 13, 2021 7:14 AM (7 minutes)

We report the results of cross-match between the hard X-ray and GeV gamma-ray catalogs, by making use of the latest 105-month Swift/BAT and 10-yr Fermi/LAT catalogs, respectively. We found 181 matched sources in total, which include 36 of false-match, unidentified, and ambiguous sources. The firmly matched sources consist of blazars (> 60%), pulsars and pulsar wind nebulae (~10%), radio galaxies (~ 7%), binaries (~ 5%), and others. Compared to the original catalogs, the matched sources are characterized by double-peaked photon index distributions, higher flux, and larger gamma-ray variability index. This difference arises from the different population of sources, particularly the large proportion of blazars (i.e., FSRQs and BL Lac types). We also report 13 cross-matched and unidentified sources. The matched sources in this study would be promising in the intermediate energy band between the hard X-ray and GeV gamma-ray observations, that is the unexplored MeV gamma-ray domain.

Primary author: TSUJI, Naomi

Presenter: TSUJI, Naomi

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Catalogs

Contribution ID: **194** Type: **Poster**

Fermi-GBM and Swift-BAT detection of an extragalactic magnetar giant flare

Tuesday, April 13, 2021 7:12 PM (4 minutes)

We present the observations of the first unambiguous magnetar giant flare from outside of our galactic neighborhood. At the beginning, GRB 200415A was identified as a short GRB, but upon further investigation and observations from additional instruments, we concluded this event was a giant flare from a magnetar located in the Sculptor galaxy, 3.5 Mpc away. The GBM lightcurve shows very fast (shorter than 0.1 ms) variability, which is unprecedented among both magnetar giant flare and GRB observations. Based on the MeV range photons that Fermi-GBM detected, we find proof of relativistic expansion. We will show the detailed data analysis, the fast spectral evolution and the interpretation of this unique event.

Primary author: VERES, Peter

Presenter: VERES, Peter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **196** Type: **Poster**

FACT - Results from more than 8 Years of Monitoring

Tuesday, April 13, 2021 7:00 PM (4 minutes)

Operational since October 2011, the First G-APD Cherenkov Telescope (FACT) has been monitoring TeV-blazars. An unbiased observing strategy, robotic operation and the usage of solid state photo sensors (SiPM, aka G-APDs) increase the instrument's duty cycle and minimize observational gaps, making FACT an ideal instrument for long-term monitoring. In more than eight years, an unprecedented data sample of more than 14700 hours of physics data has been collected.

Results of an automatic quick-look analysis are published with low latency on an open-access website. Based on this, close to 150 alerts including 12 astronomer's telegrams have been issued in six years, triggering a variety of multi-wavelength studies including target-of-opportunity observations with X-ray satellites.

Results for various triggered multi-wavelength studies, e.g. Mrk 501 in 2014, 1ES 2344+51.4 in 2016 and Mrk 421 in 2019, are presented together with long-term studies, like e.g. a multi-wavelength study of 5.5 years of observations of Mrk 421 and studies on the variability characteristics of blazars including periodicity studies.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Instrumentation

Contribution ID: **197** Type: **Poster**

Multi-wavelength study of large-scale outflows from the Circinus galaxy

Tuesday, April 13, 2021 7:45 AM (3 minutes)

The Circinus galaxy is a composite starburst/Seyfert galaxy which exhibits radio lobes inflated by kpc scale outflows along its minor axis. Its proximity (4 Mpc) makes it a unique target to study the physical nature of these outflows. We investigate if they originate from nuclear star formation activity or if they are jets from an active galactic core. The MeerKAT radio observations allow us to study the morphology of the arcminute lobes of the Circinus galaxy. In this work, a multi-wavelength analysis of this system is conducted using the available MeerKAT observations and Fermi-LAT data, to aid in the understanding of the origin of these structures. The results are also compared to the star-formation driven Fermi bubbles in the Milky Way, which have also been observed in both the gamma-ray and the radio bands to determine physical similarities between these structures.

Primary author: EBRAHIM, Rozeena

Presenter: EBRAHIM, Rozeena

Session Classification: AGN-1

Track Classification: AGN

Contribution ID: **198** Type: **Poster**

Peculiar Prompt Emission and Afterglow in the H.E.S.S.-detected GRB 190829A

Tuesday, April 13, 2021 6:04 PM (4 minutes)

We present the results of a detailed investigation of the prompt and afterglow emission in the High Energy Stereoscopic System(H.E.S.S.)-detected GRB190829A. Swift and Fermi observations of the prompt phase of this gamma-ray burst(GRB) reveal two isolated sub bursts or episodes, separated by a quiescent phase. The energetic and the spectral properties of the first episode are in stark contrast to the second. The first episode, which has a higher spectral peak~120 keV and a low isotropic energy~1050erg is an outlier to the Amati correlation and marginally satisfies the Yonetoku correlation. However, the energetically dominant second episode has lower peak energy and is consistent with the above correlations. We compared this GRB to other low-luminosity GRBs (LLGRBs). Prompt emission of LLGRBs also indicates a relativistic shock breakout origin of the radiation. For GRB190829A, some of the properties of a shock breakout origin are satisfied. However, the absence of an accompanying thermal component and energy above the shock breakout critical limit precludes a shock breakout origin. In the afterglow, an unusual long-lasting late-time flare of duration~104s is observed. We also analyzed the late-time Fermi Large Area Telescope(LAT)emission that encapsulates the H.E.S.S. detection. Some of the LAT photons are likely to be associated with the source. All of the above observational facts suggest GRB190829A is a peculiar low-luminosity GRB that is not powered by a shock breakout, and has an unusual rebrightening due to patchy emission or a refreshed shock during the afterglow. Furthermore, our results show that teraelectronvolt-energy photons seem common in both high-luminosity GRBs and LLGRBs.

Primary author: GUPTA, Rahul

Presenter: GUPTA, Rahul

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **199** Type: **Poster**

The Transient program of the Cherenkov Telescope Array

Tuesday, April 13, 2021 6:56 PM (4 minutes)

The Cherenkov Telescope Array (CTA) will be the next generation very high-energy (VHE) gamma-ray observatory. It will improve the sensitivity of current VHE instruments up to an order of magnitude and will cover the energy range from 20 GeV to at least 300 TeV. With its sensitivity, it will explore high redshift sources and extreme accelerators and will give access to the shortest timescale phenomena. CTA will be then a uniquely powerful instrument for the exploration of the transient universe. Thanks to its capabilities, CTA will play also a central role in the era of multi-messenger astrophysics.

In this presentation, we will outline the CTA Transient program that includes follow-up observations of a broad range of multi-wavelength and multi-messenger alerts, ranging from Galactic transient objects to novel phenomena like Fast Radio Bursts. A very promising case is that of gamma-ray bursts (GRBs) where CTA will for the first time enable high-statistics measurements above ~10 GeV, probing new spectral components and shedding light on the physical processes at work in these systems. Dedicated programs searching VHE gamma-ray counterparts to gravitational waves and high-energy neutrinos complete the CTA transients program.

Primary author: LONGO, Francesco

Co-authors: CAROSI, Alessandro; LOPEZ, Alicia

Presenters: CAROSI, Alessandro; LOPEZ, Alicia; LONGO, Francesco

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Instrumentation

Contribution ID: **200** Type: **Poster**

Search for transient sources on monthly time scale.

Tuesday, April 13, 2021 7:07 AM (7 minutes)

Gamma-ray catalogs produced with data of the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope typically integrate years of exposure. Since Active Galactic Nuclei (AGNs) are characterized by strong and fast variability, their emission is diluted by long-time data integration. Transient sources can be more easily detected over short time scales. In order to search for these transient sources we have analyzed the first 10 years of data (as for the 4FGL - DR2 Catalog) collected by the LAT integrating over 1-month time intervals. The analysis was performed between 0.1 and 300 GeV using the Pass-8 event-level selection. In the analysis we considered only photons with $|b| > 10°$ to exclude the Galactic plane and therefore to avoid confusion with low latitude diffuse emission. We have also excluded all sources closer than 0.8 deg from any previous Fermi-LAT catalog source. We have analyzed 120 months and also performed a 15-day shift of each month in order to not lose any flare at the edges of each time bin. The list of those transient sources will be reported in the 1FLT catalog (the first Fermi-LAT transient source catalog).
Starting from this work, we have constructed a pipeline dedicated to the routine search of the transient sources on monthly time scale, complementary to the routine search on shorter time scales (day and week) done by the Fermi-LAT Flare Advocate activity and Fermi All-sky Variability Analysis (FAVA).

Primary author: MEREU, Isabella

Presenter: MEREU, Isabella

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Catalogs

Contribution ID: **201** Type: **Poster**

The results of joint GBM-LAT spectral analysis of four fluence populations of GRBs

Tuesday, April 13, 2021 6:44 PM (4 minutes)

The second Fermi LAT GRB catalog presents the results for 186 Gamma Ray Bursts (GRBs) detected by the Fermi Large Area Telescope (LAT) between 2008 and 2018. Out of these, we select the GRBs with significant detection in the LAT and GBM during the T90 time interval. We further subdivide this population into four quartiles based on the fluence from the GBM and carry out joint GBM-LAT spectral analysis for the T90 duration with single and multi-component spectral models. Here, we present the results for best fit model, spectral indices, Epeak and fluence obtained from the joint analysis. We also compare the spectral properties of the four quartiles.

Primary author: SAJJAD, Saeeda

Presenter: SAJJAD, Saeeda

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **202** Type: **Poster**

Did Dark Matter Kill the Dinosaurs?

Tuesday, April 13, 2021 7:35 AM (7 minutes)

Recent studies of the effects on the Earth's atmosphere by astrophysical sources, such as nearby gamma-ray bursts or supernovae, have shown that these events could lead to severe changes in atmospheric composition. Depletion of ozone, the most notable of these changes, is extremely dangerous to living organisms as any decrease in ozone levels leads to an increase in the irradiance of harmful solar radiation at the Earth's surface. In this work we consider dark matter as an astrophysical source of gamma rays, by the annihilation and decay of WIMPs found within dark compact halo objects known as UltraCompact MiniHalos
(UCMHs). We calculate the fluence of gamma rays produced in this way and simulate the resulting changes to terrestrial ozone levels using the Goddard Space Flight Center 2D Atmospheric Model. We also calculate the rate at which such events would occur, using estimates for the mass distribution of these halos within the Milky Way. We find that the ozone depletion from UCMHs can be significant, and even of similar magnitude to the levels which have been linked to the cause of the Late-Ordovician mass extinction event. However, the probability of such encounters over the Earth's entire history is relatively low. This suggests that, while dark compact objects like UCMHs could have had an impact on the Earth's biosphere, other astrophysical phenomena like gamma-ray bursts or supernovae seem a more likely source of these effects.

Primary author: SARKIS, Michael

Presenter: SARKIS, Michael

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Dark Matter

Contribution ID: **203** Type: **Poster**

Classification and Ranking of Fermi LAT gamma-ray sources from the 4FGL Catalog using Machine Learning Techniques

Tuesday, April 13, 2021 7:00 AM (7 minutes)

The Fermi LAT Fourth Source Catalog (4FGL) contains over 5000 gamma-ray sources detected using 8 years of LAT data. Among these sources, over 3000 are associated with known blazars, 239 are associated with pulsars, and over 1300 are classified as 'unassociated' sources, meaning they have no known plausible counterpart at any other wavelength. Following on our previous work on the 3FGL Catalog (Saz Parkinson et al. 2016), we use the information from the known classes of gamma-ray sources to infer the nature of the unassociated sources from 4FGL using machine learning techniques. We will present the results of our predictions, as well as examples of the follow-up multiwavelength observations and pulsar searches on some the top candidates identified in our studies.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Dark Matter/CR/Catalogs-1

Track Classification: Catalogs

Contribution ID: **204** Type: **Poster**

Multiwavelength observations of the mode change in PSR J2021+4026

Tuesday, April 13, 2021 6:05 PM (5 minutes)

PSR J2021+4026 in the Cygnus region is one of the most interesting radio-quiet pulsars detected by Fermi-LAT. This source, thought to be associated with the Gamma Cygni supernova remnant, is the first isolated gamma-ray pulsar that exhibited clear evidence of variability, with a simultaneous flux and spindown change first occurred in October 2011. After a long recovery phase, in August 2015 the pulsar reached the pre-2011 flux and timing characteristics and in September 2017 underwent a new mode change. This behaviour is still unique among the population of gamma-ray pulsars and therefore we performed multiwavelength follow-up observations in order to understand the physics behind this event. We have analyzed Fermi-LAT gamma rays simultaneous to two deep XMM-Newton observations taken after the flux drop and during the recovery phase. We also analyzed a deep observation with the Gran Telescopio Canarias carried on after the recovery in order to search for its optical counterpart. We present the results of this multiwavelength campaign and how such studies can help constraining the pulsar geometry and deciphering these rare gamma-ray variability events.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **205** Type: **Poster**

Plucking the Web: Searching Unassociated Fermi Gamma-ray Sources for Spider Pulsars with a Jerk search Algorithm

Tuesday, April 13, 2021 6:00 PM (5 minutes)

In the past decade, the most successful approach to search for millisecond pulsars (MSPs) has been to use acceleration searches to look for radio pulsations in the error bars of Gamma-ray sources identified by the Large Area Telescope (LAT) aboard the Fermi Satellite. However, 1000s of gamma-ray sources found by LAT still remain unassociated with any astrophysical object. It is believed that many of these could be MSPs. One of the reasons for their non-detection is that the present method of doing acceleration searches to account for the orbital motion of the pulsar is only effective when the observation time is less than 1/10th of the orbital period. We have been using the novel jerk search algorithm implemented in the PRESTO software package to re-search Fermi sources that remain unidentified. Jerk search is sensitive to changes in the period of the pulsed signal up to its second derivative caused by the orbital motion, resulting in increased sensitivity to tight binary systems. We are using radio data gathered from the Robert C. Byrd Green Bank Telescope (GBT) at 820 MHz for unassociated sources from Fermi LAT catalogs as part of the Fermi Pulsar Search Consortium. Here we present the Discovery of 11 MSPs as a result of such a search, one of which has been confirmed as a black-widow. There's also a MSP which has companion more massive than expected through evolutionary models. Another of these has already been confirmed as an isolated gamma-ray MSP.

Primary author: TABASSUM, Shawaiz

Presenter: TABASSUM, Shawaiz

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-1

Track Classification: Pulsar

Contribution ID: **206** Type: **Poster**

Constraining the number of classes of gamma-ray burst: multidimensional modelling with skewed distributions

Tuesday, April 13, 2021 6:32 PM (4 minutes)

Two classes of gamma-ray bursts (GRBs), short and long, have been confidently identified thus far and are prescribed to different physical scenarios. A third class, intermediate in duration, was suggested to be present in various catalogues based on a mixture-modelling with two or three Gaussian distributions of the log-durations, log(T90). This might not be an adequate model. An analysis of log(T90) from CGRO/BATSE, Swift/BAT, and Fermi/GBM revealed that mixtures of skewed distributions with only two components are a better description than a three-component Gaussian mixture. The same results were obtained by analysing a duration-hardness ratio plane, log(T90)-log(H32), for BATSE and Fermi GRBs. Similar results were obtained for Swift, Konus-Wind, RHESSI, and Suzaku/WAM. This implies that the presumed intermediate class of GRBs is unnecessary to explain the observations. A comprehensive, multivariate analysis, performed on various sets of BATSE parameters, including several three-dimensional spaces, and reaching up to a four-dimensional space of T90-H32-Ftot-P256, gave inconclusive results of 2-4 components, depending on the parameter set. A similar investigation of the Fermi data in the 3D and 5D spaces of T90-Ftot-P256 and T90-Ftot-Epeak-alpha-beta (with the Band parameters) lead to 3 and 2 components, respectively. This outcome is in a sense undesired, since for the same set of GRBs one would expect to get consistent results. A Monte Carlo testing suggests that additional components might be artifacts owing to the finiteness of the data and be a result of examining a particular realisation of the data as a random sample, resulting in spurious identifications. All in all, the presumed third class of GRBs appears to be non-existent.

Primary author: TARNOPOLSKI, Mariusz

Presenter: TARNOPOLSKI, Mariusz

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **207** Type: **Poster**

Shaken, not stirred: test particles in binary black hole mergers

Tuesday, April 13, 2021 6:00 PM (4 minutes)

In 2015 the advanced Laser Interferometer Gravitational-Wave Observatory (aLIGO) detected the first ever gravitational event, gravitational wave event GW150914, with multiple new gravitational wave events, originating from both binary neutron stars and binary black hole (BBH) mergers, detected in subsequent years. In light of these detections, we simulate the dynamics of ambient test particles in the gravitational potential well of a BBH system close to its inspiral phase. The goal of simulating the associated electromagnetic radiation and resulting spectral energy density distribution of such a BBH system, as this could shed light on possible detection ranges of electromagnetic counterparts to BBH mergers. The potentials are numerically calculated using finite difference methods, under the assumption of non-rotating black holes with the post-Newtonian Paczynski-Wiita potential approximation in tandem with retarded time concepts analogous to electrodynamics. We find that the frequencies of potential electromagnetic radiation produced by these systems (possibly reaching earth), range between a few kHz to a few 100kHz. The bulk of radiation is distributed at frequencies below 100kHz.

Primary author: VAN DER MERWE, Pieter

Presenter: VAN DER MERWE, Pieter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-1

Track Classification: Gamma-ray Bursts

Contribution ID: **211** Type: **Poster**

Absorption spectroscopy of GRB160410A: First complete study of the ISM of a short GRB

Wednesday, April 14, 2021 7:54 AM (3 minutes)

Short gamma-ray burst are, as we now know, produced as the result of the coalescence of two compact objects. These objects are also known to release large amounts of energy in gravitational waves during the merger. We present our first results on the study of GRB 160410A, an undoubtedly short GRB at z=1.717, making it one of the farthest short GRBs to date. We observed the afterglow emission starting just 8.2 minutes after the detection with Neil Gehrels Swift Observatory using the Rapid Response Mode from X-Shooter spectrograph mounted in VLT at Paranal Observatory. Our fast reaction gave us high-quality data that show a large number of absorption lines as well as Lyman α. This allows us the first ever detailed study of chemical properties in the sight-line of a short GRB and the first metallicity measurement for a short GRB in absorption. The environment seems to have an unusually low ionization state compared to long GRBs with all high ionization states such as CIV and SiIV being completely absent while they are frequently observed in long GRBs. The low ionization is consistent with the idea of a neutron star binary coalescence with a long delay time, where the host galaxy would no longer have the very active star formation that is normally seen in long GRB hosts. In addition to the host galaxy features we find several intervening absorbers at lower redshifts. Our spectra is the first ever complete study of the ISM in the host of a short GRB.

Primary author: AGÜÍ FERNÁNDEZ, José Feliciano

Presenter: AGÜÍ FERNÁNDEZ, José Feliciano

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **212** Type: **Poster**

Absorption spectroscopy of GRB160410A: First complete study of the ISM of a short GRB

Friday, April 16, 2021 8:16 AM (4 minutes)

Short gamma-ray burst are, as we now know, produced as the result of the coalescence of two compact objects. These objects are also known to release large amounts of energy in gravitational waves during the merger. We present our first results on the study of GRB 160410A, an undoubtedly short GRB at z=1.717, making it one of the farthest short GRBs to date. We observed the afterglow emission starting just 8.2 minutes after the detection with Neil Gehrels Swift Observatory using the Rapid Response Mode from X-Shooter spectrograph mounted in VLT at Paranal Observatory. Our fast reaction gave us high-quality data that show a large number of absorption lines as well as Lyman α. This allows us the first ever detailed study of chemical properties in the sight-line of a short GRB and the first metallicity measurement for a short GRB in absorption. The environment seems to have an unusually low ionization state compared to long GRBs with all high ionization states such as CIV and SiIV being completely absent while they are frequently observed in long GRBs. The low ionization is consistent with the idea of a neutron star binary coalescence with a long delay time, where the host galaxy would no longer have the very active star formation that is normally seen in long GRB hosts. In addition to the host galaxy features we find several intervening absorbers at lower redshifts. Our spectra is the first ever complete study of the ISM in the host of a short GRB.

Primary author: AGÜÍ FERNÁNDEZ, José Feliciano

Presenter: AGÜÍ FERNÁNDEZ, José Feliciano

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **213** Type: **Poster**

Temporal and Spectral Modelling of Intermediate Luminosity type Ib Supernova SN2015ap.

Wednesday, April 14, 2021 7:51 AM (3 minutes)

In this paper,we present the observed photo metric and spectroscopic properties of a type Ib supernova (SN) SN2015ap. Our aim in this paper is to model a reliable progenitor for SN2015ap, which can undergo core-collapse and explain the observed properties of this SN. Initially, this SN shows some broad-lined features like SN2008D and later it shows features matching with normal type Ib supernovae (SNe). We tried to synthetically reproduce the explosion. For this purpose, we modelled a 12 M zero-age main sequence star and evolved it until the onset of core-collapse using the stellar evolution code MESA. Thereafter a synthetic explosion is produced using SNEC, which provides properties such as observed bolometric luminosity, black body radius, temperature and velocity evolution of the photo-sphere. We compare the observed parameters of SN2015ap with those produced by synthetic explosion and find satisfactory agreement with each other supporting a 12 M progenitor for SN2015ap.

Primary author: ARYAN, Amar

Presenter: ARYAN, Amar

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: SN

Contribution ID: **214** Type: **Poster**

Temporal and Spectral Modelling of Intermediate Luminosity type Ib Supernova SN2015ap.

Friday, April 16, 2021 8:12 AM (4 minutes)

In this paper,we present the observed photo metric and spectroscopic properties of a type Ib supernova (SN) SN2015ap. Our aim in this paper is to model a reliable progenitor for SN2015ap, which can undergo core-collapse and explain the observed properties of this SN. Initially, this SN shows some broad-lined features like SN2008D and later it shows features matching with normal type Ib supernovae (SNe). We tried to synthetically reproduce the explosion. For this purpose, we modelled a 12 M zero-age main sequence star and evolved it until the onset of core-collapse using the stellar evolution code MESA. Thereafter a synthetic explosion is produced using SNEC, which provides properties such as observed bolometric luminosity, black body radius, temperature and velocity evolution of the photo-sphere. We compare the observed parameters of SN2015ap with those produced by synthetic explosion and find satisfactory agreement with each other supporting a 12 M progenitor for SN2015ap.

Primary author: ARYAN, Amar

Presenter: ARYAN, Amar

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: SN

Contribution ID: **215** Type: **Poster**

GRB 171205A/SN2017iuk as a reference for GRB studies

Wednesday, April 14, 2021 7:48 AM (3 minutes)

GRB 171205A was one of the closest GRBs that we have ever detected and one of the best-followed events. In this talk I will present the result of several studies of this event, its afterglow, associated supernova SN2017iuk, and host galaxy. Optical spectroscopy ranges from one hour after the event to more than 7 months later. These data served to identify cocoon signatures during the first 3 days, with material expanding at speeds that reached 0.3c (Izzo, de Ugarte Postigo et al. 2019, Nature 565, 324), and study the supernova evolution into the nebular phase. The interaction of the jet that emerged from the collapsing star with the interstellar medium generated a weak afterglow. In spite of its intrinsic faintness, thanks to the proximity of the GRB, we have been able to follow the radio emission for over 2 years now, obtaining a detailed insight on the physics involved in this event. Finally the data are complemented with a very detailed study of the host galaxy in which this GRB happened, thanks to high-resolution HST imaging, resolved molecular spectroscopy from ALMA and optical integrated field spectroscopy from VLT/MUSE. The GRB is located in the outskirts of a barred grand-design spiral galaxy, a very unique environment for a long GBR.

Primary author: DE UGARTE POSTIGO, Antonio

Presenter: DE UGARTE POSTIGO, Antonio

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **216** Type: **Poster**

GRB 171205A/SN2017iuk as a reference for GRB studies

Friday, April 16, 2021 8:08 AM (4 minutes)

GRB 171205A was one of the closest GRBs that we have ever detected and one of the best-followed events. In this talk I will present the result of several studies of this event, its afterglow, associated supernova SN2017iuk, and host galaxy. Optical spectroscopy ranges from one hour after the event to more than 7 months later. These data served to identify cocoon signatures during the first 3 days, with material expanding at speeds that reached 0.3c (Izzo, de Ugarte Postigo et al. 2019, Nature 565, 324), and study the supernova evolution into the nebular phase. The interaction of the jet that emerged from the collapsing star with the interstellar medium generated a weak afterglow. In spite of its intrinsic faintness, thanks to the proximity of the GRB, we have been able to follow the radio emission for over 2 years now, obtaining a detailed insight on the physics involved in this event. Finally the data are complemented with a very detailed study of the host galaxy in which this GRB happened, thanks to high-resolution HST imaging, resolved molecular spectroscopy from ALMA and optical integrated field spectroscopy from VLT/MUSE. The GRB is located in the outskirts of a barred grand-design spiral galaxy, a very unique environment for a long GBR.

Primary author: DE UGARTE POSTIGO, Antonio

Presenter: DE UGARTE POSTIGO, Antonio

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **217** Type: **Poster**

M@TE - Extending the Coverage of TeV Monitoring

Wednesday, April 14, 2021 7:45 AM (3 minutes)

Blazars are extremely variable sources showing flux variations on time scales from minutes to years. To study typical variability time scales of few hours to one day, continuous observations are crucial. Furthermore, studying the temporal evolution of the spectral energy distribution is a key to discriminate between different theoretical models for the emission mechanisms and processes underlying the
observed variability.

Monitoring at TeV Energies (M@TE) is a project aiming at long-term observations of blazars in gamma rays. Combining these observations with the long-term monitoring carried out by FACT the continuous coverage will be extended to 12 hours. For this, a small imaging air Cherenkov telescope is being installed in Mexico. A mount from a previous experiment is being refurbished and will be equipped with a new SiPM camera. Providing an excellent and stable performance, these semi-conductor photo sensors are ideal for long-term monitoring. The mount, a new drive system and new mirrors are already available. The new SiPMs
purchased provide an improved photon detection efficiency. Different options for the production of the light guides are under investigation. Simulations of the different detector components are being implemented. With the observatory of San Pedro Martir, an excellent site has been chosen.

In the presentation, an overview of the project will be given and its status discussed.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Instrumentation

Contribution ID: **218** Type: **Poster**

M@TE - Extending the Coverage of TeV Monitoring

Friday, April 16, 2021 8:04 AM (4 minutes)

Blazars are extremely variable sources showing flux variations on time scales from minutes to years. To study typical variability time scales of few hours to one day, continuous observations are crucial. Furthermore, studying the temporal evolution of the spectral energy distribution is a key to discriminate between different theoretical models for the emission mechanisms and processes underlying the
observed variability.

Monitoring at TeV Energies (M@TE) is a project aiming at long-term observations of blazars in gamma rays. Combining these observations with the long-term monitoring carried out by FACT the continuous coverage will be extended to 12 hours. For this, a small imaging air Cherenkov telescope is being installed in Mexico. A mount from a previous experiment is being refurbished and will be equipped with a new SiPM camera. Providing an excellent and stable performance, these semi-conductor photo sensors are ideal for long-term monitoring. The mount, a new drive system and new mirrors are already available. The new SiPMs
purchased provide an improved photon detection efficiency. Different options for the production of the light guides are under investigation. Simulations of the different detector components are being implemented. With the observatory of San Pedro Martir, an excellent site has been chosen.

In the presentation, an overview of the project will be given and its status discussed.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Instrumentation

Contribution ID: **219** Type: **Poster**

SN 2010kd: Photometric and Spectroscopic Analysis of a Slow-Decaying Superluminous Supernova.

Wednesday, April 14, 2021 7:42 AM (3 minutes)

This poster presents data and analysis of SN 2010kd, a low-redshift (z = 0.101) H-deficient superluminous supernova (SLSN), based on ultraviolet/optical photometry and optical spectroscopy spanning between −28 and +193 days relative to B band maximum light. The B band light curve comparison of SN 2010kd with a subset of well-studied SLSNe at comparable redshifts indicates that it is a slow-decaying but less luminous SLSN. Analytical light-curve modeling using the Minim code suggests that the bolometric light curve of SN
2010kd favors models having combined circumstellar matter interaction and heating from radioactive decay for the powering mechanism. SYNAPPS modeling of the early-phase spectra does not identify broad H or He lines, whereas the photospheric-phase spectra are dominated by O I, O II, C II, C IV and Si II, particularly, presence of both low and high-velocity components of O II and Si II lines. The nebular-phase spectra of SN 2010kd are
dominated by O I and Ca II emission lines similar to those seen in other SLSNe I. The line velocities in SN 2010kd exhibit flatter evolution curves similar to SN 2015bn but with comparatively higher values. SN 2010kd shows a higher single-zone local thermodynamic equilibrium temperature in comparison to PTF12dam and SN 2015bn, and it has an upper O I ejected mass limit of ~ 10 M. The host of SN 2010kd is a dwarf galaxy with a high star-formation rate (~ 0.18 ± 0.04 M yr−1) and extreme emission lines.

Primary author: KUMAR, Amit

Presenter: KUMAR, Amit

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: SN

Contribution ID: **220** Type: **Poster**

SN 2010kd: Photometric and Spectroscopic Analysis of a Slow-Decaying Superluminous Supernova.

Friday, April 16, 2021 8:00 AM (4 minutes)

This poster presents data and analysis of SN 2010kd, a low-redshift (z = 0.101) H-deficient superluminous supernova (SLSN), based on ultraviolet/optical photometry and optical spectroscopy spanning between −28 and +193 days relative to B band maximum light. The B band light curve comparison of SN 2010kd with a subset of well-studied SLSNe at comparable redshifts indicates that it is a slow-decaying but less luminous SLSN. Analytical light-curve modeling using the Minim code suggests that the bolometric light curve of SN
2010kd favors models having combined circumstellar matter interaction and heating from radioactive decay for the powering mechanism. SYNAPPS modeling of the early-phase spectra does not identify broad H or He lines, whereas the photospheric-phase spectra are dominated by O I, O II, C II, C IV and Si II, particularly, presence of both low and high-velocity components of O II and Si II lines. The nebular-phase spectra of SN 2010kd are
dominated by O I and Ca II emission lines similar to those seen in other SLSNe I. The line velocities in SN 2010kd exhibit flatter evolution curves similar to SN 2015bn but with comparatively higher values. SN 2010kd shows a higher single-zone local thermodynamic equilibrium temperature in comparison to PTF12dam and SN 2015bn, and it has an upper O I ejected mass limit of ~ 10 M. The host of SN 2010kd is a dwarf galaxy with a high star-formation rate (~ 0.18 ± 0.04 M yr−1) and extreme emission lines.

Primary author: KUMAR, Amit

Presenter: KUMAR, Amit

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: SN

Contribution ID: **221** Type: **Poster**

High energy face of Gamma-ray bursts

Wednesday, April 14, 2021 7:39 AM (3 minutes)

TeV emissions from Gamma-ray bursts (GRBs) are very important to study the origin and the radiation mechanisms in detail. Recent discoveries of TeV photons in some of the GRBs are challenging to be explained by Synchrotron mechanism. In this work, we present the results of a detailed investigation of the prompt and afterglow emission of recently discovered TeV GRBs (GRB 180720B, GRB 190114C and GRB 190829A) based on the publicly available prompt and afterglow data. We studied the time-resolved spectroscopy of their prompt emission data to understand their emission mechanisms and to search for spectral parameter correlations based on various binning methods such as Bayesian blocks and signal to noise (SNR). GRB 190829A is a peculiar low luminous burst and it could have shock- breakout origin. We analyzed the late time Fermi-LAT emission that encapsulates the H.E.S.S. and MAGIC detection. Some of the LAT photons are likely to be associated with the GRBs and they could have Inverse Compton mechanism origin.

Primary author: PANDEY, Shashi Bhushan

Presenter: PANDEY, Shashi Bhushan

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **222** Type: **Poster**

High energy face of Gamma-ray bursts

Friday, April 16, 2021 7:56 AM (4 minutes)

TeV emissions from Gamma-ray bursts (GRBs) are very important to study the origin and the radiation mechanisms in detail. Recent discoveries of TeV photons in some of the GRBs are challenging to be explained by Synchrotron mechanism. In this work, we present the results of a detailed investigation of the prompt and afterglow emission of recently discovered TeV GRBs (GRB 180720B, GRB 190114C and GRB 190829A) based on the publicly available prompt and afterglow data. We studied the time-resolved spectroscopy of their prompt emission data to understand their emission mechanisms and to search for spectral parameter correlations based on various binning methods such as Bayesian blocks and signal to noise (SNR). GRB 190829A is a peculiar low luminous burst and it could have shock- breakout origin. We analyzed the late time Fermi-LAT emission that encapsulates the H.E.S.S. and MAGIC detection. Some of the LAT photons are likely to be associated with the GRBs and they could have Inverse Compton mechanism origin.

Primary author: PANDEY, Shashi Bhushan

Presenter: PANDEY, Shashi Bhushan

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **223** Type: **Poster**

GRB 131014A: A Laboratory for Studying the Thermal-like and Non-thermal Emissions in Gamma-Ray Bursts

Wednesday, April 14, 2021 7:36 AM (3 minutes)

Over the past few years, evidence has been accumulated in support of the existence of a thermal-like component during the GRB prompt phase. This component–often associated with the GRB jet's photosphere–is usually subdominant compared to a much stronger non-thermal one. The prompt emission of GRB 131014A detected by Fermi provides a unique opportunity to trace the history of this thermal-like component. In this GRB, the thermal emission is much more intense than in other bursts and a pure thermal episode is observed at early times. The intensity of the non-thermal component progressively increases until being energetically dominant at late times, similar to what is typically observed. GRB 131014A is a case study to disentangle the thermal component from the non-thermal component. Using this analysis, we derived fundamental physical quantities describing the GRB relativistic jet such as the evolution of (i) the bulk Lorentz Factor of the outflow, (ii) the photospheric radius, (iii) the injection radius, and (iv) the injected power.

Primary author: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Presenter: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **224** Type: **Poster**

GRB 131014A: A Laboratory for Studying the Thermal-like and Non-thermal Emissions in Gamma-Ray Bursts

Friday, April 16, 2021 7:52 AM (4 minutes)

Over the past few years, evidence has been accumulated in support of the existence of a thermal-like component during the GRB prompt phase. This component–often associated with the GRB jet's photosphere–is usually subdominant compared to a much stronger non-thermal one. The prompt emission of GRB 131014A detected by Fermi provides a unique opportunity to trace the history of this thermal-like component. In this GRB, the thermal emission is much more intense than in other bursts and a pure thermal episode is observed at early times. The intensity of the non-thermal component progressively increases until being energetically dominant at late times, similar to what is typically observed. GRB 131014A is a case study to disentangle the thermal component from the non-thermal component. Using this analysis, we derived fundamental physical quantities describing the GRB relativistic jet such as the evolution of (i) the bulk Lorentz Factor of the outflow, (ii) the photospheric radius, (iii) the injection radius, and (iv) the injected power.

Primary author: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Presenter: GUIRIEC, Sylvain (NASA Goddard Space Flight Center / UMD / CRESST)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **225** Type: **Poster**

Investigation of gamma rays at an altitude of 3340 meters above sea level on a complex installation HADRON-55

Wednesday, April 14, 2021 7:33 AM (3 minutes)

For research, our group uses an installation with an area of 55 m2, consisting of two recording levels, gamma and hadron blocks, separated by a two-meter gap, located at the Tien Shan high-altitude scientific station. The main idea is to select interactions that are only observed in the gamma block, and not observed in the hadron block.
The upgraded ionization calorimeter with a field of scintillation detectors will be used for research in the field of high-energy gamma astronomy. The ionization calorimeter consists of two parts - the upper gamma-block and the lower hadron block, separated by a two-meter gap. The gamma block registers, i.e. absorbs the electron-photon component (EPC) of cosmic rays, the hadronic component, due to the small thickness of the gamma block, passes through the gamma block without interactions and begins to interact and generate particles in the hadron block.

Primary author: IDRISSOVA, Tynik

Presenter: IDRISSOVA, Tynik

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **226** Type: **Poster**

Investigation of gamma rays at an altitude of 3340 meters above sea level on a complex installation HADRON-55

Friday, April 16, 2021 7:48 AM (4 minutes)

For research, our group uses an installation with an area of 55 m2, consisting of two recording levels, gamma and hadron blocks, separated by a two-meter gap, located at the Tien Shan high-altitude scientific station. The main idea is to select interactions that are only observed in the gamma block, and not observed in the hadron block.
The upgraded ionization calorimeter with a field of scintillation detectors will be used for research in the field of high-energy gamma astronomy. The ionization calorimeter consists of two parts - the upper gamma-block and the lower hadron block, separated by a two-meter gap. The gamma block registers, i.e. absorbs the electron-photon component (EPC) of cosmic rays, the hadronic component, due to the small thickness of the gamma block, passes through the gamma block without interactions and begins to interact and generate particles in the hadron block.

Primary author: IDRISSOVA, Tynik

Presenter: IDRISSOVA, Tynik

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **227** Type: **Poster**

Constraints on Lorentz Invariance Violation from MAGIC observation of GRB 190114C

Wednesday, April 14, 2021 7:30 AM (3 minutes)

On January 14th 2019, MAGIC, a stereoscopic system of two 17m diameter Imaging Atmospheric Cherenkov Telescopes located on the Canary island of La Palma, observed for the first time a gamma-ray burst (GRB) at TeV energies, namely GRB 190114C. MAGIC measurements started ~60s after the onset of GRB 190114C, predominantly in the featureless smooth afterglow phase. Nevertheless, in the first 30s of MAGIC observation the gamma-ray intensity from GRB 190114C reached the unprecedented level of around 130 times the Crab nebula flux. Such GRB observations are regarded as one of the best targets to test quantum gravity models, several of them predicting an energy dependence of the speed of light that can be probed thanks to the cosmological distances traveled by the emitted photons and the time variability of the emission. In this talk, we will report on the search of such LIV effect using a maximum likelihood analysis of the GRB 190114C observation by MAGIC.

Primary author: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Presenter: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **228** Type: **Poster**

Constraints on Lorentz Invariance Violation from MAGIC observation of GRB 190114C

Friday, April 16, 2021 7:44 AM (4 minutes)

On January 14th 2019, MAGIC, a stereoscopic system of two 17m diameter Imaging Atmospheric Cherenkov Telescopes located on the Canary island of La Palma, observed for the first time a gamma-ray burst (GRB) at TeV energies, namely GRB 190114C. MAGIC measurements started ~60s after the onset of GRB 190114C, predominantly in the featureless smooth afterglow phase. Nevertheless, in the first 30s of MAGIC observation the gamma-ray intensity from GRB 190114C reached the unprecedented level of around 130 times the Crab nebula flux. Such GRB observations are regarded as one of the best targets to test quantum gravity models, several of them predicting an energy dependence of the speed of light that can be probed thanks to the cosmological distances traveled by the emitted photons and the time variability of the emission. In this talk, we will report on the search of such LIV effect using a maximum likelihood analysis of the GRB 190114C observation by MAGIC.

Primary author: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Presenter: KERSZBERG, Daniel (IFAE - Institute for High Energy Physics)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **229** Type: **Poster**

3D magnetised jet break-out from neutron-star binary merger ejecta: afterglow emission from the jet and the ejecta

Wednesday, April 14, 2021 7:27 AM (3 minutes)

We perform three-dimensional (3D) general-relativistic magnetohydrodynamic simulations to model the jet break-out from the ejecta expected to be produced in a binary neutron-star merger. The structure of the relativistic outflow from the 3D simulation confirms our previous results from 2D simulations, namely, that a relativistic magnetized outflow breaking out from the merger ejecta exhibits a hollow core of $\theta_{core} \approx 4^{\circ}$, an opening angle of $\theta_{jet} > 10^{\circ}$, and is accompanied by a wind of ejected matter that will contribute to the kilonova emission. We also compute the non-thermal afterglow emission of the relativistic outflow and fit it to the panchromatic afterglow from GRB170817A, together with the superluminal motion reported from VLBI observations. In this way, we deduce an observer angle of $\theta_{obs} = 35.7^{\circ\,+1.8}_{\;-2.2}$. We further compute the afterglow emission from the ejected matter and constrain the parameter space for a scenario in which the matter responsible for the thermal kilonova emission will also lead to a non-thermal emission yet to be observed.

Primary author: NATHANAIL, Antonios

Presenter: NATHANAIL, Antonios

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **230** Type: **Poster**

3D magnetised jet break-out from neutron-star binary merger ejecta: afterglow emission from the jet and the ejecta

Friday, April 16, 2021 7:40 AM (4 minutes)

We perform three-dimensional (3D) general-relativistic magnetohydrodynamic simulations to model the jet break-out from the ejecta expected to be produced in a binary neutron-star merger. The structure of the relativistic outflow from the 3D simulation confirms our previous results from 2D simulations, namely, that a relativistic magnetized outflow breaking out from the merger ejecta exhibits a hollow core of $\theta_{core} \approx 4^\circ$, an opening angle of $\theta_{jet} > 10^\circ$, and is accompanied by a wind of ejected matter that will contribute to the kilonova emission. We also compute the non-thermal afterglow emission of the relativistic outflow and fit it to the panchromatic afterglow from GRB170817A, together with the superluminal motion reported from VLBI observations. In this way, we deduce an observer angle of $\theta_{obs} = 35.7^{\circ\,+1.8}_{\;\;-2.2}$. We further compute the afterglow emission from the ejected matter and constrain the parameter space for a scenario in which the matter responsible for the thermal kilonova emission will also lead to a non-thermal emission yet to be observed.

Primary author: NATHANAIL, Antonios

Presenter: NATHANAIL, Antonios

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **231** Type: **Poster**

Unveiling the origin of steep decay in gamma-ray bursts

Wednesday, April 14, 2021 7:24 AM (3 minutes)

γ-ray bursts (GRBs) are cataclysmic events, whose role became central in the new multi-messenger era. GRBs are thought to originate from internal dissipation of the energy carried by ultra-relativistic jets launched by the remnant of a massive star's death or a compact binary coalescence. In the present work I propose a novel investigation of the GRB emission mechanism, via time-resolved spectral analysis of the X-ray tails of bright GRB pulses, discovering a unique relation between the spectral index and the flux. The investigation of the spectral evolution is the ideal diagnostic to understand the connection between the emission processes and the outflow. I thoroughly discuss possible interpretations in relation to current available models and I show the incompatibility of our results with the high latitude emission of efficiently cooled particles. Our results for the first time show evidence of adiabatic cooling of the emitting particles, shedding light on fundamental physics of relativistic outflows in GRBs.

Primary author: RONCHINI, Samuele (Gran Sasso Science Institute)

Presenter: RONCHINI, Samuele (Gran Sasso Science Institute)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **232** Type: **Poster**

Unveiling the origin of steep decay in gamma-ray bursts

Friday, April 16, 2021 7:36 AM (4 minutes)

γ-ray bursts (GRBs) are cataclysmic events, whose role became central in the new multi-messenger era. GRBs are thought to originate from internal dissipation of the energy carried by ultra-relativistic jets launched by the remnant of a massive star's death or a compact binary coalescence. In the present work I propose a novel investigation of the GRB emission mechanism, via time-resolved spectral analysis of the X-ray tails of bright GRB pulses, discovering a unique relation between the spectral index and the flux. The investigation of the spectral evolution is the ideal diagnostic to understand the connection between the emission processes and the outflow. I thoroughly discuss possible interpretations in relation to current available models and I show the incompatibility of our results with the high latitude emission of efficiently cooled particles. Our results for the first time show evidence of adiabatic cooling of the emitting particles, shedding light on fundamental physics of relativistic outflows in GRBs.

Primary author: RONCHINI, Samuele (Gran Sasso Science Institute)

Presenter: RONCHINI, Samuele (Gran Sasso Science Institute)

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **233** Type: **Poster**

Identifying Black Hole Central Engines in Gamma-Ray Bursts

Wednesday, April 14, 2021 7:21 AM (3 minutes)

The nature of the gamma-ray burst (GRB) central engine remains an enigma. Entities widely considered to be capable of powering the extreme jets are: (i) a hyper-accreting stellar-mass black hole, and (ii) a rapidly spinning, highly magnetized, neutron star (NS) or fast magnetar. The maximum rotational energy that is feasible in a millisecond magnetar to form a jet is ~10^52 erg and hence presents an upper limit on energy budget available for the magnetar model. In this paper, analysing the jet-opening angle-corrected energetics of the prompt emission of gamma-ray bursts detected by the Fermi gamma-ray space telescope for the last eleven years, we identify eight long GRBs whose central engines are black holes. The majority of these GRBs exhibit significant emission in the sub-GeV energy range. Their X-ray light curves also lack the 'plateau'feature often attributed to magnetars; however, a few cases exhibit flares and multiple breaks. By considering the Blandford–Znajek mechanism of jet formation, we estimate the masses of these black holes to range between ~2 and 60 Msun. Interestingly, some of the lighter black holes formed in these catastrophic events are likely candidates to lie in the mass-gap region (2–5 Msun).

Primary author: SHARMA, Vidushi

Presenter: SHARMA, Vidushi

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **234** Type: **Poster**

Identifying Black Hole Central Engines in Gamma-Ray Bursts

Friday, April 16, 2021 7:32 AM (4 minutes)

The nature of the gamma-ray burst (GRB) central engine remains an enigma. Entities widely considered to be capable of powering the extreme jets are: (i) a hyper-accreting stellar-mass black hole, and (ii) a rapidly spinning, highly magnetized, neutron star (NS) or fast magnetar. The maximum rotational energy that is feasible in a millisecond magnetar to form a jet is ~10^52 erg and hence presents an upper limit on energy budget available for the magnetar model. In this paper, analysing the jet-opening angle-corrected energetics of the prompt emission of gamma-ray bursts detected by the Fermi gamma-ray space telescope for the last eleven years, we identify eight long GRBs whose central engines are black holes. The majority of these GRBs exhibit significant emission in the sub-GeV energy range. Their X-ray light curves also lack the 'plateau'feature often attributed to magnetars; however, a few cases exhibit flares and multiple breaks. By considering the Blandford–Znajek mechanism of jet formation, we estimate the masses of these black holes to range between ~2 and 60 Msun. Interestingly, some of the lighter black holes formed in these catastrophic events are likely candidates to lie in the mass-gap region (2–5 Msun).

Primary author: SHARMA, Vidushi

Presenter: SHARMA, Vidushi

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **235** Type: **Poster**

Fermi-GBM and Swift-BAT detection of an extragalactic magnetar giant flare

Wednesday, April 14, 2021 7:18 AM (3 minutes)

We present the observations of the first unambiguous magnetar giant flare from outside of our galactic neighborhood. At the beginning, GRB 200415A was identified as a short GRB, but upon further investigation and observations from additional instruments, we concluded this event was a giant flare from a magnetar located in the Sculptor galaxy, 3.5 Mpc away. The GBM lightcurve shows very fast (shorter than 0.1 ms) variability, which is unprecedented among both magnetar giant flare and GRB observations. Based on the MeV range photons that Fermi-GBM detected, we find proof of relativistic expansion. We will show the detailed data analysis, the fast spectral evolution and the interpretation of this unique event.

Primary author: VERES, Peter

Presenter: VERES, Peter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **236** Type: **Poster**

Fermi-GBM and Swift-BAT detection of an extragalactic magnetar giant flare

Friday, April 16, 2021 7:28 AM (4 minutes)

We present the observations of the first unambiguous magnetar giant flare from outside of our galactic neighborhood. At the beginning, GRB 200415A was identified as a short GRB, but upon further investigation and observations from additional instruments, we concluded this event was a giant flare from a magnetar located in the Sculptor galaxy, 3.5 Mpc away. The GBM lightcurve shows very fast (shorter than 0.1 ms) variability, which is unprecedented among both magnetar giant flare and GRB observations. Based on the MeV range photons that Fermi-GBM detected, we find proof of relativistic expansion. We will show the detailed data analysis, the fast spectral evolution and the interpretation of this unique event.

Primary author: VERES, Peter

Presenter: VERES, Peter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **237** Type: **Poster**

FACT - Results from more than 8 Years of Monitoring

Wednesday, April 14, 2021 7:15 AM (3 minutes)

Operational since October 2011, the First G-APD Cherenkov Telescope (FACT) has been monitoring TeV-blazars. An unbiased observing strategy, robotic operation and the usage of solid state photo sensors (SiPM, aka G-APDs) increase the instrument's duty cycle and minimize observational gaps, making FACT an ideal instrument for long-term monitoring. In more than eight years, an unprecedented data sample of more than 14700 hours of physics data has been collected.

Results of an automatic quick-look analysis are published with low latency on an open-access website. Based on this, close to 150 alerts including 12 astronomer's telegrams have been issued in six years, triggering a variety of multi-wavelength studies including target-of-opportunity observations with X-ray satellites.

Results for various triggered multi-wavelength studies, e.g. Mrk 501 in 2014, 1ES 2344+51.4 in 2016 and Mrk 421 in 2019, are presented together with long-term studies, like e.g. a multi-wavelength study of 5.5 years of observations of Mrk 421 and studies on the variability characteristics of blazars including periodicity studies.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Instrumentation

Contribution ID: **238** Type: **Poster**

FACT - Results from more than 8 Years of Monitoring

Friday, April 16, 2021 7:24 AM (4 minutes)

Operational since October 2011, the First G-APD Cherenkov Telescope (FACT) has been monitoring TeV-blazars. An unbiased observing strategy, robotic operation and the usage of solid state photo sensors (SiPM, aka G-APDs) increase the instrument's duty cycle and minimize observational gaps, making FACT an ideal instrument for long-term monitoring. In more than eight years, an unprecedented data sample of more than 14700 hours of physics data has been collected.

Results of an automatic quick-look analysis are published with low latency on an open-access website. Based on this, close to 150 alerts including 12 astronomer's telegrams have been issued in six years, triggering a variety of multi-wavelength studies including target-of-opportunity observations with X-ray satellites.

Results for various triggered multi-wavelength studies, e.g. Mrk 501 in 2014, 1ES 2344+51.4 in 2016 and Mrk 421 in 2019, are presented together with long-term studies, like e.g. a multi-wavelength study of 5.5 years of observations of Mrk 421 and studies on the variability characteristics of blazars including periodicity studies.

Primary author: DORNER, Daniela

Presenter: DORNER, Daniela

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Instrumentation

Contribution ID: **239** Type: **Poster**

Peculiar Prompt Emission and Afterglow in the H.E.S.S.-detected GRB 190829A

Wednesday, April 14, 2021 7:12 AM (3 minutes)

We present the results of a detailed investigation of the prompt and afterglow emission in the High Energy Stereoscopic System(H.E.S.S.)-detected GRB190829A. Swift and Fermi observations of the prompt phase of this gamma-ray burst(GRB) reveal two isolated sub bursts or episodes, separated by a quiescent phase. The energetic and the spectral properties of the first episode are in stark contrast to the second. The first episode, which has a higher spectral peak~120 keV and a low isotropic energy~1050erg is an outlier to the Amati correlation and marginally satisfies the Yonetoku correlation. However, the energetically dominant second episode has lower peak energy and is consistent with the above correlations. We compared this GRB to other low-luminosity GRBs (LLGRBs). Prompt emission of LLGRBs also indicates a relativistic shock breakout origin of the radiation. For GRB190829A, some of the properties of a shock breakout origin are satisfied. However, the absence of an accompanying thermal component and energy above the shock breakout critical limit precludes a shock breakout origin. In the afterglow, an unusual long-lasting late-time flare of duration~104s is observed. We also analyzed the late-time Fermi Large Area Telescope(LAT)emission that encapsulates the H.E.S.S. detection. Some of the LAT photons are likely to be associated with the source. All of the above observational facts suggest GRB190829A is a peculiar low-luminosity GRB that is not powered by a shock breakout, and has an unusual rebrightening due to patchy emission or a refreshed shock during the afterglow. Furthermore, our results show that teraelectronvolt-energy photons seem common in both high-luminosity GRBs and LLGRBs.

Primary author: GUPTA, Rahul

Presenter: GUPTA, Rahul

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **240** Type: **Poster**

Peculiar Prompt Emission and Afterglow in the H.E.S.S.-detected GRB 190829A

Friday, April 16, 2021 7:20 AM (4 minutes)

We present the results of a detailed investigation of the prompt and afterglow emission in the High Energy Stereoscopic System(H.E.S.S.)-detected GRB190829A. Swift and Fermi observations of the prompt phase of this gamma-ray burst(GRB) reveal two isolated sub bursts or episodes, separated by a quiescent phase. The energetic and the spectral properties of the first episode are in stark contrast to the second. The first episode, which has a higher spectral peak~120 keV and a low isotropic energy~1050erg is an outlier to the Amati correlation and marginally satisfies the Yonetoku correlation. However, the energetically dominant second episode has lower peak energy and is consistent with the above correlations. We compared this GRB to other low-luminosity GRBs (LLGRBs). Prompt emission of LLGRBs also indicates a relativistic shock breakout origin of the radiation. For GRB190829A, some of the properties of a shock breakout origin are satisfied. However, the absence of an accompanying thermal component and energy above the shock breakout critical limit precludes a shock breakout origin. In the afterglow, an unusual long-lasting late-time flare of duration~104s is observed. We also analyzed the late-time Fermi Large Area Telescope(LAT)emission that encapsulates the H.E.S.S. detection. Some of the LAT photons are likely to be associated with the source. All of the above observational facts suggest GRB190829A is a peculiar low-luminosity GRB that is not powered by a shock breakout, and has an unusual rebrightening due to patchy emission or a refreshed shock during the afterglow. Furthermore, our results show that teraelectronvolt-energy photons seem common in both high-luminosity GRBs and LLGRBs.

Primary author: GUPTA, Rahul

Presenter: GUPTA, Rahul

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **241** Type: **Poster**

The Transient program of the Cherenkov Telescope Array

Wednesday, April 14, 2021 7:09 AM (3 minutes)

The Cherenkov Telescope Array (CTA) will be the next generation very high-energy (VHE) gamma-ray observatory. It will improve the sensitivity of current VHE instruments up to an order of magnitude and will cover the energy range from 20 GeV to at least 300 TeV. With its sensitivity, it will explore high redshift sources and extreme accelerators and will give access to the shortest timescale phenomena. CTA will be then a uniquely powerful instrument for the exploration of the transient universe. Thanks to its capabilities, CTA will play also a central role in the era of multi-messenger astrophysics.

In this presentation, we will outline the CTA Transient program that includes follow-up observations of a broad range of multi-wavelength and multi-messenger alerts, ranging from Galactic transient objects to novel phenomena like Fast Radio Bursts. A very promising case is that of gamma-ray bursts (GRBs) where CTA will for the first time enable high-statistics measurements above ~10 GeV, probing new spectral components and shedding light on the physical processes at work in these systems. Dedicated programs searching VHE gamma-ray counterparts to gravitational waves and high-energy neutrinos complete the CTA transients program.

Primary author: LONGO, Francesco

Co-authors: CAROSI, Alessandro; LOPEZ, Alicia

Presenters: CAROSI, Alessandro; LOPEZ, Alicia; LONGO, Francesco

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Instrumentation

Contribution ID: **242** Type: **Poster**

The Transient program of the Cherenkov Telescope Array

Friday, April 16, 2021 7:16 AM (4 minutes)

The Cherenkov Telescope Array (CTA) will be the next generation very high-energy (VHE) gamma-ray observatory. It will improve the sensitivity of current VHE instruments up to an order of magnitude and will cover the energy range from 20 GeV to at least 300 TeV. With its sensitivity, it will explore high redshift sources and extreme accelerators and will give access to the shortest timescale phenomena. CTA will be then a uniquely powerful instrument for the exploration of the transient universe. Thanks to its capabilities, CTA will play also a central role in the era of multi-messenger astrophysics.

In this presentation, we will outline the CTA Transient program that includes follow-up observations of a broad range of multi-wavelength and multi-messenger alerts, ranging from Galactic transient objects to novel phenomena like Fast Radio Bursts. A very promising case is that of gamma-ray bursts (GRBs) where CTA will for the first time enable high-statistics measurements above ~10 GeV, probing new spectral components and shedding light on the physical processes at work in these systems. Dedicated programs searching VHE gamma-ray counterparts to gravitational waves and high-energy neutrinos complete the CTA transients program.

Primary author: LONGO, Francesco

Co-authors: CAROSI, Alessandro; LOPEZ, Alicia

Presenters: CAROSI, Alessandro; LOPEZ, Alicia; LONGO, Francesco

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Instrumentation

Contribution ID: **243** Type: **Poster**

The results of joint GBM-LAT spectral analysis of four fluence populations of GRBs

Wednesday, April 14, 2021 7:06 AM (3 minutes)

The second Fermi LAT GRB catalog presents the results for 186 Gamma Ray Bursts (GRBs) detected by the Fermi Large Area Telescope (LAT) between 2008 and 2018. Out of these, we select the GRBs with significant detection in the LAT and GBM during the T90 time interval. We further subdivide this population into four quartiles based on the fluence from the GBM and carry out joint GBM-LAT spectral analysis for the T90 duration with single and multi-component spectral models. Here, we present the results for best fit model, spectral indices, Epeak and fluence obtained from the joint analysis. We also compare the spectral properties of the four quartiles.

Primary author: SAJJAD, Saeeda

Presenter: SAJJAD, Saeeda

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **244** Type: **Poster**

The results of joint GBM-LAT spectral analysis of four fluence populations of GRBs

Friday, April 16, 2021 7:12 AM (4 minutes)

The second Fermi LAT GRB catalog presents the results for 186 Gamma Ray Bursts (GRBs) detected by the Fermi Large Area Telescope (LAT) between 2008 and 2018. Out of these, we select the GRBs with significant detection in the LAT and GBM during the T90 time interval. We further subdivide this population into four quartiles based on the fluence from the GBM and carry out joint GBM-LAT spectral analysis for the T90 duration with single and multi-component spectral models. Here, we present the results for best fit model, spectral indices, Epeak and fluence obtained from the joint analysis. We also compare the spectral properties of the four quartiles.

Primary author: SAJJAD, Saeeda

Presenter: SAJJAD, Saeeda

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **245** Type: **Poster**

Constraining the number of classes of gamma-ray burst: multidimensional modelling with skewed distributions

Wednesday, April 14, 2021 7:03 AM (3 minutes)

Two classes of gamma-ray bursts (GRBs), short and long, have been confidently identified thus far and are prescribed to different physical scenarios. A third class, intermediate in duration, was suggested to be present in various catalogues based on a mixture-modelling with two or three Gaussian distributions of the log-durations, log(T90). This might not be an adequate model. An analysis of log(T90) from CGRO/BATSE, Swift/BAT, and Fermi/GBM revealed that mixtures of skewed distributions with only two components are a better description than a three-component Gaussian mixture. The same results were obtained by analysing a duration-hardness ratio plane, log(T90)-log(H32), for BATSE and Fermi GRBs. Similar results were obtained for Swift, Konus-Wind, RHESSI, and Suzaku/WAM. This implies that the presumed intermediate class of GRBs is unnecessary to explain the observations. A comprehensive, multivariate analysis, performed on various sets of BATSE parameters, including several three-dimensional spaces, and reaching up to a four-dimensional space of T90-H32-Ftot-P256, gave inconclusive results of 2-4 components, depending on the parameter set. A similar investigation of the Fermi data in the 3D and 5D spaces of T90-Ftot-P256 and T90-Ftot-Epeak-alpha-beta (with the Band parameters) lead to 3 and 2 components, respectively. This outcome is in a sense undesired, since for the same set of GRBs one would expect to get consistent results. A Monte Carlo testing suggests that additional components might be artifacts owing to the finiteness of the data and be a result of examining a particular realisation of the data as a random sample, resulting in spurious identifications. All in all, the presumed third class of GRBs appears to be non-existent.

Primary author: TARNOPOLSKI, Mariusz

Presenter: TARNOPOLSKI, Mariusz

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **246** Type: **Poster**

Constraining the number of classes of gamma-ray burst: multidimensional modelling with skewed distributions

Friday, April 16, 2021 7:08 AM (4 minutes)

Two classes of gamma-ray bursts (GRBs), short and long, have been confidently identified thus far and are prescribed to different physical scenarios. A third class, intermediate in duration, was suggested to be present in various catalogues based on a mixture-modelling with two or three Gaussian distributions of the log-durations, log(T90). This might not be an adequate model. An analysis of log(T90) from CGRO/BATSE, Swift/BAT, and Fermi/GBM revealed that mixtures of skewed distributions with only two components are a better description than a three-component Gaussian mixture. The same results were obtained by analysing a duration-hardness ratio plane, log(T90)-log(H32), for BATSE and Fermi GRBs. Similar results were obtained for Swift, Konus-Wind, RHESSI, and Suzaku/WAM. This implies that the presumed intermediate class of GRBs is unnecessary to explain the observations. A comprehensive, multivariate analysis, performed on various sets of BATSE parameters, including several three-dimensional spaces, and reaching up to a four-dimensional space of T90-H32-Ftot-P256, gave inconclusive results of 2-4 components, depending on the parameter set. A similar investigation of the Fermi data in the 3D and 5D spaces of T90-Ftot-P256 and T90-Ftot-Epeak-alpha-beta (with the Band parameters) lead to 3 and 2 components, respectively. This outcome is in a sense undesired, since for the same set of GRBs one would expect to get consistent results. A Monte Carlo testing suggests that additional components might be artifacts owing to the finiteness of the data and be a result of examining a particular realisation of the data as a random sample, resulting in spurious identifications. All in all, the presumed third class of GRBs appears to be non-existent.

Primary author: TARNOPOLSKI, Mariusz

Presenter: TARNOPOLSKI, Mariusz

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **247** Type: **Poster**

Shaken, not stirred: test particles in binary black hole mergers

Wednesday, April 14, 2021 7:00 AM (3 minutes)

In 2015 the advanced Laser Interferometer Gravitational-Wave Observatory (aLIGO) detected the first ever gravitational event, gravitational wave event GW150914, with multiple new gravitational wave events, originating from both binary neutron stars and binary black hole (BBH) mergers, detected in subsequent years. In light of these detections, we simulate the dynamics of ambient test particles in the gravitational potential well of a BBH system close to its inspiral phase. The goal of simulating the associated electromagnetic radiation and resulting spectral energy density distribution of such a BBH system, as this could shed light on possible detection ranges of electromagnetic counterparts to BBH mergers. The potentials are numerically calculated using finite difference methods, under the assumption of non-rotating black holes with the post-Newtonian Paczynski-Wiita potential approximation in tandem with retarded time concepts analogous to electrodynamics. We find that the frequencies of potential electromagnetic radiation produced by these systems (possibly reaching earth), range between a few kHz to a few 100kHz. The bulk of radiation is distributed at frequencies below 100kHz.

Primary author: VAN DER MERWE, Pieter

Presenter: VAN DER MERWE, Pieter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **248** Type: **Poster**

Shaken, not stirred: test particles in binary black hole mergers

Friday, April 16, 2021 7:04 AM (4 minutes)

In 2015 the advanced Laser Interferometer Gravitational-Wave Observatory (aLIGO) detected the first ever gravitational event, gravitational wave event GW150914, with multiple new gravitational wave events, originating from both binary neutron stars and binary black hole (BBH) mergers, detected in subsequent years. In light of these detections, we simulate the dynamics of ambient test particles in the gravitational potential well of a BBH system close to its inspiral phase. The goal of simulating the associated electromagnetic radiation and resulting spectral energy density distribution of such a BBH system, as this could shed light on possible detection ranges of electromagnetic counterparts to BBH mergers. The potentials are numerically calculated using finite difference methods, under the assumption of non-rotating black holes with the post-Newtonian Paczynski-Wiita potential approximation in tandem with retarded time concepts analogous to electrodynamics. We find that the frequencies of potential electromagnetic radiation produced by these systems (possibly reaching earth), range between a few kHz to a few 100kHz. The bulk of radiation is distributed at frequencies below 100kHz.

Primary author: VAN DER MERWE, Pieter

Presenter: VAN DER MERWE, Pieter

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **259** Type: **Poster**

GRB 190114C: from prompt to afterglow?

Wednesday, April 14, 2021 7:57 AM (12 minutes)

I will present the interesting case of GRB 190114C, the first GRB ever detected by MAGIC at Very High Energy (VHE). We analyzed the spectral evolution of its gamma-ray emission as detected by the Fermi Gamma-Ray Burst Monitor (GBM) up to~60 s. We revealed the presence of an extra component starting on ~4 s post-trigger. This extra component rises and decays quickly (peaking at~6 s) and it is characterized by a non-thermal spectrum that can be fit by a power law. We interpret this additional component as due to the afterglow of the burst. The onset time allows us to estimate the initial jet bulk Lorentz factor Gamma0 which is ~ 130-700, depending on the assumed circum-burst density profile.

Primary author: RAVASIO, Maria Edvige

Presenter: RAVASIO, Maria Edvige

Session Classification: Gamma-ray Bursts/SN/Instrumentation-2

Track Classification: Gamma-ray Bursts

Contribution ID: **260** Type: **Poster**

GRB 190114C: from prompt to afterglow?

Friday, April 16, 2021 7:00 AM (4 minutes)

I will present the interesting case of GRB 190114C, the first GRB ever detected by MAGIC at Very High Energy (VHE). We analyzed the spectral evolution of its gamma-ray emission as detected by the Fermi Gamma-Ray Burst Monitor (GBM) up to~60 s. We revealed the presence of an extra component starting on ~4 s post-trigger. This extra component rises and decays quickly (peaking at~6 s) and it is characterized by a non-thermal spectrum that can be fit by a power law. We interpret this additional component as due to the afterglow of the burst. The onset time allows us to estimate the initial jet bulk Lorentz factor Gamma0 which is ~ 130-700, depending on the assumed circum-burst density profile.

Primary author: RAVASIO, Maria Edvige

Presenter: RAVASIO, Maria Edvige

Session Classification: Gamma-ray Bursts/SN/Instrumentation-3

Track Classification: Gamma-ray Bursts

Contribution ID: **261** Type: **Poster**

A Fundamental Plane of Gamma-Ray Pulsars: Observations and Kinetic PIC Models

Thursday, April 15, 2021 7:10 PM (9 minutes)

The Fermi data imply that the gamma-ray observables, i.e., the gamma-ray luminosity, spectral cut-off energy, stellar surface magnetic field, and spin-down power obey a relation that represents a 3D plane in the 4D log-space. This observed fundamental plane (FP) is remarkably close to the theoretical relation that is obtained, assuming that the pulsar gamma-ray emission is due to curvature radiation. We present advanced kinetic particle-in-cell (PIC) models that reproduce both the shapes of the gamma-ray light curves and the FP. Our modeling predicts also that the cutoff energies decrease toward low spin-down powers for both young and millisecond pulsars implying that the observed death line of gamma-ray pulsars is due to cutoff energies dropping below the Fermi band.

Presenter: KALAPOTHARAKOS, Constantinos (UMCP CRESST / NASA GSFC)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **262** Type: **Poster**

A Fundamental Plane of Gamma-Ray Pulsars: Observations and Kinetic PIC Models

Friday, April 16, 2021 8:15 AM (5 minutes)

The Fermi data imply that the gamma-ray observables, i.e., the gamma-ray luminosity, spectral cut-off energy, stellar surface magnetic field, and spin-down power obey a relation that represents a 3D plane in the 4D log-space. This observed fundamental plane (FP) is remarkably close to the theoretical relation that is obtained, assuming that the pulsar gamma-ray emission is due to curvature radiation. We present advanced kinetic particle-in-cell (PIC) models that reproduce both the shapes of the gamma-ray light curves and the FP. Our modeling predicts also that the cutoff energies decrease toward low spin-down powers for both young and millisecond pulsars implying that the observed death line of gamma-ray pulsars is due to cutoff energies dropping below the Fermi band.

Presenter: KALAPOTHARAKOS, Constantinos (UMCP CRESST / NASA GSFC)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **263** Type: **Poster**

Constraining TeV emission regions in gamma-ray binaries with gamma-gamma absorption

Thursday, April 15, 2021 7:06 PM (4 minutes)

Gamma-ray binaries are a class of high-mass binary systems which are distinguished by their spectral energy distributions peaking above 1 MeV. Gamma-ray binaries consist of an O or B type companion and an orbiting compact object which is either a neutron star or a black hole. Generally in these systems the nature of the compact object is unknown except for two cases, namely PSR B1259-63 and PSR J2032+4127, where the compact objects have been identified to be pulsars. For a neutron star compact object the non-thermal emission is believed to originate from the interaction between the stellar and pulsar winds. It has been suggested that there are multiple regions of emission in these systems with the GeV and TeV emission potentially originating from different locations. The influence of gamma-gamma absorption on the gamma-ray emission may, therefore, be a tool in constraining the location of the TeV emission region. We have calculated the gamma-gamma absorption expected around six of the seven known gamma-ray binaries and are studying the influence on the observed spectrum. With this we plan to place constraints on the TeV production location. The results of this study will be used for predictions based on the upcoming Cherenkov Telescope Array (CTA).

Primary author: PLOOY, Drikus

Presenter: PLOOY, Drikus

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Binaries

Contribution ID: **264** Type: **Poster**

Constraining TeV emission regions in gamma-ray binaries with gamma-gamma absorption

Friday, April 16, 2021 8:10 AM (5 minutes)

Gamma-ray binaries are a class of high-mass binary systems which are distinguished by their spectral energy distributions peaking above 1 MeV. Gamma-ray binaries consist of an O or B type companion and an orbiting compact object which is either a neutron star or a black hole. Generally in these systems the nature of the compact object is unknown except for two cases, namely PSR B1259-63 and PSR J2032+4127, where the compact objects have been identified to be pulsars. For a neutron star compact object the non-thermal emission is believed to originate from the interaction between the stellar and pulsar winds. It has been suggested that there are multiple regions of emission in these systems with the GeV and TeV emission potentially originating from different locations. The influence of gamma-gamma absorption on the gamma-ray emission may, therefore, be a tool in constraining the location of the TeV emission region. We have calculated the gamma-gamma absorption expected around six of the seven known gamma-ray binaries and are studying the influence on the observed spectrum. With this we plan to place constraints on the TeV production location. The results of this study will be used for predictions based on the upcoming Cherenkov Telescope Array (CTA).

Primary author: PLOOY, Drikus

Presenter: PLOOY, Drikus

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Binaries

Contribution ID: **265** Type: **Poster**

The impact of the circumstellar magnetic field on the observed gamma-ray spectrum from supernova remnants

Thursday, April 15, 2021 7:02 PM (4 minutes)

Supernova remnants (SNRs) are widely believed to be one of the main candidates for the origin of Galactic cosmic rays. Very-high-energy gamma-ray emission observed from a number of SNRs suggests that particles are indeed accelerated to high energies by shock in remnants. However, it is extremely difficult to discriminate which particles are responsible for this emission as both protons (through hadronic interactions and subsequent pion decay) and electrons (through inverse Compton scattering on ambient photon fields) can potentially generate gamma-ray photons. The recent detection of the abrupt cut-off at lower energies in the gamma-ray spectra of two SNRs, IC 443 and W44, with the Fermi-LAT provided strong evidence that cosmic-ray protons are indeed accelerated in SNRs based on the interpretation of this cutoff as a characteristic pion-decay feature. However, it can be shown that certain spatial or temporal variability of the ambient medium can result in similar spectral features in the leptonic scenario adding another uncertainty to the determination of the emitting process. SNRs created in core-collapse explosions expand inside the stellar wind bubble blown up by a progenitor star. The magnetic field in the wind medium follows a 1/r profile with high values at the surface of the star, e.g. 1-10 G for red supergiants. This means that at the early stages of its evolution the remnant interacts with a very strong magnetic field, which results in a synchrotron cooling feature in the electron spectrum, which in turn shows up in the gamma-ray spectrum as a break at similar energies as a pion-decay signature. In this work, we study how the circumstellar magnetic field might modify the resulting spectrum of electrons and subsequent gamma-ray spectrum.

Primary author: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Presenter: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: SNR

Contribution ID: **266** Type: **Poster**

The impact of the circumstellar magnetic field on the observed gamma-ray spectrum from supernova remnants

Friday, April 16, 2021 8:05 AM (5 minutes)

Supernova remnants (SNRs) are widely believed to be one of the main candidates for the origin of Galactic cosmic rays. Very-high-energy gamma-ray emission observed from a number of SNRs suggests that particles are indeed accelerated to high energies by shock in remnants. However, it is extremely difficult to discriminate which particles are responsible for this emission as both protons (through hadronic interactions and subsequent pion decay) and electrons (through inverse Compton scattering on ambient photon fields) can potentially generate gamma-ray photons. The recent detection of the abrupt cut-off at lower energies in the gamma-ray spectra of two SNRs, IC 443 and W44, with the Fermi-LAT provided strong evidence that cosmic-ray protons are indeed accelerated in SNRs based on the interpretation of this cutoff as a characteristic pion-decay feature. However, it can be shown that certain spatial or temporal variability of the ambient medium can result in similar spectral features in the leptonic scenario adding another uncertainty to the determination of the emitting process. SNRs created in core-collapse explosions expand inside the stellar wind bubble blown up by a progenitor star. The magnetic field in the wind medium follows a 1/r profile with high values at the surface of the star, e.g. 1-10 G for red supergiants. This means that at the early stages of its evolution the remnant interacts with a very strong magnetic field, which results in a synchrotron cooling feature in the electron spectrum, which in turn shows up in the gamma-ray spectrum as a break at similar energies as a pion-decay signature. In this work, we study how the circumstellar magnetic field might modify the resulting spectrum of electrons and subsequent gamma-ray spectrum.

Primary author: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Presenter: SUSHCH, Iurii (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: SNR

Contribution ID: **267** Type: **Poster**

GeV emission from protostellar jets

Thursday, April 15, 2021 6:58 PM (4 minutes)

Synchrotron radio emission from non-relativistic jets powered by massive protostars has been reported, indicating the presence of relativistic electrons and mG magnetic fields. We study diffusive shock acceleration and magnetic field amplification in protostellar jets with speeds between 300 and 1000 km/s. We show that the magnetic field in the synchrotron emitter can be amplified by the non-resonant hybrid (Bell) instability excited by the cosmic-ray streaming. By combining the synchrotron data with basic theory of Bell instability we estimate the magnetic field in the synchrotron emitter and the maximum energy of protons. Protons can achieve maximum energies of about 0.1 TeV and emit GeV gamma rays in their interaction with matter fields. We predict that Fermi can detect gamma rays in IRAS 16547-5247 and IRAS 16848-4603. The detection of this radiation by the Fermi satellite in the GeV domain may open a new window to study the formation of massive stars, as well as diffusive acceleration and magnetic field amplification in shocks with velocities of about 1000 km/s.

Primary author: ARAUDO, Anabella

Presenter: ARAUDO, Anabella

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Galactic

Contribution ID: **268** Type: **Poster**

GeV emission from protostellar jets

Friday, April 16, 2021 8:00 AM (5 minutes)

Synchrotron radio emission from non-relativistic jets powered by massive protostars has been reported, indicating the presence of relativistic electrons and mG magnetic fields. We study diffusive shock acceleration and magnetic field amplification in protostellar jets with speeds between 300 and 1000 km/s. We show that the magnetic field in the synchrotron emitter can be amplified by the non-resonant hybrid (Bell) instability excited by the cosmic-ray streaming. By combining the synchrotron data with basic theory of Bell instability we estimate the magnetic field in the synchrotron emitter and the maximum energy of protons. Protons can achieve maximum energies of about 0.1 TeV and emit GeV gamma rays in their interaction with matter fields. We predict that Fermi can detect gamma rays in IRAS 16547-5247 and IRAS 16848-4603. The detection of this radiation by the Fermi satellite in the GeV domain may open a new window to study the formation of massive stars, as well as diffusive acceleration and magnetic field amplification in shocks with velocities of about 1000 km/s.

Primary author: ARAUDO, Anabella

Presenter: ARAUDO, Anabella

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Galactic

Contribution ID: **269** Type: **Poster**

Morphology of SNRs and their halos

Thursday, April 15, 2021 6:54 PM (4 minutes)

Supernova remnants are known to accelerate particles to relativistic energies on account of their non-thermal emission. The observational progress from radio to gamma-ray observations reveals more and more morphological features that need to be accounted for when modeling the emission from those objects.
We use our time-dependent acceleration code RATPaC to study the formation of extended gamma-ray halos around supernova remnants and the morphological implications that arise when the high-energetic particles start to escape from the remnant.
We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in a volume large enough to keep all cosmic rays in the simulation.
We find strong difference in the morphology of the gamma-ray emission in supernova remnants at later stages dependent on the emission process. At early times both - the inverse-Compton and the Pion-decay morphology - are shell-like. However, as soon as the maximum-energy of the freshly accelerated particles starts to fall, the inverse-Compton morphology starts to become center-filled whereas the Pion-decay morphology keeps its shell-like structure. Escaping high-energy electrons start to form an emission halo around the remnant at this time. There are good prospects for detecting this hard emission-spectra with the future Cerenkov Telescope Array as there are for detecting variation of the gamma-ray spectral index across the interior of the remnant. Due to the projection effects there is no significant variation of the spectral index expected with current-generation gamma-ray observatories.

Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: SNR

Contribution ID: **270** Type: **Poster**

Morphology of SNRs and their halos

Friday, April 16, 2021 7:55 AM (5 minutes)

Supernova remnants are known to accelerate particles to relativistic energies on account of their non-thermal emission. The observational progress from radio to gamma-ray observations reveals more and more morphological features that need to be accounted for when modeling the emission from those objects.
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Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: SNR

Contribution ID: **271** Type: **Poster**

Gamma-rays from young SNRs in dense circumstellar environments

Thursday, April 15, 2021 6:50 PM (4 minutes)

Supernova remnants are known to accelerate cosmic rays on account of their non-thermal emission of radio waves, X-rays, and gamma rays. However, the ability to accelerate cosmic-rays up to PeV-energies has yet to be demonstrated. The presence of cut-offs in the gamma-ray spectra of several young SNRs led to the idea that PeV-energies might only be achieved during the very initial stages of a remnant's evolution.
We use our time-dependent acceleration code RATPaC to study the acceleration of cosmic rays in dense environments around massive stars where the plenty target material might offer a path to the detection of gamma-rays by current and future experiments.
We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in the test-particle limit. We investigated typical CSM-parameters expected around RSG and LBV-stars expected for free-expanding winds as well as structured ambient media due to photoionization-confined shells or episodes of enhanced mass-loss prior to the SN-explosion.
We show that potentially detectable gamma-ray signals can be expected in the Fermi-Lat band weeks to months after the explosion for free expanding wind-zones. Likewise does the interaction with dense shells enhance the gamma-ray luminosity which is accompanied by a re-brightening in thermal X-rays that might be used as trigger for dedicated gamma-ray observations. The maximum achievable might be limited due to the strong magnetic fields close to the progenitor star that enhances turbulence-damping due to cascading.

Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: SNR

Contribution ID: **272** Type: **Poster**

Gamma-rays from young SNRs in dense circumstellar environments

Friday, April 16, 2021 7:50 AM (5 minutes)

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Primary author: BROSE, Robert

Presenter: BROSE, Robert

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: SNR

Contribution ID: **273** Type: **Poster**

Gamma-ray Eclipses from Redback and Black Widow Pulsars

Thursday, April 15, 2021 6:46 PM (4 minutes)

The ability of the Fermi Large Area Telescope to identify pulsar-like gamma-ray sources has sparked a huge increase in discoveries of "Spider" millisecond pulsar binaries (Black Widows and Redbacks). These systems are characterised by long radio eclipses due to scattering and absorption by diffuse intra-binary material that has been evaporated from the companion star's surface. Unlike radio emission, gamma-ray pulsations cannot be absorbed or scattered by this diffuse intra-binary material, and therefore the presence of a gamma-ray eclipse provides conclusive evidence that the pulsar passes directly behind the companion star. These subtle gamma-ray eclipses are only just becoming detectable thanks to the duration of the Fermi mission. I will present the results of our searches for gamma-ray eclipses from Spider MSPs, including the discovery of significant gamma-ray eclipses from several systems. I will describe how the detection, or significant exclusion, of a gamma-ray eclipse provides a crucial independent diagnostic for pulsar emission models and Spider optical light curve models, and how the new constraints on Spider binary inclination angles lead to robust constraints on their otherwise elusive pulsar masses.

Primary author: CLARK, Colin

Presenter: CLARK, Colin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **274** Type: **Poster**

Gamma-ray Eclipses from Redback and Black Widow Pulsars

Friday, April 16, 2021 7:45 AM (5 minutes)

The ability of the Fermi Large Area Telescope to identify pulsar-like gamma-ray sources has sparked a huge increase in discoveries of "Spider" millisecond pulsar binaries (Black Widows and Redbacks). These systems are characterised by long radio eclipses due to scattering and absorption by diffuse intra-binary material that has been evaporated from the companion star's surface. Unlike radio emission, gamma-ray pulsations cannot be absorbed or scattered by this diffuse intra-binary material, and therefore the presence of a gamma-ray eclipse provides conclusive evidence that the pulsar passes directly behind the companion star. These subtle gamma-ray eclipses are only just becoming detectable thanks to the duration of the Fermi mission. I will present the results of our searches for gamma-ray eclipses from Spider MSPs, including the discovery of significant gamma-ray eclipses from several systems. I will describe how the detection, or significant exclusion, of a gamma-ray eclipse provides a crucial independent diagnostic for pulsar emission models and Spider optical light curve models, and how the new constraints on Spider binary inclination angles lead to robust constraints on their otherwise elusive pulsar masses.

Primary author: CLARK, Colin

Presenter: CLARK, Colin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **275** Type: **Poster**

Investigating Superorbital Modulation in the X-ray Binary 4U 1538-52 with the BAT and GBM

Thursday, April 15, 2021 6:42 PM (4 minutes)

Superorbital periods in Roche-lobe overflowing X-ray binaries such as Her X-1 have been known for some time. These can be understood as being related to the presence of an accretion disk. However, more recently a number of HMXBs accreting from the wind of their supergiant companion, where the presence of a persistent accretion disk is unlikely, have also been found to show superorbital modulation. Swift BAT observations now reveal superorbital modulation in the wind-accreting supergiant high-mass X-ray binary (HMXB) 4U 1538-52 at a period of 14.9130 +/- 0.0026 days that is consistent with four times the 3.73 day orbital period. These periods agree with a previously suggested correlation between superorbital and orbital periods in similar HMXBs. During the ~14 years of observations the superorbital modulation changes amplitude, and since ~MJD 57,650 it was no longer detected in the power spectrum, although a peak near the second harmonic of this was present for some time. Measurements of the spin period of the neutron star in the system with the Fermi Gamma-ray Burst Monitor show a long-term spin-down trend which halted towards the end of the light curve, suggesting a connection between dP(spin)/dt and superorbital modulation, as proposed for 2S 0114+650. However, an earlier torque reversal from INTEGRAL observations was not associated with superorbital modulation changes. B and V band photometry from the Las Cumbres Observatory reveals orbital ellipsoidal photometric variability, but no superorbital optical modulation. However the photometry was obtained when the 14.9130 day period was no longer detected in the BAT power spectrum. We consider superorbital modulation mechanisms, and suggest that the Corotating Interaction Region model, with small deviations from orbital synchronization, appears promising. Since the start of 2020 (MJD ~58,850), 4U 1538-52 has been exhibiting a spin-up trend and we have been monitoring the system to determine whether the superorbital modulation has reappeared.

Primary author: CORBET, Robin

Presenter: CORBET, Robin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Binaries

Contribution ID: **276** Type: **Poster**

Investigating Superorbital Modulation in the X-ray Binary 4U 1538-52 with the BAT and GBM

Friday, April 16, 2021 7:40 AM (5 minutes)

Superorbital periods in Roche-lobe overflowing X-ray binaries such as Her X-1 have been known for some time. These can be understood as being related to the presence of an accretion disk. However, more recently a number of HMXBs accreting from the wind of their supergiant companion, where the presence of a persistent accretion disk is unlikely, have also been found to show superorbital modulation. Swift BAT observations now reveal superorbital modulation in the wind-accreting supergiant high-mass X-ray binary (HMXB) 4U 1538-52 at a period of 14.9130 +/- 0.0026 days that is consistent with four times the 3.73 day orbital period. These periods agree with a previously suggested correlation between superorbital and orbital periods in similar HMXBs. During the ~14 years of observations the superorbital modulation changes amplitude, and since ~MJD 57,650 it was no longer detected in the power spectrum, although a peak near the second harmonic of this was present for some time. Measurements of the spin period of the neutron star in the system with the Fermi Gamma-ray Burst Monitor show a long-term spin-down trend which halted towards the end of the light curve, suggesting a connection between dP(spin)/dt and superorbital modulation, as proposed for 2S 0114+650. However, an earlier torque reversal from INTEGRAL observations was not associated with superorbital modulation changes. B and V band photometry from the Las Cumbres Observatory reveals orbital ellipsoidal photometric variability, but no superorbital optical modulation. However the photometry was obtained when the 14.9130 day period was no longer detected in the BAT power spectrum. We consider superorbital modulation mechanisms, and suggest that the Corotating Interaction Region model, with small deviations from orbital synchronization, appears promising. Since the start of 2020 (MJD ~58,850), 4U 1538-52 has been exhibiting a spin-up trend and we have been monitoring the system to determine whether the superorbital modulation has reappeared.

Primary author: CORBET, Robin

Presenter: CORBET, Robin

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Binaries

Contribution ID: **277** Type: **Poster**

A study of super-luminous stars with the Fermi Large Area Telescope

Thursday, April 15, 2021 6:38 PM (4 minutes)

The gamma-ray emission from stars is induced by the interaction of cosmic rays with stellar atmospheres and photon fields. This emission is expected to come in two components: a stellar disk emission, where gamma-rays are mainly produced in atmospheric showers generated by hadronic cosmic rays, and an extended halo emission, where the high density of soft photons in the surroundings of stars create a suitable environment for gamma-ray production via inverse Compton (IC) scattering by cosmic ray leptons. Besides the Sun, no other isolated star has ever been detected in gamma-rays. However, by assuming a cosmic ray distribution similar to that observed on Earth, the predicted gamma-ray emission of super-luminous stars, like e.g. Betelgeuse and Rigel, should be high enough to be detected by the Fermi Large Area Telescope (LAT) after its first decade of operations. In this work, we use 12 years of Fermi-LAT observations along with IC models to study 9 luminous nearby stars, both individually and via stacking analysis. Our results show no significant gamma-ray emission from any of the targets, but allow us to derive gamma-ray flux upper limits and to use them to constrain the local density of electrons in different places of the Galaxy.

Primary author: MENEZES, Raniere (Universidade de São Paulo)

Presenter: MENEZES, Raniere (Universidade de São Paulo)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Galactic

Contribution ID: **278** Type: **Poster**

A study of super-luminous stars with the Fermi Large Area Telescope

Friday, April 16, 2021 7:35 AM (5 minutes)

The gamma-ray emission from stars is induced by the interaction of cosmic rays with stellar atmospheres and photon fields. This emission is expected to come in two components: a stellar disk emission, where gamma-rays are mainly produced in atmospheric showers generated by hadronic cosmic rays, and an extended halo emission, where the high density of soft photons in the surroundings of stars create a suitable environment for gamma-ray production via inverse Compton (IC) scattering by cosmic ray leptons. Besides the Sun, no other isolated star has ever been detected in gamma-rays. However, by assuming a cosmic ray distribution similar to that observed on Earth, the predicted gamma-ray emission of super-luminous stars, like e.g. Betelgeuse and Rigel, should be high enough to be detected by the Fermi Large Area Telescope (LAT) after its first decade of operations. In this work, we use 12 years of Fermi-LAT observations along with IC models to study 9 luminous nearby stars, both individually and via stacking analysis. Our results show no significant gamma-ray emission from any of the targets, but allow us to derive gamma-ray flux upper limits and to use them to constrain the local density of electrons in different places of the Galaxy.

Primary author: MENEZES, Raniere (Universidade de São Paulo)

Presenter: MENEZES, Raniere (Universidade de São Paulo)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Galactic

Contribution ID: **279** Type: **Poster**

Relativistic Fluid Modeling of the Gamma-Ray Binary LS5039

Thursday, April 15, 2021 6:34 PM (4 minutes)

LS 5039 is one of the best-observed gamma-ray binaries with non-thermal emission ranging from soft X-rays to VHE gamma-ray. Explaining the observed anti-correlation between the X-ray/VHE and the HE gamma-ray bands, while accounting for its complex spectral features, has become a challenge for current modelling efforts.
We investigate this system in a wind-driven context, where non-thermal leptons are thought to be accelerated in the interaction of the stellar and pulsar wind. Numerical simulations have shown that neither the shock structure nor the downstream flow are stationary but depend on the orbital phase. They are subject to the combined effects of orbital motion and dynamical turbulence arising in the wind collision. This has an impact on the system's radiative output that was largely neglected or simplified in previous models.
We investigate this dynamical behavior with a recently developed relativistic extension to the CRONOS code. The transport of accelerated leptons is thereby solved simultaneously alongside a three-dimensional, relativistic hydrodynamic simulation of the wind-interaction. This consistent treatment allows us to fully capture the effects of fluid dynamics on the particle evolution and the subsequent phase-dependent emission of gamma-rays. Relativistic boosting and gamma-gamma absorption can be included consistently for the extended emission region.
Our model successfully reproduces the main spectral features of the LS 5039 system, further supporting the applicability of wind-driven models for LS 5039. Furthermore, we provide first insights into the impact of fluid dynamics on the radiative output of gamma-ray binaries.

Primary author: HUBER, David

Presenter: HUBER, David

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Binaries

Contribution ID: **280** Type: **Poster**

Relativistic Fluid Modeling of the Gamma-Ray Binary LS5039

Friday, April 16, 2021 7:30 AM (5 minutes)

LS 5039 is one of the best-observed gamma-ray binaries with non-thermal emission ranging from soft X-rays to VHE gamma-ray. Explaining the observed anti-correlation between the X-ray/VHE and the HE gamma-ray bands, while accounting for its complex spectral features, has become a challenge for current modelling efforts.
We investigate this system in a wind-driven context, where non-thermal leptons are thought to be accelerated in the interaction of the stellar and pulsar wind. Numerical simulations have shown that neither the shock structure nor the downstream flow are stationary but depend on the orbital phase. They are subject to the combined effects of orbital motion and dynamical turbulence arising in the wind collision. This has an impact on the system's radiative output that was largely neglected or simplified in previous models.
We investigate this dynamical behavior with a recently developed relativistic extension to the CRONOS code. The transport of accelerated leptons is thereby solved simultaneously alongside a three-dimensional, relativistic hydrodynamic simulation of the wind-interaction. This consistent treatment allows us to fully capture the effects of fluid dynamics on the particle evolution and the subsequent phase-dependent emission of gamma-rays. Relativistic boosting and gamma-gamma absorption can be included consistently for the extended emission region.
Our model successfully reproduces the main spectral features of the LS 5039 system, further supporting the applicability of wind-driven models for LS 5039. Furthermore, we provide first insights into the impact of fluid dynamics on the radiative output of gamma-ray binaries.

Primary author: HUBER, David

Presenter: HUBER, David

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Binaries

Contribution ID: **281** Type: **Poster**

Stacked Analysis of Galactic Wolf-Rayet Stars

Thursday, April 15, 2021 6:30 PM (4 minutes)

Wolf-Rayet (WR) stars are massive evolved stars undergoing advanced nuclear burning in their cores and possess strong stellar winds. WR stars – and in particular WR binary systems – are also predicted to be potential emitters of gamma rays. Although details of the high-energy emission mechanisms are not well-understood, a majority of the emission is likely due to strong shocks produced by the colliding winds of WR binary systems. The shocked winds accelerate cosmic rays via diffusive shock acceleration, which subsequently produce X rays and gamma rays through inverse Compton processes, as well as producing neutral pions that quickly decay into gamma-ray photons. To date, only one WR system (WR11) has been detected in both X rays and gamma rays, and typically the WR gamma-ray emission is expected to be below the detection threshold of the Fermi-LAT. We conduct the first comprehensive analysis of the entire population of Galactic WR stars, including both isolated and binary systems. Since the gamma-ray emission from any one of these systems is expected to be faint, we employ a stacking technique. In this talk I will detail the motivation for our analysis, outline the analysis procedure, and present preliminary results.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Galactic

Contribution ID: **282** Type: **Poster**

Stacked Analysis of Galactic Wolf-Rayet Stars

Friday, April 16, 2021 7:25 AM (5 minutes)

Wolf-Rayet (WR) stars are massive evolved stars undergoing advanced nuclear burning in their cores and possess strong stellar winds. WR stars – and in particular WR binary systems – are also predicted to be potential emitters of gamma rays. Although details of the high-energy emission mechanisms are not well-understood, a majority of the emission is likely due to strong shocks produced by the colliding winds of WR binary systems. The shocked winds accelerate cosmic rays via diffusive shock acceleration, which subsequently produce X rays and gamma rays through inverse Compton processes, as well as producing neutral pions that quickly decay into gamma-ray photons. To date, only one WR system (WR11) has been detected in both X rays and gamma rays, and typically the WR gamma-ray emission is expected to be below the detection threshold of the Fermi-LAT. We conduct the first comprehensive analysis of the entire population of Galactic WR stars, including both isolated and binary systems. Since the gamma-ray emission from any one of these systems is expected to be faint, we employ a stacking technique. In this talk I will detail the motivation for our analysis, outline the analysis procedure, and present preliminary results.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Galactic

Contribution ID: **283** Type: **Poster**

StellarICS: Inverse Compton Emission from the Quiet Sun and Stars from keV to TeV

Thursday, April 15, 2021 6:26 PM (4 minutes)

Gamma rays from the quiet Sun are produced by Cosmic Rays (CRs) interacting with its surface (disk component) and with its photon field (spatially extended inverse-Compton component, IC). IC is maximum close to the Sun and it extends over the whole sky. Monitoring the IC component with Fermi-LAT allows to obtain information on CR electrons close to the Sun and in the heliosphere for different solar activity and polarity. The detection of IC emission from stars allows to learn about CR electrons in their photosphere. Fermi-LAT data analyses are usually model-driven. Hence advances in model calculations and constraints from precise CR measurements are timely and needed.
We present our StellarICS code to compute the gamma-ray IC emission from the Sun and also from single stars. The code is publicly available and it is extensively used by the scientific community to analyze Fermi-LAT data. It has been used by the Fermi-LAT collaboration to produce the solar models released with the FSSC Fermi Tools. Our modeling provides the basis for analyzing and interpreting high-energy data of the Sun and of stars. After presenting examples of updated solar IC models in the Fermi-LAT energy range that account for the various CR measurements, we extend the models to keV, MeV, and TeV energies for predictions for future possible telescopes such as AMEGO, GECCO, e-ASTROGAM, HAWC, LHAASO, SWGO, and present X-ray telescopes. We also present predictions for some of the closest and most luminous stars. Work based on arXiv:2012.13126, JCAP submitted.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Solar

Contribution ID: **284** Type: **Poster**

StellarICS: Inverse Compton Emission from the Quiet Sun and Stars from keV to TeV

Friday, April 16, 2021 7:20 AM (5 minutes)

Gamma rays from the quiet Sun are produced by Cosmic Rays (CRs) interacting with its surface (disk component) and with its photon field (spatially extended inverse-Compton component, IC). IC is maximum close to the Sun and it extends over the whole sky. Monitoring the IC component with Fermi-LAT allows to obtain information on CR electrons close to the Sun and in the heliosphere for different solar activity and polarity. The detection of IC emission from stars allows to learn about CR electrons in their photosphere. Fermi-LAT data analyses are usually model-driven. Hence advances in model calculations and constraints from precise CR measurements are timely and needed.

We present our StellarICS code to compute the gamma-ray IC emission from the Sun and also from single stars. The code is publicly available and it is extensively used by the scientific community to analyze Fermi-LAT data. It has been used by the Fermi-LAT collaboration to produce the solar models released with the FSSC Fermi Tools. Our modeling provides the basis for analyzing and interpreting high-energy data of the Sun and of stars. After presenting examples of updated solar IC models in the Fermi-LAT energy range that account for the various CR measurements, we extend the models to keV, MeV, and TeV energies for predictions for future possible telescopes such as AMEGO, GECCO, e-ASTROGAM, HAWC, LHAASO, SWGO, and present X-ray telescopes. We also present predictions for some of the closest and most luminous stars. Work based on arXiv:2012.13126, JCAP submitted.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Solar

Contribution ID: **285** Type: **Poster**

Search for VHE emission from PSR J0218+4232

Thursday, April 15, 2021 6:22 PM (4 minutes)

PSR J0218+4232 is one of the most energetic millisecond pulsars (MSP) known and has been considered as one of the best candidates for very high energy (>100 GeV) γ-ray emission. It has a period of 2.3 ms in a 2-day orbit with a ~ $0.2M_\odot$ white dwarf companion. With a characteristic age τ <0.5 Gyr it is one of the youngest MSPs known, with an extremely strong magnetic field at the light cylinder (BLC ~ 3.2 × 105 G), only slightly weaker than young Crab-like pulsars. PSR J0218+4232 is in the Third Fermi-LAT Catalog of High-Energy Sources and was shown to have pulsations above 10 and 25 GeV.
Using 11.5 years of Fermi Large Area Telescope (LAT) data (2008-2020) and ~90 hours of MAGIC observations (from 2018 November 2 to 2019 November 4), we have searched for high energy gamma-ray pulsed emission from PSR J0218+4232. The MAGIC data were collected in stereoscopic mode with the Sum-Trigger-II system, designed to improve the performance of the telescopes in the sub-100 GeV energy range.
In this contribution we will show the results of our searches for gamma-ray emission, together with our theoretical modeling.

Primary author: SPOLON, Alessia

Presenter: SPOLON, Alessia

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **286** Type: **Poster**

Search for VHE emission from PSR J0218+4232

Friday, April 16, 2021 7:15 AM (5 minutes)

PSR J0218+4232 is one of the most energetic millisecond pulsars (MSP) known and has been considered as one of the best candidates for very high energy (>100 GeV) γ-ray emission. It has a period of 2.3 ms in a 2-day orbit with a ~ 0.2M⊙ white dwarf companion. With a characteristic age τ <0.5 Gyr it is one of the youngest MSPs known, with an extremely strong magnetic field at the light cylinder (BLC ~ 3.2 × 105 G), only slightly weaker than young Crab-like pulsars. PSR J0218+4232 is in the Third Fermi-LAT Catalog of High-Energy Sources and was shown to have pulsations above 10 and 25 GeV.
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In this contribution we will show the results of our searches for gamma-ray emission, together with our theoretical modeling.

Primary author: SPOLON, Alessia

Presenter: SPOLON, Alessia

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **287** Type: **Poster**

A MeerKAT Pulsar Survey of Fermi Unidentified Sources

Thursday, April 15, 2021 6:18 PM (4 minutes)

In the last decade, Fermi LAT has provided an amazing roadmap to assist with pulsar searches conducted in other parts of the electromagnetic system. Indeed, multiple surveys have used Fermi unidentified sources with pulsar-like structures as their targets. Following this strategy, we present in this poster a survey conducted using the MeerKAT telescope to find energetic new pulsars associated with gamma-ray sources. MeerKAT's expected performances have been compared to those achieved in previous surveys (conducted with Parkes, GBT, Arecibo and Effelsberg) in order to determine the required integration time to reach comparable sensitivity. As a result, we concluded that a 10-minute observation for each source would be sufficient, thus enabling us to perform a relatively swift survey of a large number of targets. We also investigated other observing parameters such as the optimal de-dispersion and acceleration search strategy that would maximise our chance of finding new pulsars. Lastly, we carefully selected sources from the latest Fermi LAT 4FGL catalogue for the first phase of our survey based on criteria such as declination, Galactic latitude, gamma-ray emission characteristics and localisation. After applying these criteria, 79 targets were selected for a two-pass survey.

Primary author: THONGMEEARKOM, Tinn

Presenter: THONGMEEARKOM, Tinn

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **288** Type: **Poster**

A MeerKAT Pulsar Survey of Fermi Unidentified Sources

Friday, April 16, 2021 7:10 AM (5 minutes)

In the last decade, Fermi LAT has provided an amazing roadmap to assist with pulsar searches conducted in other parts of the electromagnetic system. Indeed, multiple surveys have used Fermi unidentified sources with pulsar-like structures as their targets. Following this strategy, we present in this poster a survey conducted using the MeerKAT telescope to find energetic new pulsars associated with gamma-ray sources. MeerKAT's expected performances have been compared to those achieved in previous surveys (conducted with Parkes, GBT, Arecibo and Effelsberg) in order to determine the required integration time to reach comparable sensitivity. As a result, we concluded that a 10-minute observation for each source would be sufficient, thus enabling us to perform a relatively swift survey of a large number of targets. We also investigated other observing parameters such as the optimal de-dispersion and acceleration search strategy that would maximise our chance of finding new pulsars. Lastly, we carefully selected sources from the latest Fermi LAT 4FGL catalogue for the first phase of our survey based on criteria such as declination, Galactic latitude, gamma-ray emission characteristics and localisation. After applying these criteria, 79 targets were selected for a two-pass survey.

Primary author: THONGMEEARKOM, Tinn

Presenter: THONGMEEARKOM, Tinn

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **289** Type: **Poster**

Multiwavelength observations of the mode change in PSR J2021+4026

Thursday, April 15, 2021 6:14 PM (4 minutes)

PSR J2021+4026 in the Cygnus region is one of the most interesting radio-quiet pulsars detected by Fermi-LAT. This source, thought to be associated with the Gamma Cygni supernova remnant, is the first isolated gamma-ray pulsar that exhibited clear evidence of variability, with a simultaneous flux and spindown change first occurred in October 2011. After a long recovery phase, in August 2015 the pulsar reached the pre-2011 flux and timing characteristics and in September 2017 underwent a new mode change. This behaviour is still unique among the population of gamma-ray pulsars and therefore we performed multiwavelength follow-up observations in order to understand the physics behind this event. We have analyzed Fermi-LAT gamma rays simultaneous to two deep XMM-Newton observations taken after the flux drop and during the recovery phase. We also analyzed a deep observation with the Gran Telescopio Canarias carried on after the recovery in order to search for its optical counterpart. We present the results of this multiwavelength campaign and how such studies can help constraining the pulsar geometry and deciphering these rare gamma-ray variability events.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **290** Type: **Poster**

Multiwavelength observations of the mode change in PSR J2021+4026

Friday, April 16, 2021 7:05 AM (5 minutes)

PSR J2021+4026 in the Cygnus region is one of the most interesting radio-quiet pulsars detected by Fermi-LAT. This source, thought to be associated with the Gamma Cygni supernova remnant, is the first isolated gamma-ray pulsar that exhibited clear evidence of variability, with a simultaneous flux and spindown change first occurred in October 2011. After a long recovery phase, in August 2015 the pulsar reached the pre-2011 flux and timing characteristics and in September 2017 underwent a new mode change. This behaviour is still unique among the population of gamma-ray pulsars and therefore we performed multiwavelength follow-up observations in order to understand the physics behind this event. We have analyzed Fermi-LAT gamma rays simultaneous to two deep XMM-Newton observations taken after the flux drop and during the recovery phase. We also analyzed a deep observation with the Gran Telescopio Canarias carried on after the recovery in order to search for its optical counterpart. We present the results of this multiwavelength campaign and how such studies can help constraining the pulsar geometry and deciphering these rare gamma-ray variability events.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **291** Type: **Poster**

Plucking the Web: Searching Unassociated Fermi Gamma-ray Sources for Spider Pulsars with a Jerk search Algorithm

Thursday, April 15, 2021 6:10 PM (4 minutes)

In the past decade, the most successful approach to search for millisecond pulsars (MSPs) has been to use acceleration searches to look for radio pulsations in the error bars of Gamma-ray sources identified by the Large Area Telescope (LAT) aboard the Fermi Satellite. However, 1000s of gamma-ray sources found by LAT still remain unassociated with any astrophysical object. It is believed that many of these could be MSPs. One of the reasons for their non-detection is that the present method of doing acceleration searches to account for the orbital motion of the pulsar is only effective when the observation time is less than 1/10th of the orbital period. We have been using the novel jerk search algorithm implemented in the PRESTO software package to re-search Fermi sources that remain unidentified. Jerk search is sensitive to changes in the period of the pulsed signal up to its second derivative caused by the orbital motion, resulting in increased sensitivity to tight binary systems. We are using radio data gathered from the Robert C. Byrd Green Bank Telescope (GBT) at 820 MHz for unassociated sources from Fermi LAT catalogs as part of the Fermi Pulsar Search Consortium. Here we present the Discovery of 11 MSPs as a result of such a search, one of which has been confirmed as a black-widow. There's also a MSP which has companion more massive than expected through evolutionary models. Another of these has already been confirmed as an isolated gamma-ray MSP.

Primary author: TABASSUM, Shawaiz

Presenter: TABASSUM, Shawaiz

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-2

Track Classification: Pulsar

Contribution ID: **292** Type: **Poster**

Plucking the Web: Searching Unassociated Fermi Gamma-ray Sources for Spider Pulsars with a Jerk search Algorithm

Friday, April 16, 2021 7:00 AM (5 minutes)

In the past decade, the most successful approach to search for millisecond pulsars (MSPs) has been to use acceleration searches to look for radio pulsations in the error bars of Gamma-ray sources identified by the Large Area Telescope (LAT) aboard the Fermi Satellite. However, 1000s of gamma-ray sources found by LAT still remain unassociated with any astrophysical object. It is believed that many of these could be MSPs. One of the reasons for their non-detection is that the present method of doing acceleration searches to account for the orbital motion of the pulsar is only effective when the observation time is less than 1/10th of the orbital period. We have been using the novel jerk search algorithm implemented in the PRESTO software package to re-search Fermi sources that remain unidentified. Jerk search is sensitive to changes in the period of the pulsed signal up to its second derivative caused by the orbital motion, resulting in increased sensitivity to tight binary systems. We are using radio data gathered from the Robert C. Byrd Green Bank Telescope (GBT) at 820 MHz for unassociated sources from Fermi LAT catalogs as part of the Fermi Pulsar Search Consortium. Here we present the Discovery of 11 MSPs as a result of such a search, one of which has been confirmed as a black-widow. There's also a MSP which has companion more massive than expected through evolutionary models. Another of these has already been confirmed as an isolated gamma-ray MSP.

Primary author: TABASSUM, Shawaiz

Presenter: TABASSUM, Shawaiz

Session Classification: Binaries/Galactic/Pulsars/SNR/Solar-3

Track Classification: Pulsar

Contribution ID: **293** Type: **Poster**

Constraining the intergalactic magnetic field with Fermi-LAT observations of seven ultra-high-frequency peaked BL Lac sources.

Thursday, April 15, 2021 7:13 PM (6 minutes)

Galaxies and galaxy clusters are separated by large distances of nearly empty
space called the intergalactic space. In these large, nearly empty regions a weak magnetic field of strength < 10 nG is present that is predicted to be of primordial (early universe) origin. This is called the intergalactic magnetic field (IGMF) and knowledge about its strength, coherence length, origin etc. is limited. Understanding the origin of the IGMF is crucial because of the impact it may have had on early star and galaxy formations. Gamma-ray observations of very high energy emitting blazars provide one method to indirectly probe the IGMF. The gamma ray photons emitted from the blazars will undergo gamma-gamma absorption due to their interaction with the extragalactic background light (EBL), producing electrons-positrons pairs. These electron-positron pairs can then upscatter photons from the cosmic microwave background (CMB) to produce a secondary cascade component at lower energies ($\approx 0.1 - 10$ GeV). However the IGMF can scatter the electron-positron pairs away and thus attenuating the emission that will be superimposed on the blazars intrinsic spectrum. This attenuation is highly dependent on the IGMF strength and the coherence length. Seven hard and non-variable sources were selected to be re-analysed, using the Fermi Science Tools package (version 1.0.5 released on 05/21/2019) with the improved Pass 8 analysis pipeline. Using previous IACT observations results, the secondary cascade component was modelled using the Monte Carlo code of Kachelrieß et al. and the primary and total spectrum components were compared to the Fermi-LAT spectrum, allowing constraints to be placed on the strength of the IGMF.

Primary author: BISSCHOFF, Brandon

Presenter: BISSCHOFF, Brandon

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **294** Type: **Poster**

Ultrahigh-energy cosmic-ray interactions as the origin of very high-energy gamma-rays from BL Lacertae objects

Thursday, April 15, 2021 7:10 PM (3 minutes)

We explain the observed multiwavelength photon spectrum of some high energy BL Lac objects, using a lepto-hadronic model. The one-zone leptonic emission is employed to fit the synchrotron peak. Subsequently, the SSC spectrum is calculated, such that it extends up to the highest energy possible for the jet parameters considered. The data points beyond this and also in the entire VHE range (E>30 GeV) are well explained using a hadronic origin. The UHECRs escaping from the source interacts with the EBL background during propagation over cosmological distances to initiate electromagnetic cascade down to GeV energies. The resulting photon spectrum peaks at ~ TeV energies. We consider a random turbulent EGMF with a Kolmogorov power spectrum to find the survival rate of UHECRs within 0.1 degrees of the direction of propagation in which the observer is situated. We restrict ourselves to an RMS value of EGMF ~ 10^-5 nG for a significant contribution to the photon SED from UHECR interactions. The kinetic power in UHECRs required in this scenario is estimated and compared with the Eddington luminosity of the sources. We discuss the possibility of UHECR detection from these sources and find the neutrino fluxes produced from each source. The uncertainties posed due to the choice of EBL models are also presented.

Primary author: DAS, Saikat

Presenter: DAS, Saikat

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **295** Type: **Poster**

X-ray luminosity function of FSRQ with BAT 105 month catalog and contribution to cosmic MeV gamma-ray background

Thursday, April 15, 2021 7:07 PM (3 minutes)

FSRQs are important to study cosmic evolution of AGN jet and also interesting how they contribute to the cosmic MeV gamma-ray background. Past studies with hard X-ray (Swift/BAT 22 month catalog) and GeV gamma-ray (Fermi/LAT) reported the X-ray and gamma-ray luminosity function, but predicts a different evolution between X-ray and GeV gamma-ray. Here we used the Swift/BAT 105 month catalog to double the number of sample FSRQs and derived a X-ray luminosity function with luminosity-dependent density evolution model as used in the GeV gamma-ray study. Then we found that the X-ray luminosity function is consistent with that of GeV gamma-ray within uncertainties. Also we calculated the contribution of FSRQs to the cosmic MeV gamma-ray background and found that their contribution is minor. Interestingly, half of our sample FSRQs are not detected by Fermi/LAT, indicating many MeV-peak FRRQs

Primary author: FUKAZAWA, Yasushi

Presenter: FUKAZAWA, Yasushi

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **296** Type: **Poster**

The first gamma-ray flare of the peculiar source PKS 2004-447

Thursday, April 15, 2021 7:04 PM (3 minutes)

While blazars are abundant in the gamma-ray sky, there is only a handful of narrow-line Seyfert 1 galaxies that Fermi/LAT detected in more than 10 years of observation. Flares from this elusive source class are among the rarest events that Fermi has seen so far.
One of them is the radio- and gamma-ray loud source PKS 2004-447. It exhibits blazar-like features, i.e., a flat featureless X-ray spectrum and a core-dominated, one-sided parsec-scale jet with indications for relativistic beaming.
However, the spectrum also shows properties atypical for blazars, such as a steep radio spectrum and large-scale size consistent with compact-steep-spectrum objects, which are usually associated with young radio galaxies. Such characteristics are unique among all gamma-loud NLS1s and extremely rare among gamma-loud AGN.
Very recently, PKS 2004-447 showed its first bright gamma-ray flare since the beginning of the Fermi Mission, for which optical/UV, X-ray and radio follow-up observations took place.
We will present results on the multi-wavelength analysis, focusing on the source classification based on the X-ray spectra and the construction of the spectral energy distribution with a quasi-simultaneous dataset.

Primary author: GOKUS, Andrea

Presenter: GOKUS, Andrea

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **297** Type: **Poster**

Extragalactic Radio Background from Synchrotron Emission of Radio and Normal Galaxies

Thursday, April 15, 2021 7:01 PM (3 minutes)

The extragalactic radio background in the universe is mainly due to emission from the radio galaxies and normal galaxies. This emission is synchrotron radiation by relativistic electrons gyrating in the magnetic field of the galaxies. Synchrotron self-absorption and free-free absorptions by hot ionised gas in the interstellar medium play an important role to modify radio emission. In this study, we calculate the radio spectra of the radio and normal galaxies. Thereafter, we develop a model for the intensity of extragalactic radio background by using the resulting radio spectra and by integrating over the observed luminosity functions according to cosmological evolution. We compare our model with the latest radio source count data.

Primary author: MOTHA, Nomthendeleko

Presenter: MOTHA, Nomthendeleko

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **298** Type: **Poster**

Hadronic synchrotron mirror model for blazars-Application to 3C279

Thursday, April 15, 2021 6:58 PM (3 minutes)

On the 28th of January, an orphan very-high-energy γ-ray flare from 3C279 was detected, not accompanied by flaring in the adjacent GeV gamma-ray regime. Orphan flares have to be caused by different processes than normal γ-ray flares. Specifically, the Hadronic Synchrotron Mirror Model has been proposed to provide a consistent explanation of this flare. The expected target photon densities have been calculated analytically using the cloud/mirror model. The results suggest that the Hadronic Synchrotron Mirror Model may provide a plausible explanation. A semi-analytical model has been developed to represent the Hadronic Synchrotron Mirror Model in a realistic fashion. Our analytical estimates are confirmed by detailed numerical simulations of the Hadronic Synchrotron Mirror scenario, predicting snap-shot SEDs and light curves as well as neutrino emission.

Primary author: OBERHOLZER, Laenita

Presenter: OBERHOLZER, Laenita

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **299** Type: **Poster**

Measure the weighted cross correlation between GeV and MeV fluxes of Blazars

Thursday, April 15, 2021 6:55 PM (3 minutes)

An active galactic nucleus with a relativistic jet pointing within 10o of the line of the sight of the earth is known as a Blazar. Normally a Blazar has two relativistic jets. These jets are linear features instigating very close to the super massive black hole (SMBH) at the center of an Active Galactic Nucleus (AGN). A broad region of energies consist in these jets from radio rays to gamma rays. Blazars emitting energies due to non-thermal processes called the inverse Compton Effect and Synchrotron radiation. The model for blazers were proposed in 1978 by Blandford and Rees. Even though it has taken almost 40 years still the model is incomplete. This research is an effort to complete the model of Blazars. In this research a weighted cross correlation was calculated using a python script. Mrk421 and Mrk501 was selected as sources for this research. Three day bin analysis has been used for 22 months. Data was taken for two energy ranges, 100MeV −1000MeV for MeV file and 1GeV to 100GeV for GeV file. Then weighted cross correlation was taken. As the results of this project two weighted cross correlation graphs were plotted. First graph was plotted to Mrk501 and second graph was plotted to Mrk421. Mrk501 was showed nothing but the plot of Mrk421 had a six day lag between GeV and MeV fluxes. There are three possibilities to explain this kind of lag. First one is there might be two different places for triggering MeV and GeV fluxes, second one is there might be different triggering mechanisms and the third one is the possibility of having Lorentz Invariant Violation (LIV).

Primary author: RANDU, Mithun

Presenter: RANDU, Mithun

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **300** Type: **Poster**

Characterizing long-term leptonic variability in blazars

Thursday, April 15, 2021 6:52 PM (3 minutes)

Most research on blazar variability focuses on individual flares to explain acceleration and radiation mechanisms and improve on current models. These short-time events (being minutes, hours, or days) might not be representative of the underlying mechanisms causing small-amplitude variability and/or continuous emission which is present most of the time. We will therefore investigate long-term (months to years) variability of blazar emission in the framework of current leptonic blazar models. For this purpose, we introduce generated time-dependent parameter variations which are based on typical Power Spectral Densities (PSDs) associated with the variability of accretion flows. The PSDs from the resulting light curves are analyzed and compared to one another, as well as the PSD of the input variation. Correlations between light curves are also investigated to aid identification of characteristic variation patterns associated with leptonic models. The resulting multi-wavelength PSDs were found to follow the input variation PSD trend closely, however, it presented no clear distinctions between the varied parameters. The multi-wavelength cross-correlations showed significant difference among the varied parameters. We therefore conclude that the PSDs are plausible candidates for extracting the variational trends of variability progenitors while multi-wavelength cross-correlations would be a plausible diagnostic for identifying radiative mechanism characteristics as well as the varying quantity in the emission region.

Primary author: THIERSEN, Hannes

Presenter: THIERSEN, Hannes

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **301** Type: **Poster**

Systematic physical characterization of the gamma-ray spectra of 2FHL blazars

Thursday, April 15, 2021 6:49 PM (3 minutes)

We test different physically motivated models for the spectral shape of the gamma-ray emission in a sample of 128 blazars with known redshifts detected by Fermi-LAT at energies above 50 GeV. The first nine years of LAT data in the energy range from 300 MeV to 2 TeV are analyzed in order to extend the spectral energy coverage of the 2FHL blazars in our sample. We compare these spectral data to four leptonic models for the production of gamma-rays through Compton scattering by a population of electrons with different spectral shapes. In the first three models we consider Compton scattering in the Thomson regime with different acceleration mechanisms for the electrons. In the fourth model we consider Compton scattering by a pure power law distribution of electrons with spectral curvature due to scattering in the Klein-Nishina regime. The majority of blazar gamma-ray spectra are preferentially fit with either a power law with exponential cut-off in the Thomson regime or a power law electron distribution with Compton scattering in the Klein-Nishina regime, while a log-parabola with a low-energy power-law and broken power-law spectral shape in the Thomson regime appear systematically disfavoured, which is likely a consequence of the restriction to pure Thomson scattering which we imposed on those models. This finding may be an indication that the gamma-ray emission from FSRQs in the 2FHL catalog is dominated by Compton scattering of radiation from the dusty torus, while in the case of bL Lac objects, it is dominated by synchrotron self-Compton radiation.

Primary author: VAN DEN BERG, Jacobus

Presenter: VAN DEN BERG, Jacobus

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **302** Type: **Poster**

The ablation of gas clouds by blazar jets and the long-lasting flare in CTA 102

Thursday, April 15, 2021 6:46 PM (3 minutes)

The FSRQ CTA 102 (z=1.032) has been tremendously active over the last few years. During its peak activity lasting several months in late 2016 and early 2017, the gamma-ray and optical fluxes rose by up to a factor 100 above the quiescence level. We have interpreted the peak activity as the ablation of a gas cloud by the relativistic jet, which can nicely account for the months-long lightcurve in 2016 and 2017. The peak activity was in the middle of a 2-year-long high-state, which was characterized by increased fluxes and increased rms variability compared to the previous low-states, and which was flanked by two bright flares. In this presentation, we put the cloud-ablation scenario into the broader context of the 2-year-long high-state.

Primary author: MICHAEL, Zacharias

Presenter: MICHAEL, Zacharias

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **303** Type: **Poster**

An association of a Fermi-LAT flaring activity with a blazar candidate behind the Large Magellanic Cloud

Thursday, April 15, 2021 6:43 PM (3 minutes)

We present the results of a preliminary investigation of a potential association of a blazar candidate behind the Large Magellanic Cloud (LMC) and a gamma-ray transient object.
The hint of flaring activity appeared at the position (RA,dec)~(86.60 deg,-69.02 deg), while the J0545-6846 blazar candidate is located at (RA,dec)=(86.47 deg,-68.77 deg). J0545-6846 is characterised by a particularly large radio flux of 176.3 mJy at 843 MHz, a high value of the radio-loudness parameter R=6900, and an integrated gamma-ray flux >1 GeV of ~9.6 × 10-12 erg cm-2 s-1.
We have analysed the Fermi-Large Area Telescope (LAT) data from the LMC region in order to verify the flaring activity detected in July/August 2008 and later in April 2015 in MeV and GeV energies, using the latest Fermi-LAT point source catalogue. The performed unbinned maximum likelihood analysis took into account the positions of all known point-like sources, diffuse emission as well as the advanced gas modelling from the investigated region.
Our preliminary analyses indicate positional consistency between J0545-6846 and the flaring activity in both periods. This suggests that the observed transient activities are related to the same blazar.

Primary author: ZYWUCKA, Natalia

Presenter: ZYWUCKA, Natalia

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **304** Type: **Poster**

The Gamma-ray Emission of Ultra-Fast Outflows

Thursday, April 15, 2021 6:40 PM (3 minutes)

Massive black holes at the centers of galaxies can launch powerful wide-angle winds, which if sustained over time can unbind the gas from the stellar bulges of galaxies. Propagating through the galaxy, the wind should interact with the interstellar medium creating a strong shock, similar to those observed in supernovae explosions, which is able to accelerate charged particles to high energies. Here we report the Fermi Large Area Telescope detection of gamma-ray emission from these shocks in a small sample of galaxies exhibiting ultra-fast outflows. The detection implies that energetic black-hole winds transfer ~0.04 % of their mechanical power to gamma rays and that the gamma-ray emission may represent the onset of the wind-host interaction.

Primary author: AJELLO, Marco

Presenter: AJELLO, Marco

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **305** Type: **Poster**

Searching for misaligned active galactic nuclei among blazar candidates in the Fourth Fermi-LAT catalog

Thursday, April 15, 2021 6:37 PM (3 minutes)

Radio-loud sources with blazar-like properties, but having a jet that does not directly point in the direction of the observer are among the most interesting classes of gamma-ray emitters. These sources are known as Misaligned Active Galactic Nuclei (MAGN). We searched for new MAGN candidates among the remaining blazars of uncertain type detected by the Fermi Large Area Telescope (LAT) using a methodology based on characterizing their radio morphology. We identified 10 new candidates associated with gamma-ray sources. Their features are consistent with a source with a misaligned relativistic jet consistent with the definition of MAGN.

Primary author: CHIARO, Graziano

Presenter: CHIARO, Graziano

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **306** Type: **Poster**

Variability of the Mg II 2798λ Emission Line during the 2017 Nonthermal Outburst in the Gamma-Ray Bright Quasar 1156+295

Thursday, April 15, 2021 6:34 PM (3 minutes)

The quasar 1156+295 (4C 29.45, Ton599) underwent a dramatic nonthermal outburst in late 2017, with detection at energies > 100 GeV. The outburst was essentially simultaneous at gamma-ray and optical bands, indicating co-spatiality of the emission regions. We present multi-epoch optical spectra of 1156+295 obtained with the 4.3 m Lowell Discovery Telescope at various times, including the outburst period. We find that the flux of the Mg II 2798-Angstrom emission line, as well as blended Fe II lines at shorter wavelengths, increased with the optical synchrotron continuum with a delay less than 2 weeks. We interpret such a correlation within a scenario that the line-emitting clouds lie alongside the jet, well outside the canonical broad-line region. These extended polar clouds have the properties needed to be the source of seed photons that are scattered to gamma-ray energies.
This research was supported in part by NASA Fermi guest investigator program grants 80NSSC19K1504 and 80NSSC20K1565.

Primary author: HALLUM, Melissa

Presenter: HALLUM, Melissa

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **307** Type: **Poster**

Multiwavelength monitoring of gravitationally lensed blazar QSO B0218+357 between 2016 and 2020

Thursday, April 15, 2021 6:31 PM (3 minutes)

QSO B0218+357 is currently the only gravitationally lensed source from which both high-energy (HE, >~100 MeV) and very-high-energy (VHE,>~100GeV) gamma-ray emission has been detected.

We report the Fermi/LAT and multiwavelength monitoring observations of this source in radio interferometry, optical and X-rays performed between 2016 and 2020. During the monitoring, individual flares in the optical, X-ray and HE bands were observed.

We analysed the MAGIC telescopes data during the flaring states to search for the associated VHE emission, constraining the VHE gamma-ray duty cycle of the source.

We model the quiescent emission in which the high-energy bump is explained as a combination of Synchrotron-Self-Compton and External Compton processes. The bulk of the low-energy emission is explained as originating from a tens of parsecs scale jet.

Primary author: LONGO, Francesco

Presenter: LONGO, Francesco

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **308** Type: **Poster**

Optical spectroscopic classification of a selection of Southern Hemisphere 3FHL unclassified blazar candidates

Thursday, April 15, 2021 6:28 PM (3 minutes)

The Fermi-LAT has detected more than 5000 gamma-ray sources which show emission above 50 MeV of which 58 per cent belong to the blazar class. However, the Fourth Fermi-LAT catalogue (4FGL) lists 1312 of these as blazar candidates of uncertain type (BCU). Increasing the number of classified Fermi-LAT sources is important for improving our understanding of extra-galactic gamma-ray sources and can be used to search for new classes of very high energy sources. We report on the optical spectroscopy of thirteen unclassified BCUs with hard photon indices included in the Third Catalogue of Hard Fermi-LAT Sources (3FHL) during 2016 and 2017 using the SAAO 1.9-m telescope. We were able to classify all the sources observed as BL Lac objects, and were able to calculate the redshift for three sources and potential redshift for a further three. Additionally we were able to calculate redshifts to four previously observed BL Lacs without a confirmed redshift.

Primary author: MARAIS, JP

Presenter: MARAIS, JP

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **309** Type: **Poster**

Gamma-ray Emission from Molecular Outflows

Thursday, April 15, 2021 6:25 PM (3 minutes)

Many star-forming galaxies and those hosting active galactic nuclei (AGN) show evidence of massive outflows of material in a variety of phases including ionized, neutral atomic, and molecular outflows. Molecular outflows in particular have been the focus of recent interest as they may be responsible for removing gas from the galaxy, thereby suppressing star formation. As the material is ejected from the core of the galaxies, interactions of accelerated cosmic rays with the interstellar medium can produce high-energy gamma rays. However, the gamma-ray emission from these individual objects is expected to be below the threshold for LAT detection and has yet to be directly observed. In order to search for this faint gamma-ray signal we conduct a stacked analysis of a sample of molecular outflows in the nearby universe using 11 years of Fermi-LAT data and present preliminary evidence of a detection. Confirmed observations of gamma-ray emission from these sources can have significant implications for our understanding of AGN feedback mechanisms and the extragalactic gamma-ray background.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **310** Type: **Poster**

Spectral analysis of S5 1803+784 BL Lacs Blazar

Thursday, April 15, 2021 6:22 PM (3 minutes)

Phenomenological spectral analysis of S5 1803+784 was done in both the high state and the low state using leptonic jet models. The jet energetic and spectral properties using single zone synchrotron-self Compton (SSC) and SSC with external photons (SSC+EC) jet models are presented. S5 1803+784 is a low synchrotron peak (LSP) blazar with the characteristics weak emission lines (EW < 5A). Data obtained from NED and Fermi-LAT was used for the analysis and the spectral energy distribution (SED) of the best-fit model is used to constraint the emission process of the blazar.

Primary author: OMOJOLA, Joseph

Presenter: OMOJOLA, Joseph

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **311** Type: **Poster**

Two-component model of gamma-ray emission for Fermi/LAT-blazars

Thursday, April 15, 2021 6:19 PM (3 minutes)

In this talk, we will present a two-component model of the γ-ray emission which assumes that the total γ-ray output of blazars consists of relativistically beamed and unbeamed components. 584 Fermi/LAT-blazars are listed in our compiled catalogue. This idea leverages the correlation between the radio core-dominance parameter and the γ-ray beaming factor. We firstly propose a so-called "γ-ray core-dominance parameter" and we successful divide the γ-ray emission into beamed and unbeamed contributions theoretically for those 584 sources. Our analysis confirms that the γ-ray emission in blazars is mainly from the beamed component.

Primary author: PEI, Zhiyuan

Presenter: PEI, Zhiyuan

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **312** Type: **Poster**

The gamma-ray emission of young radio galaxies and quasars

Thursday, April 15, 2021 6:16 PM (3 minutes)

According to radiative models, radio galaxies are predicted to produce gamma rays since the first stages of their evolution. The study of the high-energy emission from young radio sources is crucial for providing information on the most energetic processes associated with these sources, the actual region responsible for this emission, as well as the structure of the newly born radio jets. Despite systematic searches for young radio sources at gamma-ray energies, only a handful of detections have been reported so far. Taking advantage of more than 11 years of Fermi-LAT data, we investigate the gamma-ray emission of 162 young radio sources (103 galaxies and 59 quasars), the largest sample of young radio sources used so far for a gamma-ray study. We analyse the Fermi-LAT data of each individual source separately to search for a significant detection. In addition, we perform the first stacking analysis of this class of sources in order to investigate the gamma-ray emission of the young radio sources that are undetected at high energies.
We report the detection of significant gamma-ray emission from 11 young radio sources, including the discovery of significant gamma-ray emission by the compact radio galaxy PKS 1007+142.
Although, the stacking analysis of below-threshold young radio sources does not result in a significant detection, it provides stringent upper limits to constrain the gamma-ray emission from these objects.
In this talk we present the results of our study and we discuss their implications for the predictions of gamma-ray emission from this class of sources.

Primary author: PRINCIPE, Giacomo

Presenter: PRINCIPE, Giacomo

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **313** Type: **Poster**

Are we seeing magnetic reconnection generated gamma-ray flares in 3C 84

Thursday, April 15, 2021 6:13 PM (3 minutes)

Magnetic reconnection - relinking of magnetic field lines - has been proposed as a possible mechanism to power the high-energy flares in gamma-ray bright Active Galactic Nuclei but has not been confirmed via observations. Our study found observational evidence of magnetic reconnection generated gamma-ray flares in a radio galaxy, 3C 84. In a sequence of radio images, the radio-emitting region (plasma blob) gets brighter and larger, then splits into two, and finally dissipates. A gamma-ray flare is observed shortly before the split. This 'split-flare-dissipate'behavior - detected for three gamma-ray events - provides an indication of magnetic reconnection in the source.

Primary author: RANI, Bindu

Presenter: RANI, Bindu

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **314** Type: **Poster**

Multi-wavelength study of large-scale outflows from the Circinus galaxy

Thursday, April 15, 2021 6:10 PM (3 minutes)

The Circinus galaxy is a composite starburst/Seyfert galaxy which exhibits radio lobes inflated by kpc scale outflows along its minor axis. Its proximity (4 Mpc) makes it a unique target to study the physical nature of these outflows. We investigate if they originate from nuclear star formation activity or if they are jets from an active galactic core. The MeerKAT radio observations allow us to study the morphology of the arcminute lobes of the Circinus galaxy. In this work, a multi-wavelength analysis of this system is conducted using the available MeerKAT observations and Fermi-LAT data, to aid in the understanding of the origin of these structures. The results are also compared to the star-formation driven Fermi bubbles in the Milky Way, which have also been observed in both the gamma-ray and the radio bands to determine physical similarities between these structures.

Primary author: EBRAHIM, Rozeena

Presenter: EBRAHIM, Rozeena

Session Classification: AGN-2

Track Classification: AGN

Contribution ID: **316** Type: **Poster**

Constraining the intergalactic magnetic field with Fermi-LAT observations of seven ultra-high-frequency peaked BL Lac sources.

Friday, April 16, 2021 6:20 PM (6 minutes)

Galaxies and galaxy clusters are separated by large distances of nearly empty
space called the intergalactic space. In these large, nearly empty regions a weak magnetic field of strength < 10 nG is present that is predicted to be of primordial (early universe) origin. This is called the intergalactic magnetic field (IGMF) and knowledge about its strength, coherence length, origin etc. is limited. Understanding the origin of the IGMF is crucial because of the impact it may have had on early star and galaxy formations. Gamma-ray observations of very high energy emitting blazars provide one method to indirectly probe the IGMF. The gamma ray photons emitted from the blazars will undergo gamma-gamma absorption due to their interaction with the extragalactic background light (EBL), producing electrons-positrons pairs. These electron-positron pairs can then upscatter photons from the cosmic microwave background (CMB) to produce a secondary cascade component at lower energies ($\approx 0.1 - 10$ GeV). However the IGMF can scatter the electron-positron pairs away and thus attenuating the emission that will be superimposed on the blazars intrinsic spectrum. This attenuation is highly dependent on the IGMF strength and the coherence length. Seven hard and non-variable sources were selected to be re-analysed, using the Fermi Science Tools package (version 1.0.5 released on 05/21/2019) with the improved Pass 8 analysis pipeline. Using previous IACT observations results, the secondary cascade component was modelled using the Monte Carlo code of Kachelrieß et al. and the primary and total spectrum components were compared to the Fermi-LAT spectrum, allowing constraints to be placed on the strength of the IGMF.

Primary author: BISSCHOFF, Brandon

Presenter: BISSCHOFF, Brandon

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **317** Type: **Poster**

Ultrahigh-energy cosmic-ray interactions as the origin of very high-energy gamma-rays from BL Lacertae objects

Friday, April 16, 2021 6:26 PM (3 minutes)

We explain the observed multiwavelength photon spectrum of some high energy BL Lac objects, using a lepto-hadronic model. The one-zone leptonic emission is employed to fit the synchrotron peak. Subsequently, the SSC spectrum is calculated, such that it extends up to the highest energy possible for the jet parameters considered. The data points beyond this and also in the entire VHE range (E>30 GeV) are well explained using a hadronic origin. The UHECRs escaping from the source interacts with the EBL background during propagation over cosmological distances to initiate electromagnetic cascade down to GeV energies. The resulting photon spectrum peaks at ~ TeV energies. We consider a random turbulent EGMF with a Kolmogorov power spectrum to find the survival rate of UHECRs within 0.1 degrees of the direction of propagation in which the observer is situated. We restrict ourselves to an RMS value of EGMF ~ 10^-5 nG for a significant contribution to the photon SED from UHECR interactions. The kinetic power in UHECRs required in this scenario is estimated and compared with the Eddington luminosity of the sources. We discuss the possibility of UHECR detection from these sources and find the neutrino fluxes produced from each source. The uncertainties posed due to the choice of EBL models are also presented.

Primary author: DAS, Saikat

Presenter: DAS, Saikat

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **318** Type: **Poster**

X-ray luminosity function of FSRQ with BAT 105 month catalog and contribution to cosmic MeV gamma-ray background

Friday, April 16, 2021 6:29 PM (3 minutes)

FSRQs are important to study cosmic evolution of AGN jet and also interesting how they contribute to the cosmic MeV gamma-ray background. Past studies with hard X-ray (Swift/BAT 22 month catalog) and GeV gamma-ray (Fermi/LAT) reported the X-ray and gamma-ray luminosity function, but predicts a different evolution between X-ray and GeV gamma-ray. Here we used the Swift/BAT 105 month catalog to double the number of sample FSRQs and derived a X-ray luminosity function with luminosity-dependent density evolution model as used in the GeV gamma-ray study. Then we found that the X-ray luminosity function is consistent with that of GeV gamma-ray within uncertainties. Also we calculated the contribution of FSRQs to the cosmic MeV gamma-ray background and found that their contribution is minor. Interestingly, half of our sample FSRQs are not detected by Fermi/LAT, indicating many MeV-peak FRRQs

Primary author: FUKAZAWA, Yasushi

Presenter: FUKAZAWA, Yasushi

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **319** Type: **Poster**

The first gamma-ray flare of the peculiar source PKS 2004-447

Friday, April 16, 2021 6:32 PM (3 minutes)

While blazars are abundant in the gamma-ray sky, there is only a handful of narrow-line Seyfert 1 galaxies that Fermi/LAT detected in more than 10 years of observation. Flares from this elusive source class are among the rarest events that Fermi has seen so far.
One of them is the radio- and gamma-ray loud source PKS 2004-447. It exhibits blazar-like features, i.e., a flat featureless X-ray spectrum and a core-dominated, one-sided parsec-scale jet with indications for relativistic beaming.
However, the spectrum also shows properties atypical for blazars, such as a steep radio spectrum and large-scale size consistent with compact-steep-spectrum objects, which are usually associated with young radio galaxies. Such characteristics are unique among all gamma-loud NLS1s and extremely rare among gamma-loud AGN.
Very recently, PKS 2004-447 showed its first bright gamma-ray flare since the beginning of the Fermi Mission, for which optical/UV, X-ray and radio follow-up observations took place.
We will present results on the multi-wavelength analysis, focusing on the source classification based on the X-ray spectra and the construction of the spectral energy distribution with a quasi-simultaneous dataset.

Primary author: GOKUS, Andrea

Presenter: GOKUS, Andrea

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **320** Type: **Poster**

Extragalactic Radio Background from Synchrotron Emission of Radio and Normal Galaxies

Friday, April 16, 2021 6:35 PM (3 minutes)

The extragalactic radio background in the universe is mainly due to emission from the radio galaxies and normal galaxies. This emission is synchrotron radiation by relativistic electrons gyrating in the magnetic field of the galaxies. Synchrotron self-absorption and free-free absorptions by hot ionised gas in the interstellar medium play an important role to modify radio emission. In this study, we calculate the radio spectra of the radio and normal galaxies. Thereafter, we develop a model for the intensity of extragalactic radio background by using the resulting radio spectra and by integrating over the observed luminosity functions according to cosmological evolution. We compare our model with the latest radio source count data.

Primary author: MOTHA, Nomthendeleko

Presenter: MOTHA, Nomthendeleko

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **321** Type: **Poster**

Hadronic synchrotron mirror model for blazars- Application to 3C279

Friday, April 16, 2021 6:38 PM (3 minutes)

On the 28th of January, an orphan very-high-energy γ-ray flare from 3C279 was detected, not accompanied by flaring in the adjacent GeV gamma-ray regime. Orphan flares have to be caused by different processes than normal γ-ray flares. Specifically, the Hadronic Synchrotron Mirror Model has been proposed to provide a consistent explanation of this flare. The expected target photon densities have been calculated analytically using the cloud/mirror model. The results suggest that the Hadronic Synchrotron Mirror Model may provide a plausible explanation. A semi-analytical model has been developed to represent the Hadronic Synchrotron Mirror Model in a realistic fashion. Our analytical estimates are confirmed by detailed numerical simulations of the Hadronic Synchrotron Mirror scenario, predicting snap-shot SEDs and light curves as well as neutrino emission.

Primary author: OBERHOLZER, Laenita

Presenter: OBERHOLZER, Laenita

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **322** Type: **Poster**

Measure the weighted cross correlation between GeV and MeV fluxes of Blazars

Friday, April 16, 2021 6:41 PM (3 minutes)

An active galactic nucleus with a relativistic jet pointing within 10o of the line of the sight of the earth is known as a Blazar. Normally a Blazar has two relativistic jets. These jets are linear features instigating very close to the super massive black hole (SMBH) at the center of an Active Galactic Nucleus (AGN). A broad region of energies consist in these jets from radio rays to gamma rays. Blazars emitting energies due to non-thermal processes called the inverse Compton Effect and Synchrotron radiation. The model for blazers were proposed in 1978 by Blandford and Rees. Even though it has taken almost 40 years still the model is incomplete. This research is an effort to complete the model of Blazars. In this research a weighted cross correlation was calculated using a python script. Mrk421 and Mrk501 was selected as sources for this research. Three day bin analysis has been used for 22 months. Data was taken for two energy ranges, 100MeV −1000MeV for MeV file and 1GeV to 100GeV for GeV file. Then weighted cross correlation was taken. As the results of this project two weighted cross correlation graphs were plotted. First graph was plotted to Mrk501 and second graph was plotted to Mrk421. Mrk501 was showed nothing but the plot of Mrk421 had a six day lag between GeV and MeV fluxes. There are three possibilities to explain this kind of lag. First one is there might be two different places for triggering MeV and GeV fluxes, second one is there might be different triggering mechanisms and the third one is the possibility of having Lorentz Invariant Violation (LIV).

Primary author: RANDU, Mithun

Presenter: RANDU, Mithun

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **323** Type: **Poster**

Characterizing long-term leptonic variability in blazars

Friday, April 16, 2021 6:44 PM (3 minutes)

Most research on blazar variability focuses on individual flares to explain acceleration and radiation mechanisms and improve on current models. These short-time events (being minutes, hours, or days) might not be representative of the underlying mechanisms causing small-amplitude variability and/or continuous emission which is present most of the time. We will therefore investigate long-term (months to years) variability of blazar emission in the framework of current leptonic blazar models. For this purpose, we introduce generated time-dependent parameter variations which are based on typical Power Spectral Densities (PSDs) associated with the variability of accretion flows. The PSDs from the resulting light curves are analyzed and compared to one another, as well as the PSD of the input variation. Correlations between light curves are also investigated to aid identification of characteristic variation patterns associated with leptonic models. The resulting multi-wavelength PSDs were found to follow the input variation PSD trend closely, however, it presented no clear distinctions between the varied parameters. The multi-wavelength cross-correlations showed significant difference among the varied parameters. We therefore conclude that the PSDs are plausible candidates for extracting the variational trends of variability progenitors while multi-wavelength cross-correlations would be a plausible diagnostic for identifying radiative mechanism characteristics as well as the varying quantity in the emission region.

Primary author: THIERSEN, Hannes

Presenter: THIERSEN, Hannes

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **324** Type: **Poster**

Systematic physical characterization of the gamma-ray spectra of 2FHL blazars

Friday, April 16, 2021 6:47 PM (3 minutes)

We test different physically motivated models for the spectral shape of the gamma-ray emission in a sample of 128 blazars with known redshifts detected by Fermi-LAT at energies above 50 GeV. The first nine years of LAT data in the energy range from 300 MeV to 2 TeV are analyzed in order to extend the spectral energy coverage of the 2FHL blazars in our sample. We compare these spectral data to four leptonic models for the production of gamma-rays through Compton scattering by a population of electrons with different spectral shapes. In the first three models we consider Compton scattering in the Thomson regime with different acceleration mechanisms for the electrons. In the fourth model we consider Compton scattering by a pure power law distribution of electrons with spectral curvature due to scattering in the Klein-Nishina regime. The majority of blazar gamma-ray spectra are preferentially fit with either a power law with exponential cut-off in the Thomson regime or a power law electron distribution with Compton scattering in the Klein-Nishina regime, while a log-parabola with a low-energy power-law and broken power-law spectral shape in the Thomson regime appear systematically disfavoured, which is likely a consequence of the restriction to pure Thomson scattering which we imposed on those models. This finding may be an indication that the gamma-ray emission from FSRQs in the 2FHL catalog is dominated by Compton scattering of radiation from the dusty torus, while in the case of bL Lac objects, it is dominated by synchrotron self-Compton radiation.

Primary author: VAN DEN BERG, Jacobus

Presenter: VAN DEN BERG, Jacobus

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **325** Type: **Poster**

The ablation of gas clouds by blazar jets and the long-lasting flare in CTA 102

Friday, April 16, 2021 6:50 PM (3 minutes)

The FSRQ CTA 102 (z=1.032) has been tremendously active over the last few years. During its peak activity lasting several months in late 2016 and early 2017, the gamma-ray and optical fluxes rose by up to a factor 100 above the quiescence level. We have interpreted the peak activity as the ablation of a gas cloud by the relativistic jet, which can nicely account for the months-long lightcurve in 2016 and 2017. The peak activity was in the middle of a 2-year-long high-state, which was characterized by increased fluxes and increased rms variability compared to the previous low-states, and which was flanked by two bright flares. In this presentation, we put the cloud-ablation scenario into the broader context of the 2-year-long high-state.

Primary author: MICHAEL, Zacharias

Presenter: MICHAEL, Zacharias

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **326** Type: **Poster**

An association of a Fermi-LAT flaring activity with a blazar candidate behind the Large Magellanic Cloud

Friday, April 16, 2021 6:53 PM (3 minutes)

We present the results of a preliminary investigation of a potential association of a blazar candidate behind the Large Magellanic Cloud (LMC) and a gamma-ray transient object.
The hint of flaring activity appeared at the position (RA,dec)~(86.60 deg,-69.02 deg), while the J0545-6846 blazar candidate is located at (RA,dec)=(86.47 deg,-68.77 deg). J0545-6846 is characterised by a particularly large radio flux of 176.3 mJy at 843 MHz, a high value of the radio-loudness parameter R=6900, and an integrated gamma-ray flux >1 GeV of ~9.6 × 10-12 erg cm-2 s-1.
We have analysed the Fermi-Large Area Telescope (LAT) data from the LMC region in order to verify the flaring activity detected in July/August 2008 and later in April 2015 in MeV and GeV energies, using the latest Fermi-LAT point source catalogue. The performed unbinned maximum likelihood analysis took into account the positions of all known point-like sources, diffuse emission as well as the advanced gas modelling from the investigated region.
Our preliminary analyses indicate positional consistency between J0545-6846 and the flaring activity in both periods. This suggests that the observed transient activities are related to the same blazar.

Primary author: ZYWUCKA, Natalia

Presenter: ZYWUCKA, Natalia

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **327** Type: **Poster**

The Gamma-ray Emission of Ultra-Fast Outflows

Friday, April 16, 2021 6:56 PM (3 minutes)

Massive black holes at the centers of galaxies can launch powerful wide-angle winds, which if sustained over time can unbind the gas from the stellar bulges of galaxies. Propagating through the galaxy, the wind should interact with the interstellar medium creating a strong shock, similar to those observed in supernovae explosions, which is able to accelerate charged particles to high energies. Here we report the Fermi Large Area Telescope detection of gamma-ray emission from these shocks in a small sample of galaxies exhibiting ultra-fast outflows. The detection implies that energetic black-hole winds transfer ~0.04 % of their mechanical power to gamma rays and that the gamma-ray emission may represent the onset of the wind-host interaction.

Primary author: AJELLO, Marco

Presenter: AJELLO, Marco

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **328** Type: **Poster**

Searching for misaligned active galactic nuclei among blazar candidates in the Fourth Fermi-LAT catalog

Friday, April 16, 2021 6:59 PM (3 minutes)

Radio-loud sources with blazar-like properties, but having a jet that does not directly point in the direction of the observer are among the most interesting classes of gamma-ray emitters. These sources are known as Misaligned Active Galactic Nuclei (MAGN). We searched for new MAGN candidates among the remaining blazars of uncertain type detected by the Fermi Large Area Telescope (LAT) using a methodology based on characterizing their radio morphology. We identified 10 new candidates associated with gamma-ray sources. Their features are consistent with a source with a misaligned relativistic jet consistent with the definition of MAGN.

Primary author: CHIARO, Graziano

Presenter: CHIARO, Graziano

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **329** Type: **Poster**

Variability of the Mg II 2798λ Emission Line during the 2017 Nonthermal Outburst in the Gamma-Ray Bright Quasar 1156+295

Friday, April 16, 2021 7:02 PM (3 minutes)

The quasar 1156+295 (4C 29.45, Ton599) underwent a dramatic nonthermal outburst in late 2017, with detection at energies > 100 GeV. The outburst was essentially simultaneous at gamma-ray and optical bands, indicating co-spatiality of the emission regions. We present multi-epoch optical spectra of 1156+295 obtained with the 4.3 m Lowell Discovery Telescope at various times, including the outburst period. We find that the flux of the Mg II 2798-Angstrom emission line, as well as blended Fe II lines at shorter wavelengths, increased with the optical synchrotron continuum with a delay less than 2 weeks. We interpret such a correlation within a scenario that the line-emitting clouds lie alongside the jet, well outside the canonical broad-line region. These extended polar clouds have the properties needed to be the source of seed photons that are scattered to gamma-ray energies.
This research was supported in part by NASA Fermi guest investigator program grants 80NSSC19K1504 and 80NSSC20K1565.

Primary author: HALLUM, Melissa

Presenter: HALLUM, Melissa

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **330** Type: **Poster**

Multiwavelength monitoring of gravitationally lensed blazar QSO B0218+357 between 2016 and 2020

Friday, April 16, 2021 7:05 PM (3 minutes)

QSO B0218+357 is currently the only gravitationally lensed source from which both high-energy (HE, >~100 MeV) and very-high-energy (VHE,>~100GeV) gamma-ray emission has been detected.

We report the Fermi/LAT and multiwavelength monitoring observations of this source in radio interferometry, optical and X-rays performed between 2016 and 2020. During the monitoring, individual flares in the optical, X-ray and HE bands were observed.

We analysed the MAGIC telescopes data during the flaring states to search for the associated VHE emission, constraining the VHE gamma-ray duty cycle of the source.

We model the quiescent emission in which the high-energy bump is explained as a combination of Synchrotron-Self-Compton and External Compton processes. The bulk of the low-energy emission is explained as originating from a tens of parsecs scale jet.

Primary author: LONGO, Francesco

Presenter: LONGO, Francesco

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **331** Type: **Poster**

Optical spectroscopic classification of a selection of Southern Hemisphere 3FHL unclassified blazar candidates

Friday, April 16, 2021 7:08 PM (3 minutes)

The Fermi-LAT has detected more than 5000 gamma-ray sources which show emission above 50 MeV of which 58 per cent belong to the blazar class. However, the Fourth Fermi-LAT catalogue (4FGL) lists 1312 of these as blazar candidates of uncertain type (BCU). Increasing the number of classified Fermi-LAT sources is important for improving our understanding of extra-galactic gamma-ray sources and can be used to search for new classes of very high energy sources. We report on the optical spectroscopy of thirteen unclassified BCUs with hard photon indices included in the Third Catalogue of Hard Fermi-LAT Sources (3FHL) during 2016 and 2017 using the SAAO 1.9-m telescope. We were able to classify all the sources observed as BL Lac objects, and were able to calculate the redshift for three sources and potential redshift for a further three. Additionally we were able to calculate redshifts to four previously observed BL Lacs without a confirmed redshift.

Primary author: MARAIS, JP

Presenter: MARAIS, JP

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **332** Type: **Poster**

Gamma-ray Emission from Molecular Outflows

Friday, April 16, 2021 7:11 PM (3 minutes)

Many star-forming galaxies and those hosting active galactic nuclei (AGN) show evidence of massive outflows of material in a variety of phases including ionized, neutral atomic, and molecular outflows. Molecular outflows in particular have been the focus of recent interest as they may be responsible for removing gas from the galaxy, thereby suppressing star formation. As the material is ejected from the core of the galaxies, interactions of accelerated cosmic rays with the interstellar medium can produce high-energy gamma rays. However, the gamma-ray emission from these individual objects is expected to be below the threshold for LAT detection and has yet to be directly observed. In order to search for this faint gamma-ray signal we conduct a stacked analysis of a sample of molecular outflows in the nearby universe using 11 years of Fermi-LAT data and present preliminary evidence of a detection. Confirmed observations of gamma-ray emission from these sources can have significant implications for our understanding of AGN feedback mechanisms and the extragalactic gamma-ray background.

Primary author: MCDANIEL, Alex

Presenter: MCDANIEL, Alex

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **333** Type: **Poster**

Spectral analysis of S5 1803+784 BL Lacs Blazar

Friday, April 16, 2021 7:14 PM (3 minutes)

Phenomenological spectral analysis of S5 1803+784 was done in both the high state and the low state using leptonic jet models. The jet energetic and spectral properties using single zone synchrotron-self Compton (SSC) and SSC with external photons (SSC+EC) jet models are presented. S5 1803+784 is a low synchrotron peak (LSP) blazar with the characteristics weak emission lines (EW < 5A). Data obtained from NED and Fermi-LAT was used for the analysis and the spectral energy distribution (SED) of the best-fit model is used to constraint the emission process of the blazar.

Primary author: OMOJOLA, Joseph

Presenter: OMOJOLA, Joseph

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **334** Type: **Poster**

Two-component model of gamma-ray emission for Fermi/LAT-blazars

Friday, April 16, 2021 7:17 PM (3 minutes)

In this talk, we will present a two-component model of the γ-ray emission which assumes that the total γ-ray output of blazars consists of relativistically beamed and unbeamed components. 584 Fermi/LAT-blazars are listed in our compiled catalogue. This idea leverages the correlation between the radio core-dominance parameter and the γ-ray beaming factor. We firstly propose a so-called "γ-ray core-dominance parameter" and we successful divide the γ-ray emission into beamed and unbeamed contributions theoretically for those 584 sources. Our analysis confirms that the γ-ray emission in blazars is mainly from the beamed component.

Primary author: PEI, Zhiyuan

Presenter: PEI, Zhiyuan

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **335** Type: **Poster**

The gamma-ray emission of young radio galaxies and quasars

Friday, April 16, 2021 7:20 PM (3 minutes)

According to radiative models, radio galaxies are predicted to produce gamma rays since the first stages of their evolution. The study of the high-energy emission from young radio sources is crucial for providing information on the most energetic processes associated with these sources, the actual region responsible for this emission, as well as the structure of the newly born radio jets.
Despite systematic searches for young radio sources at gamma-ray energies, only a handful of detections have been reported so far. Taking advantage of more than 11 years of Fermi-LAT data, we investigate the gamma-ray emission of 162 young radio sources (103 galaxies and 59 quasars), the largest sample of young radio sources used so far for a gamma-ray study. We analyse the Fermi-LAT data of each individual source separately to search for a significant detection. In addition, we perform the first stacking analysis of this class of sources in order to investigate the gamma-ray emission of the young radio sources that are undetected at high energies.
We report the detection of significant gamma-ray emission from 11 young radio sources, including the discovery of significant gamma-ray emission by the compact radio galaxy PKS 1007+142.
Although, the stacking analysis of below-threshold young radio sources does not result in a significant detection, it provides stringent upper limits to constrain the gamma-ray emission from these objects.
In this talk we present the results of our study and we discuss their implications for the predictions of gamma-ray emission from this class of sources.

Primary author: PRINCIPE, Giacomo

Presenter: PRINCIPE, Giacomo

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **336** Type: **Poster**

Are we seeing magnetic reconnection generated gamma-ray flares in 3C 84

Friday, April 16, 2021 7:23 PM (3 minutes)

Magnetic reconnection - relinking of magnetic field lines - has been proposed as a possible mechanism to power the high-energy flares in gamma-ray bright Active Galactic Nuclei but has not been confirmed via observations. Our study found observational evidence of magnetic reconnection generated gamma-ray flares in a radio galaxy, 3C 84. In a sequence of radio images, the radio-emitting region (plasma blob) gets brighter and larger, then splits into two, and finally dissipates. A gamma-ray flare is observed shortly before the split. This 'split-flare-dissipate'behavior - detected for three gamma-ray events - provides an indication of magnetic reconnection in the source.

Primary author: RANI, Bindu

Presenter: RANI, Bindu

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **337** Type: **Poster**

Multi-wavelength study of large-scale outflows from the Circinus galaxy

Friday, April 16, 2021 7:26 PM (3 minutes)

The Circinus galaxy is a composite starburst/Seyfert galaxy which exhibits radio lobes inflated by kpc scale outflows along its minor axis. Its proximity (4 Mpc) makes it a unique target to study the physical nature of these outflows. We investigate if they originate from nuclear star formation activity or if they are jets from an active galactic core. The MeerKAT radio observations allow us to study the morphology of the arcminute lobes of the Circinus galaxy. In this work, a multi-wavelength analysis of this system is conducted using the available MeerKAT observations and Fermi-LAT data, to aid in the understanding of the origin of these structures. The results are also compared to the star-formation driven Fermi bubbles in the Milky Way, which have also been observed in both the gamma-ray and the radio bands to determine physical similarities between these structures.

Primary author: EBRAHIM, Rozeena

Presenter: EBRAHIM, Rozeena

Session Classification: AGN-3

Track Classification: AGN

Contribution ID: **339** Type: **Poster**

Double-dipping for dark matter with gamma-rays

Wednesday, April 14, 2021 7:42 AM (7 minutes)

Gamma-ray probes have historically been a gold-standard in indirect dark matter detection due to their smaller set of complicating factors and generally lower backgrounds. However, they are most optimally sensitive to the traditional supersymmetric WIMP annihilation channels and leptophilic channels (particularly for larger masses) are much harder to probe effectively in this manner. However, these channels do produce strong neutrino emissions but this has been complicated by lack of neutrino telescope sensitivity. In this work we display a method for inferring neutrino fluxes from gamma-ray data and using this to achieve superior constraints on the leptophilic channels of WIMP annihilation. This allows us to 'double-dip' re-using the same gamma-ray data sets to get a wider range of robust WIMP and stringent annihilation constraints. We demonstrate this approach with data from HESS and Fermi-LAT and use it to probe dark matter models suggested to explain recently reported cosmic-ray excesses.

Primary author: BECK, Geoff

Presenter: BECK, Geoff

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Dark Matter

Contribution ID: **340** Type: **Poster**

Double-dipping for dark matter with gamma-rays

Friday, April 16, 2021 7:02 PM (7 minutes)

Gamma-ray probes have historically been a gold-standard in indirect dark matter detection due to their smaller set of complicating factors and generally lower backgrounds. However, they are most optimally sensitive to the traditional supersymmetric WIMP annihilation channels and leptophilic channels (particularly for larger masses) are much harder to probe effectively in this manner. However, these channels do produce strong neutrino emissions but this has been complicated by lack of neutrino telescope sensitivity. In this work we display a method for inferring neutrino fluxes from gamma-ray data and using this to achieve superior constraints on the leptophilic channels of WIMP annihilation. This allows us to 'double-dip' re-using the same gamma-ray data sets to get a wider range of robust WIMP and stringent annihilation constraints. We demonstrate this approach with data from HESS and Fermi-LAT and use it to probe dark matter models suggested to explain recently reported cosmic-ray excesses.

Primary author: BECK, Geoff

Presenter: BECK, Geoff

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Dark Matter

Contribution ID: **341** Type: **Poster**

Automated classification of X-rays sources within the extent of Fermi-LAT sources

Wednesday, April 14, 2021 7:35 AM (7 minutes)

The release of the Fermi-LAT 4FGL catalog includes over 1,000 unidentified Fermi-LAT sources (roughly 25% of sources). One of the most successful ways to uncover their counterparts are through X-ray observations. Over their ~20 year lifetimes XMM-Newton and Chandra have observed a large number of Galactic fields, many of which contain unidentified Galactic Fermi-LAT sources. Often these fields can contain 10s to 100s of X-ray sources, most of which need to be vetted as potential GeV counterparts owing to the large positional uncertainties of the Fermi-LAT sources. Studying each individual X-ray source manually is a tedious and time consuming task. However, machine learning methods can substantially speed up this task. Here we present a systematic study of archival X-ray observations of fields containing these unidentified 4FGL Fermi-LAT sources, using our multi-wavelength machine learning pipeline (MUWCLASS). We will discuss the most interesting sources and present results from their IR to GeV spectral and timing analyses. Additionally, new high cadence optical surveys (e.g., ZTF, TESS, ASAS-SN), when combined with X-ray variability information, provide a new window to help identify and classify highly variable sources, such as high-mass gamma-ray binaries, spider millisecond pulsars, and AGN. We will also discuss the ongoing implementation of this information into our pipeline.

Primary author: HARE, Jeremy

Presenter: HARE, Jeremy

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Catalogs

Contribution ID: **342** Type: **Poster**

Automated classification of X-rays sources within the extent of Fermi-LAT sources

Friday, April 16, 2021 6:55 PM (7 minutes)

The release of the Fermi-LAT 4FGL catalog includes over 1,000 unidentified Fermi-LAT sources (roughly 25% of sources). One of the most successful ways to uncover their counterparts are through X-ray observations. Over their ~20 year lifetimes XMM-Newton and Chandra have observed a large number of Galactic fields, many of which contain unidentified Galactic Fermi-LAT sources. Often these fields can contain 10s to 100s of X-ray sources, most of which need to be vetted as potential GeV counterparts owing to the large positional uncertainties of the Fermi-LAT sources. Studying each individual X-ray source manually is a tedious and time consuming task. However, machine learning methods can substantially speed up this task. Here we present a systematic study of archival X-ray observations of fields containing these unidentified 4FGL Fermi-LAT sources, using our multi-wavelength machine learning pipeline (MUWCLASS). We will discuss the most interesting sources and present results from their IR to GeV spectral and timing analyses. Additionally, new high cadence optical surveys (e.g., ZTF, TESS, ASAS-SN), when combined with X-ray variability information, provide a new window to help identify and classify highly variable sources, such as high-mass gamma-ray binaries, spider millisecond pulsars, and AGN. We will also discuss the ongoing implementation of this information into our pipeline.

Primary author: HARE, Jeremy

Presenter: HARE, Jeremy

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Catalogs

Contribution ID: **343** Type: **Poster**

Cherenkov Telescope Array sensitivity to branon dark matter models

Wednesday, April 14, 2021 7:28 AM (7 minutes)

TeV DM candidates are gradually earning more and more attention within the community. Among others, extra-dimensional brane-world models may produce thermal DM candidates with masses up to 100 TeV, which could be detected with the next generation of very-high-energy gamma-ray observatories such as the Cherenkov Telescope Array (CTA).
In this work, we study the sensitivity of CTA to branon DM via the observation of dwarf spheroidal galaxies.
We computed annihilation cross section values needed to reach a 5σ detection as a function of the branon mass. Additionally, in the absence of a predicted DM signal, we obtained 2σ upper limits on the annihilation cross section.
These limits lie 1.5-2 orders of magnitude above the thermal relic cross section value.
Yet, CTA will allow to exclude a significant portion of the brane tension-mass parameter space in the 0.1-60 TeV branon mass range, and up to tensions of ~10 TeV. More importantly, CTA will significantly enlarge the region already excluded by AMS and CMS, and will provide valuable complementary information to future SKA radio observations.

Primary author: AGUIRRE-SANTAELLA, Alejandra

Presenter: AGUIRRE-SANTAELLA, Alejandra

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Dark Matter

Contribution ID: **344** Type: **Poster**

Cherenkov Telescope Array sensitivity to branon dark matter models

Friday, April 16, 2021 6:48 PM (7 minutes)

TeV DM candidates are gradually earning more and more attention within the community. Among others, extra-dimensional brane-world models may produce thermal DM candidates with masses up to 100 TeV, which could be detected with the next generation of very-high-energy gamma-ray observatories such as the Cherenkov Telescope Array (CTA).
In this work, we study the sensitivity of CTA to branon DM via the observation of dwarf spheroidal galaxies.
We computed annihilation cross section values needed to reach a 5σ detection as a function of the branon mass. Additionally, in the absence of a predicted DM signal, we obtained 2σ upper limits on the annihilation cross section.
These limits lie 1.5-2 orders of magnitude above the thermal relic cross section value.
Yet, CTA will allow to exclude a significant portion of the brane tension-mass parameter space in the 0.1-60 TeV branon mass range, and up to tensions of ~10 TeV. More importantly, CTA will significantly enlarge the region already excluded by AMS and CMS, and will provide valuable complementary information to future SKA radio observations.

Primary author: AGUIRRE-SANTAELLA, Alejandra

Presenter: AGUIRRE-SANTAELLA, Alejandra

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Dark Matter

Contribution ID: **347** Type: **Poster**

Discovery of 100 TeV gamma-rays from HESS J1702-420: a new PeVatron candidate

Wednesday, April 14, 2021 7:21 AM (7 minutes)

The identification of active PeVatrons, hadronic particle accelerators reaching the knee (at the energy of few PeV), is crucial to understand the origin of cosmic rays in the Galaxy. In this context, we report on new H.E.S.S. observations of the PeVatron candidate HESSJ1702-420, close to the source 2FHL J1703.4-4145, that have revealed the presence of gamma-rays up to 100 TeV at 5 sigma confidence level. This is the first time in H.E.S.S. history that photons with such high energy are clearly detected. Remarkably, the new deep observations allowed the discovery of a new gamma-ray source component, called HESS J1702-420A, that was previously hidden under the bulk emission traditionally associated with HESSJ1702-420. This new object has a power-law spectral slope < 2 and a gamma-ray spectrum that, extending with no sign of curvature up to 100 TeV, makes it an excellent candidate site for the presence of extremely high-energy cosmic rays. This discovery brings new information to the open debates on the nature of the unidentified source HESSJ1702-420, one of the most compelling PeVatron candidates in the gamma-ray sky, and on the origin of Galactic cosmic rays.

Primary author: GIUNTI, Luca

Presenter: GIUNTI, Luca

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: CR

Contribution ID: **348** Type: **Poster**

Discovery of 100 TeV gamma-rays from HESS J1702-420: a new PeVatron candidate

Friday, April 16, 2021 6:41 PM (7 minutes)

The identification of active PeVatrons, hadronic particle accelerators reaching the knee (at the energy of few PeV), is crucial to understand the origin of cosmic rays in the Galaxy. In this context, we report on new H.E.S.S. observations of the PeVatron candidate HESSJ1702-420, close to the source 2FHL J1703.4-4145, that have revealed the presence of gamma-rays up to 100 TeV at 5 sigma confidence level. This is the first time in H.E.S.S. history that photons with such high energy are clearly detected. Remarkably, the new deep observations allowed the discovery of a new gamma-ray source component, called HESS J1702-420A, that was previously hidden under the bulk emission traditionally associated with HESSJ1702-420. This new object has a power-law spectral slope < 2 and a gamma-ray spectrum that, extending with no sign of curvature up to 100 TeV, makes it an excellent candidate site for the presence of extremely high-energy cosmic rays. This discovery brings new information to the open debates on the nature of the unidentified source HESSJ1702-420, one of the most compelling PeVatron candidates in the gamma-ray sky, and on the origin of Galactic cosmic rays.

Primary author: GIUNTI, Luca

Presenter: GIUNTI, Luca

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: CR

Contribution ID: **349** Type: **Poster**

Population Studies of Fermi LAT sources

Wednesday, April 14, 2021 7:14 AM (7 minutes)

The Fermi Large Area Telescope (LAT) has been detecting hundreds of Galactic sources, most of which are pulsars. Many Galactic sources are still undetected or unresolved due to their low flux, below the Fermi LAT sensitivity, or because of foreground and source confusion. Moreover, among the many unassociated sources, which are one third of the detected sources, a large amount may have Galactic origin.
We present our method of source population synthesis studies for characterizing the general properties of Fermi LAT Galactic gamma-ray sources and for estimating the number of Galactic sources below the Fermi LAT flux sensitivity threshold.
Source density distribution and luminosity function of our Monte-Carlo simulation are constrained by the Galactic sources detected by Fermi LAT. Then, the number of unresolved sources and their contribution to the diffuse emission are estimated by our best model.

This is a long-term project on analyzing the point source catalog and performing theoretical studies of gamma-ray sources. Apart from being interesting on its own, characterizing the general properties of detected sources will also allow to estimate the contribution to the diffuse emission from undetected and unresolved sources. In turn this will help their detection, impacting also other studies of diffuse gamma rays including studies of the interstellar emission and dark matter. Finally, it will also help in the characterization of unassociated sources.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Catalogs

Contribution ID: **350** Type: **Poster**

Population Studies of Fermi LAT sources

Friday, April 16, 2021 6:34 PM (7 minutes)

The Fermi Large Area Telescope (LAT) has been detecting hundreds of Galactic sources, most of which are pulsars. Many Galactic sources are still undetected or unresolved due to their low flux, below the Fermi LAT sensitivity, or because of foreground and source confusion. Moreover, among the many unassociated sources, which are one third of the detected sources, a large amount may have Galactic origin.
We present our method of source population synthesis studies for characterizing the general properties of Fermi LAT Galactic gamma-ray sources and for estimating the number of Galactic sources below the Fermi LAT flux sensitivity threshold.
Source density distribution and luminosity function of our Monte-Carlo simulation are constrained by the Galactic sources detected by Fermi LAT. Then, the number of unresolved sources and their contribution to the diffuse emission are estimated by our best model.

This is a long-term project on analyzing the point source catalog and performing theoretical studies of gamma-ray sources. Apart from being interesting on its own, characterizing the general properties of detected sources will also allow to estimate the contribution to the diffuse emission from undetected and unresolved sources. In turn this will help their detection, impacting also other studies of diffuse gamma rays including studies of the interstellar emission and dark matter. Finally, it will also help in the characterization of unassociated sources.

Primary author: ORLANDO, Elena

Presenter: ORLANDO, Elena

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Catalogs

Contribution ID: **351** Type: **Poster**

Cross-match between the latest Swift/BAT and Fermi/LAT catalogs toward MeV all sky simulation

Wednesday, April 14, 2021 7:07 AM (7 minutes)

We report the results of cross-match between the hard X-ray and GeV gamma-ray catalogs, by making use of the latest 105-month Swift/BAT and 10-yr Fermi/LAT catalogs, respectively. We found 181 matched sources in total, which include 36 of false-match, unidentified, and ambiguous sources. The firmly matched sources consist of blazars (> 60%), pulsars and pulsar wind nebulae (~10%), radio galaxies (~ 7%), binaries (~ 5%), and others. Compared to the original catalogs, the matched sources are characterized by double-peaked photon index distributions, higher flux, and larger gamma-ray variability index. This difference arises from the different population of sources, particularly the large proportion of blazars (i.e., FSRQs and BL Lac types). We also report 13 cross-matched and unidentified sources. The matched sources in this study would be promising in the intermediate energy band between the hard X-ray and GeV gamma-ray observations, that is the unexplored MeV gamma-ray domain.

Primary author: TSUJI, Naomi

Presenter: TSUJI, Naomi

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Catalogs

Contribution ID: **352** Type: **Poster**

Cross-match between the latest Swift/BAT and Fermi/LAT catalogs toward MeV all sky simulation

Friday, April 16, 2021 6:27 PM (7 minutes)

We report the results of cross-match between the hard X-ray and GeV gamma-ray catalogs, by making use of the latest 105-month Swift/BAT and 10-yr Fermi/LAT catalogs, respectively. We found 181 matched sources in total, which include 36 of false-match, unidentified, and ambiguous sources. The firmly matched sources consist of blazars (> 60%), pulsars and pulsar wind nebulae (~10%), radio galaxies (~ 7%), binaries (~ 5%), and others. Compared to the original catalogs, the matched sources are characterized by double-peaked photon index distributions, higher flux, and larger gamma-ray variability index. This difference arises from the different population of sources, particularly the large proportion of blazars (i.e., FSRQs and BL Lac types). We also report 13 cross-matched and unidentified sources. The matched sources in this study would be promising in the intermediate energy band between the hard X-ray and GeV gamma-ray observations, that is the unexplored MeV gamma-ray domain.

Primary author: TSUJI, Naomi

Presenter: TSUJI, Naomi

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Catalogs

Contribution ID: **353** Type: **Poster**

On the uncertainties in the galactic gamma-ray diffuse emission from the determination of the diffusion coefficient

Galactic cosmic rays (CR) undergo diffusion by plasma-wave interactions, nuclear reactions with interstellar gas and other processes during their propagation. A good understanding of the diffusion process is crucial for the interpretation of gamma-ray emissions from electron losses (leptonic emissions) as well as hadronic emissions. Current measurements of CR fluxes have reached unprecedented accuracy thanks to the new generation experiments. Nevertheless, since the determination of the diffusion coefficient relies on the reproduction of secondary-to-primary flux ratios (typically B/C), the diffusion parameters strongly depend on the cross sections employed to compute the production of secondary cosmic rays, whose uncertainties range from 20 to 50% in the best-known reaction channels.
This work is aimed at analysing, via a Markov Chain Monte Carlo algorithm, the AMS-02 data to obtain posterior probabilities of the relevant diffusion parameters in the propagation of CRs in the Galaxy, using the DRAGON code for the evaluation of their propagation. We employ newly calculated spallation and inelastic cross sections from the FLUKA toolkit. Then, we compare two diffusion models: one with diffusion coefficient obtained from the B/C flux ratio and another one with a diffusion coefficient found from a combined analysis of the B, Be and Li, including a renormalization factor of the cross sections used. The leptons spectra are studied adding an extra component due to nearby unknown sources (likely pulsars) to explain their features at high energy. Finally, gamma-ray sky maps and local emissivity spectra are evaluated with these different models and their predictions are deeply discussed.

Primary author: DE LA TORRE LUQUE, Pedro

Presenter: DE LA TORRE LUQUE, Pedro

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Diffuse

Contribution ID: **354** Type: **Poster**

On the uncertainties in the galactic gamma-ray diffuse emission from the determination of the diffusion coefficient

Galactic cosmic rays (CR) undergo diffusion by plasma-wave interactions, nuclear reactions with interstellar gas and other processes during their propagation. A good understanding of the diffusion process is crucial for the interpretation of gamma-ray emissions from electron losses (leptonic emissions) as well as hadronic emissions. Current measurements of CR fluxes have reached unprecedented accuracy thanks to the new generation experiments. Nevertheless, since the determination of the diffusion coefficient relies on the reproduction of secondary-to-primary flux ratios (typically B/C), the diffusion parameters strongly depend on the cross sections employed to compute the production of secondary cosmic rays, whose uncertainties range from 20 to 50% in the best-known reaction channels.
This work is aimed at analysing, via a Markov Chain Monte Carlo algorithm, the AMS-02 data to obtain posterior probabilities of the relevant diffusion parameters in the propagation of CRs in the Galaxy, using the DRAGON code for the evaluation of their propagation. We employ newly calculated spallation and inelastic cross sections from the FLUKA toolkit. Then, we compare two diffusion models: one with diffusion coefficient obtained from the B/C flux ratio and another one with a diffusion coefficient found from a combined analysis of the B, Be and Li, including a renormalization factor of the cross sections used. The leptons spectra are studied adding an extra component due to nearby unknown sources (likely pulsars) to explain their features at high energy. Finally, gamma-ray sky maps and local emissivity spectra are evaluated with these different models and their predictions are deeply discussed.

Primary author: DE LA TORRE LUQUE, Pedro

Presenter: DE LA TORRE LUQUE, Pedro

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Diffuse

Contribution ID: **355** Type: **Poster**

Search for transient sources on monthly time scale.

Wednesday, April 14, 2021 7:00 AM (7 minutes)

Gamma-ray catalogs produced with data of the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope typically integrate years of exposure. Since Active Galactic Nuclei (AGNs) are characterized by strong and fast variability, their emission is diluted by long-time data integration. Transient sources can be more easily detected over short time scales. In order to search for these transient sources we have analyzed the first 10 years of data (as for the 4FGL - DR2 Catalog) collected by the LAT integrating over 1-month time intervals. The analysis was performed between 0.1 and 300 GeV using the Pass-8 event-level selection. In the analysis we considered only photons with $|b| > 10°$ to exclude the Galactic plane and therefore to avoid confusion with low latitude diffuse emission. We have also excluded all sources closer than 0.8 deg from any previous Fermi-LAT catalog source. We have analyzed 120 months and also performed a 15-day shift of each month in order to not lose any flare at the edges of each time bin. The list of those transient sources will be reported in the 1FLT catalog (the first Fermi-LAT transient source catalog).
Starting from this work, we have constructed a pipeline dedicated to the routine search of the transient sources on monthly time scale, complementary to the routine search on shorter time scales (day and week) done by the Fermi-LAT Flare Advocate activity and Fermi All-sky Variability Analysis (FAVA).

Primary author: MEREU, Isabella

Presenter: MEREU, Isabella

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Catalogs

Contribution ID: **356** Type: **Poster**

Search for transient sources on monthly time scale.

Friday, April 16, 2021 6:20 PM (7 minutes)

Gamma-ray catalogs produced with data of the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope typically integrate years of exposure. Since Active Galactic Nuclei (AGNs) are characterized by strong and fast variability, their emission is diluted by long-time data integration. Transient sources can be more easily detected over short time scales. In order to search for these transient sources we have analyzed the first 10 years of data (as for the 4FGL - DR2 Catalog) collected by the LAT integrating over 1-month time intervals. The analysis was performed between 0.1 and 300 GeV using the Pass-8 event-level selection. In the analysis we considered only photons with $|b| > 10°$ to exclude the Galactic plane and therefore to avoid confusion with low latitude diffuse emission. We have also excluded all sources closer than 0.8 deg from any previous Fermi-LAT catalog source. We have analyzed 120 months and also performed a 15-day shift of each month in order to not lose any flare at the edges of each time bin. The list of those transient sources will be reported in the 1FLT catalog (the first Fermi-LAT transient source catalog).
Starting from this work, we have constructed a pipeline dedicated to the routine search of the transient sources on monthly time scale, complementary to the routine search on shorter time scales (day and week) done by the Fermi-LAT Flare Advocate activity and Fermi All-sky Variability Analysis (FAVA).

Presenter: MEREU, Isabella

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Catalogs

Contribution ID: **357** Type: **Poster**

Did Dark Matter Kill the Dinosaurs?

Wednesday, April 14, 2021 7:56 AM (13 minutes)

Recent studies of the effects on the Earth's atmosphere by astrophysical sources, such as nearby gamma-ray bursts or supernovae, have shown that these events could lead to severe changes in atmospheric composition. Depletion of ozone, the most notable of these changes, is extremely dangerous to living organisms as any decrease in ozone levels leads to an increase in the irradiance of harmful solar radiation at the Earth's surface. In this work we consider dark matter as an astrophysical source of gamma rays, by the annihilation and decay of WIMPs found within dark compact halo objects known as UltraCompact MiniHalos
(UCMHs). We calculate the fluence of gamma rays produced in this way and simulate the resulting changes to terrestrial ozone levels using the Goddard Space Flight Center 2D Atmospheric Model. We also calculate the rate at which such events would occur, using estimates for the mass distribution of these halos within the Milky Way. We find that the ozone depletion from UCMHs can be significant, and even of similar magnitude to the levels which have been linked to the cause of the Late-Ordovician mass extinction event. However, the probability of such encounters over the Earth's entire history is relatively low. This suggests that, while dark compact objects like UCMHs could have had an impact on the Earth's biosphere, other astrophysical phenomena like gamma-ray bursts or supernovae seem a more likely source of these effects.

Primary author: SARKIS, Michael

Presenter: SARKIS, Michael

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Dark Matter

Contribution ID: **358** Type: **Poster**

Did Dark Matter Kill the Dinosaurs?

Friday, April 16, 2021 7:16 PM (13 minutes)

Recent studies of the effects on the Earth's atmosphere by astrophysical sources, such as nearby gamma-ray bursts or supernovae, have shown that these events could lead to severe changes in atmospheric composition. Depletion of ozone, the most notable of these changes, is extremely dangerous to living organisms as any decrease in ozone levels leads to an increase in the irradiance of harmful solar radiation at the Earth's surface. In this work we consider dark matter as an astrophysical source of gamma rays, by the annihilation and decay of WIMPs found within dark compact halo objects known as UltraCompact MiniHalos
(UCMHs). We calculate the fluence of gamma rays produced in this way and simulate the resulting changes to terrestrial ozone levels using the Goddard Space Flight Center 2D Atmospheric Model. We also calculate the rate at which such events would occur, using estimates for the mass distribution of these halos within the Milky Way. We find that the ozone depletion from UCMHs can be significant, and even of similar magnitude to the levels which have been linked to the cause of the Late-Ordovician mass extinction event. However, the probability of such encounters over the Earth's entire history is relatively low. This suggests that, while dark compact objects like UCMHs could have had an impact on the Earth's biosphere, other astrophysical phenomena like gamma-ray bursts or supernovae seem a more likely source of these effects.

Primary author: SARKIS, Michael

Presenter: SARKIS, Michael

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Dark Matter

Contribution ID: **359** Type: **Poster**

Classification and Ranking of Fermi LAT gamma-ray sources from the 4FGL Catalog using Machine Learning Techniques

Wednesday, April 14, 2021 7:49 AM (7 minutes)

The Fermi LAT Fourth Source Catalog (4FGL) contains over 5000 gamma-ray sources detected using 8 years of LAT data. Among these sources, over 3000 are associated with known blazars, 239 are associated with pulsars, and over 1300 are classified as 'unassociated' sources, meaning they have no known plausible counterpart at any other wavelength. Following on our previous work on the 3FGL Catalog (Saz Parkinson et al. 2016), we use the information from the known classes of gamma-ray sources to infer the nature of the unassociated sources from 4FGL using machine learning techniques. We will present the results of our predictions, as well as examples of the follow-up multiwavelength observations and pulsar searches on some the top candidates identified in our studies.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Dark Matter/CR/Catalogs-2

Track Classification: Catalogs

Contribution ID: **360** Type: **Poster**

Classification and Ranking of Fermi LAT gamma-ray sources from the 4FGL Catalog using Machine Learning Techniques

Friday, April 16, 2021 7:09 PM (7 minutes)

The Fermi LAT Fourth Source Catalog (4FGL) contains over 5000 gamma-ray sources detected using 8 years of LAT data. Among these sources, over 3000 are associated with known blazars, 239 are associated with pulsars, and over 1300 are classified as 'unassociated' sources, meaning they have no known plausible counterpart at any other wavelength. Following on our previous work on the 3FGL Catalog (Saz Parkinson et al. 2016), we use the information from the known classes of gamma-ray sources to infer the nature of the unassociated sources from 4FGL using machine learning techniques. We will present the results of our predictions, as well as examples of the follow-up multiwavelength observations and pulsar searches on some the top candidates identified in our studies.

Primary author: SAZ PARKINSON, Pablo (The University of Hong Kong)

Presenter: SAZ PARKINSON, Pablo (The University of Hong Kong)

Session Classification: Dark Matter/CR/Catalogs-3

Track Classification: Catalogs

Contribution ID: **361** Type: **not specified**

Remarks

Monday, April 12, 2021 3:10 PM (5 minutes)

Presenter: BOETTCHER, Markus (North-West University)

Session Classification: Opening session