GRAPPA @ 5: Celebrating 5 years of astroparticle physics and cosmology in Amsterdam

Report of Contributions

https://indico.cern.ch/e/GRAPPA5

Contribution ID: **1** Type: **not specified**

The Birth of the Dark Matter Problem

Monday, 16 October 2017 11:45 (15 minutes)

This contribution is a historical reflection on the rise of the dark matter hypothesis. Specifically, it focusses on understanding how the problem of dark matter came to matter in the early 1970s, decades after it had been famously introduced by Fritz Zwicky (1933). What were the conditions that brought about new conclusions on the existence of dark matter in this period? I will argue that the wide-spread belief in a closed Universe ($\Omega \geq 1$) played a significant role in this. The talk concludes in probing the origins of the a priori belief that the Universe should indeed be closed.

Author: Mr DE SWART, J. (University of Amsterdam)

Presenter: Mr DE SWART, J. (University of Amsterdam)

Session Classification: Contributed talks - Dark Matter

Contribution ID: **2** Type: **not specified**

Multimessenger studies of blazars

Wednesday, 18 October 2017 12:15 (15 minutes)

The IceCube Collaboration has published results on a neutrino flux significantly in excess of the atmospheric background. Due to low atmospheric background at PeV energies, the highest energy events are the most likely ones to be of extraterrestrial origin. We use broadband spectra in the IceCube integration period to calculate the maximum expected number of neutrinos assuming a pion photoproduction model. We show that blazars as a class are capable of explaining the first two observed neutrino events at PeV energies. For the third event at PeV energies we find a flaring blazar in positional and temporal agreement. The energy output of PKS B1424-418 alone can explain the neutrino event, indicative of a physical association. We further extend this study to >100 GeV and find that blazars contribute less at those energies.

Authors: Dr KRAUSS, Fe; Prof. KADLER, Matthias; Prof. MANNHEIM, Karl; Prof. WILMS, Joern

Presenter: Dr KRAUSS, Fe

Session Classification: Contributed talk - High-energy astrophysics

Contribution ID: **3** Type: **not specified**

The Future of Gamma-ray Observations of Galaxy Clusters

Tuesday, 17 October 2017 13:00 (15 minutes)

Clusters of galaxies should host a significant amount of relativistic cosmic-ray protons accelerated by structure formation shocks during their assembly history, and re-accelerated by turbulence in merging clusters. The quest for the pion-decay emission from hadronic interaction of these relativistic protons with the ambient gas has so far been inconclusive. Nevertheless, gamma-ray observations are a unique tool to study non-thermal phenomena in galaxy clusters. In this talk I will briefly discuss the main achievements so far and focus on expectations for the future, in particular prospects for the CTA Key Science Project on galaxy clusters.

Author: ZANDANEL, Fabio (University of Amsterdam)

Presenter: ZANDANEL, Fabio (University of Amsterdam)

Session Classification: Contributed talks - Cosmology & High-energy Astrophysics

Contribution ID: **5** Type: **not specified**

Astroparticle Physics the way ahead according to APPEC - Stavros Katsanevas

Monday, 16 October 2017 09:30 (45 minutes)

Presenter: KATSANEVAS, Stavros (CNRS/IN2P3)

Session Classification: Invited Talks

Contribution ID: **6** Type: **not specified**

Nergis Mavalvala

Monday, 16 October 2017 10:15 (45 minutes)

Presenter: Prof. MAVALVALA, Nergis (Massachusetts Institute of Technology)

Session Classification: Invited Talks

Contribution ID: **7** Type: **not specified**

Dark Matter - A showcase for GRAPPA - Lars Bergstrom

Monday, 16 October 2017 13:45 (45 minutes)

Presenter: BERGSTROM, Lars (Stockholm University)

Session Classification: Invited Talks

Contribution ID: **8** Type: **not specified**

Searching for Particle Dark Matter - Tim Tait

Monday, 16 October 2017 14:30 (45 minutes)

Presenter: TAIT, Tim M.P. (University of California, Irvine)

Session Classification: Invited Talks

Contribution ID: **9** Type: **not specified**

Dark Matter Direct Detection: News from the Low Background Frontier - Jocelyn Monroe

Monday, 16 October 2017 15:15 (45 minutes)

Presenter: MONROE, Jocelyn (RHUL)

Session Classification: Invited Talks

Contribution ID: **10** Type: **not specified**

Universal Axions - Matthew Kleban

Tuesday, 17 October 2017 10:00 (45 minutes)

Presenter: KLEBAN, Matthew (New York University)

Session Classification: Invited Talks

Contribution ID: **11** Type: **not specified**

Towards Fundamental Physics from Cosmological Surveys - Hiranya Peiris

Tuesday, 17 October 2017 10:45 (45 minutes)

Presenter: PEIRIS, Hiranya

Session Classification: Invited Talks

Contribution ID: **12** Type: **not specified**

Temporal evolution of high energy radiation in type IIn Supernovae

Wednesday, 18 October 2017 12:45 (15 minutes)

The dominant models that can describe the non - thermal radiation by high energy astrophysical objects, can be divided into two categories, i.e. the leptonic and the hadronic ones. The former one suggests that the high energy radiation is produced by physical processes associated with a population of highly relativistic electrons. On the other hand, the hadronic model assumes that the observed gamma ray emission originates from a population of relativistic protons. The physical process which is responsible for the emission in this case could be the non elastic proton - proton collisions. In this physical process, relativistic protons interact with thermal ones and as a consequence, secondary particles such as charged and neutral pions ($\pi^{\pm}$, π^{0}), muons ($\mu^{\pm}$), neutrinos ($\nu_{e,\mu}$) and photons are produced. In this talk, we present the results of the radiation from proton-proton collisions as applied to type IIn Supernovae. This type of Supernova has different properties than the usual types due to the presence of a very dense upstream medium, of the order of $10^{7} - 10^{12}\ cm^{-3}$, which has been formed by the progenitor's mass loss. Consequently, if protons do manage to accelerate at the shock wave, then it is much more possible for proton - proton collisions to occur at such type of sources. In the meantime, the aforementioned thick upstream medium seems to play a significant role in the temporal evolution of the non - thermal radiation emitted by these sources. We will present some preliminary results and discuss their relevance to potential observations.

Author: Mr KANTZAS, Dimitrios (University of Amsterdam)

Co-authors: Dr PETROPOULOU, Maria (Purdue University); Prof. MASTICHIADIS , Apostolos (National and Kapodistrian University of Athens)

Presenter: Mr KANTZAS, Dimitrios (University of Amsterdam)

Session Classification: Contributed talk - High-energy astrophysics

Contribution ID: **13** Type: **not specified**

The Dark Matter distribution of the Milky Way: its uncertainties and their effects on the determination of new physics

Monday, 16 October 2017 11:30 (15 minutes)

I will illustrate the current status of the determination of the Dark Matter content and distribution within our own Galaxy -the Milky Way- achieved by making use of improved methods and enhanced databases.
After this, I will show how the current uncertainties arising from such state-of-the-art astrophysical methods and observations affect the determination of Dark Matter properties, offering a first quantitative estimate of such effects in specific extensions of the Standard Model.
This is aimed at addressing the impact of astrophysical uncertainties on the determination of new physics -in the very parameter space of actual particle physics model- thus quantifying in specific cases the unavoidable intertwinement between astro and particle physics, one more step along synergic development.

Authors: Dr BOZORGNIA, Nassim; Mrs BENITO, Maria; Dr CALORE, Francesca; Dr BERNAL, Nicolas; IOCCO, Fabio (ICTP-SAIFR)

Presenter: IOCCO, Fabio (ICTP-SAIFR)

Session Classification: Contributed talks - Dark Matter

Contribution ID: **14** Type: **not specified**

Molecular hydrogen as probe for new physics

Wednesday, 18 October 2017 13:00 (15 minutes)

Molecular hydrogen has been identified as a search ground for physics beyond the Standard Model. This is complementary to searches motivated by high-energy and astroparticle physics, as we search for subtle effects at the low-energy scale in the spectra of simple molecules. The quantum level structure of the hydrogen molecule can now be calculated to very high precision. These theoretical results are confronted with highly accurate measurements using advanced laser-based techniques, and the comparison used as probe for new effects. The Angstrom internuclear distances in the hydrogen molecule lead to an enhanced sensitivity for possible fifth forces at the Angstrom length scale [1]. Such interactions could also be associated with new particles in the keV mass range, which may be potential dark matter candidates. The comparison could also be interpreted as a search for extra spatial dimensions, since if the compactification volume of the latter is comparable to the molecular size the resulting enhancements in gravitational effects may lead to measurable energy shifts [2].

[1] E.J. Salumbides, J.C.J. Koelemeij, J. Komasa, K. Pachucki, K.S.E. Eikema, W. Ubachs, Phys. Rev. D 87, 112008 (2013).
[2] E.J. Salumbides, A.N. Schellekens, B. Gato-Rivera, W. Ubachs, New. J. Phys. 17, 033015 (2015).

Author: Dr EDCEL, Salumbides (Vrije Universiteit Amsterdam)

Presenter: Dr EDCEL, Salumbides (Vrije Universiteit Amsterdam)

Session Classification: Contributed talk - High-energy astrophysics

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

The 3.5 keV Line: Current Status and Future Prospects - Esra Bulbul

Tuesday, 17 October 2017 14:45 (45 minutes)

Presenter: BULBUL, Esra

Session Classification: Invited Talks

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

Open questions in particle acceleration theory - Luke Drury

Tuesday, 17 October 2017 15:30 (45 minutes)

Presenter: DRURY, Luke (DIAS)

Session Classification: Invited Talks

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

The Gamma-ray view of the Universe - Stefan Funk

Tuesday, 17 October 2017 16:15 (45 minutes)

Presenter: Prof. FUNK, Stefan (ECAP, Universität Erlangen)

Session Classification: Invited Talks

Contribution ID: **19** Type: **not specified**

Neutrino Astronomy: The Low-Energy Frontier - John Beacom

Wednesday, 18 October 2017 10:00 (45 minutes)

Presenter: Prof. BEACOM, John (Ohio State University)

Session Classification: Invited Talks

Contribution ID: **20** Type: **not specified**

IceCube: Building a New Window on the Universe from Antarctica - Francis Halzen

Wednesday, 18 October 2017 10:45 (45 minutes)

Presenter: HALZEN, Francis (University of Wisconsin)

Session Classification: Invited Talks

Contribution ID: **21** Type: **not specified**

Cosmic ray positrons: constraints on propagation parameters and dark matter searches in view of AMS-02 data

Wednesday, 18 October 2017 12:30 (15 minutes)

Two years ago, the AMS collaboration released the most precise measurement of the cosmic ray positron flux. It confirms that pure secondary predictions fall below the data above 10 GeV, suggesting the presence of a primary component, e.g. annihilations of WIMPs dark matter. Most analyses have focused on the high-energy part of the spectrum, disregarding the GeV energy region where cosmic ray transport is harder to model and solar modulation comes into play. Given the high quality of AMS measurements, we re-examine the positron anomaly over the entire energy range, taking into account transport processes so far neglected, e.g. convection or diffusive re-acceleration. We devise a new semi-analytical method to take into account transport processes so far neglected, but important below a few GeV. It is based on the pinching of inverse Compton and synchrotron energy losses inside the Galactic disc. It allows to carry out extensive scans over the cosmic ray propagation parameters, which we strongly constrain by requiring that the secondary component does not overshoot the AMS measurements. Only models with large diffusion coefficients survive this test. The positron flux is a powerful and independent probe of cosmic ray propagation, complementary to the boron-to-carbon ratio. We then scan over WIMP mass to fit the annihilation cross section and branching ratios, exploring both direct annihilations into standard model particles or through light mediators. In the former case, the best fit yields a p-value of 0.4% for a mass of 264 GeV, a value that does not allow to reproduce the highest energy data points. Worse quality fits are found in the latter case. The interpretation of the positron excess in terms of single DM species annihilations is strongly disfavored. This conclusion is based solely on the positron data, and no other observation needs to be invoked.

Authors: Prof. VECCHI, Manuela (São Institute of Physics); Prof. SALATI, Pierre (LAPTh); Dr BOUDAUD, Mathieu (Laboratoire de Physique Théorique et Hautes Énergies (LPTHE)); Dr CAROFF, Sami (LLR); Dr POIREAU, Vincent (LAPP/CNRS); Dr GENOLINI, Yoann (LAPTh); Dr POULIN, Vivian (LAPTh); Dr ROSIER-LEES, Sylvie (LAPP)

Presenter: Prof. VECCHI, Manuela (São Institute of Physics)

Session Classification: Contributed talk - High-energy astrophysics

Contribution ID: **22** Type: **not specified**

Probing Light Relics with CMB and BAO

Tuesday, 17 October 2017 12:00 (15 minutes)

Future cosmic microwave background (CMB) and large-scale structure (LSS) observations will provide us with percent-level measurements of the radiation content of the universe. I will show this by discussing current observational constraints and, in particular, providing forecasts of the capabilities of future CMB and LSS experiments such as CMB-S4 and DESI. In addition, I will provide analytical insights to the constraining power of these measurements, especially related to the phase shift in baryon acoustic oscillations (BAO). This then sets the stage for the discussion of constraints on the coupling of light thermal relics, in particular scalar particles such as axions, to the Standard Model. I will present future bounds on these weak couplings which have the potential to improve on current constraints by several orders of magnitude with measurements of future cosmological surveys alone.

Authors: WALLISCH, Benjamin (DAMTP, University of Cambridge); BAUMANN, Daniel; GREEN, Daniel; MEYERS, Joel (University of Toronto)

Presenter: WALLISCH, Benjamin (DAMTP, University of Cambridge)

Session Classification: Contributed talks - Cosmology & High-energy Astrophysics

Contribution ID: **23** Type: **not specified**

Nu Interactions From the Heavens: Measurement of Neutrino Cross Sections Above 10 TeV

Wednesday, 18 October 2017 12:00 (15 minutes)

Neutrino interactions, though feeble, are tremendously important in particle physics and astrophysics. Yet, at neutrino energies above 350 GeV there has been, up to now, no direct experimental information on neutrino interactions, only predictions. Now, we can measure the neutrino-nucleon cross section above 10 TeV, thanks to the recent discovery of high-energy astrophysical neutrinos by IceCube. The distribution of arrival directions of these neutrinos carries information about their interactions with matter inside the Earth, which we extract. We will show new cross section measurements extracted from the 6-year sample of IceCube High Energy Starting Event showers between 18 TeV and 2 PeV. The measurements agree with standard predictions and show no sign of new physics at these energies.

Author: BUSTAMANTE, Mauricio (Niels Bohr Institute)

Presenter: BUSTAMANTE, Mauricio (Niels Bohr Institute)

Session Classification: Contributed talk - High-energy astrophysics

Contribution ID: **24** Type: **not specified**

Dark Information: Forecasting with the Fisher Matrix

Tuesday, 17 October 2017 12:30 (15 minutes)

Indirect dark matter (DM) searches are one of the fundamental techniques used to probe the particle nature of DM. Given the increasing interest in the community in non-WIMP scenarios, it is vital to systematically reconsider optimal strategies for observation campaigns of current and future telescopes that cover a large range of DM models and signals. In this endeavour, it is important to correctly account for both statistical and systematic uncertainties, both related to signal and background modelling. To this end, we developed a novel and surprisingly powerful technique, which we dubbed 'information flux'. It builds on the Fisher Information matrix formalism, that is well known in cosmology. It generalises signal-to-noise maps to account for systematic effects, while leading to quantitatively accurate predictions for instrumental sensitivities. Using this formalism, we show how, for some DM models, it is quickly possible to identify the most efficient search strategy for a large range experiments, from direct detection to astronomical signals to collider searches.

Authors: EDWARDS, Thomas (University of Amsterdam); WENIGER, Christoph (University of Amsterdam)

Presenter: EDWARDS, Thomas (University of Amsterdam)

Session Classification: Contributed talks - Cosmology & High-energy Astrophysics

Contribution ID: **25** Type: **not specified**

Gaia and the Local Dark Matter Density

Monday, 16 October 2017 12:00 (15 minutes)

The local dark matter density is required to interpret results from direct detection experiments, whether they are searching for WIMPs, sterile neutrinos, or axions. Here I give an update to our ongoing project to determine the local DM density using stellar motions and our advanced Jeans equation based analysis. This includes our recent measurement using SDSS-SEGUE G-dwarfs, and a look ahead to the challenges and opportunities of Gaia Data Release 2 in April 2018. Already in our SDSS-SEGUE analysis we see statistical errors becoming comparable to systematic errors caused by, for instance, the assumption of dynamical equilibrium. With the advent of DR2 we will be able to relax these assumptions, and derive a much more robust determination of the local dark matter density.

Author: Dr SILVERWOOD, Hamish (Institut de Ciències del Cosmos, Universitat de Barcelona)

Presenter: Dr SILVERWOOD, Hamish (Institut de Ciències del Cosmos, Universitat de Barcelona)

Session Classification: Contributed talks - Dark Matter

Contribution ID: **26** Type: **not specified**

The Galactic Center Excess with Skyfact

Monday, 16 October 2017 12:15 (15 minutes)

An anomalous excess at energies of a few GeV is seen in the Fermi-LAT data.
Being well fit by an NFW profile and centered on the Galactic Center, this so-called Galactic Center Excess (GCE) has generated a lot of excitement over the past years due to its consistency with a dark matter origin. However, there exist viable astrophysical explanations, most notably unresolved millisecond pulsars. We present a new analysis of the GCE using the recently developed tool SkyFACT, reanalysing the morphology of the GCE.
It is found that a template tracing the stellar distribution in the bulge gives an
equally good, if not better, fit to the data compared to an NFW template.
This result supports recent claims in favour of an astrophysical origin of the GCE.

Authors: BARTELS, Richard (University of Amsterdam); CALORE, Francesca (LAPTh, CNRS); STORM, Emma (GRAPPA, University of Amsterdam); WENIGER, Christoph (University of Amsterdam)

Presenter: BARTELS, Richard (University of Amsterdam)

Session Classification: Contributed talks - Dark Matter

Contribution ID: **27** Type: **not specified**

Better models of the gamma-ray sky with SkyFACT

Tuesday, 17 October 2017 12:45 (15 minutes)

Template fitting of the gamma-ray sky has been quite successful in both understanding existing sources of emission and discovering new sources, such as the Fermi Bubbles and the GeV excess towards the center of the Milky Way. However, existing models still yield formally poor fits to the data with significant remaining residuals, which makes quantitative comparisons between different models difficult. We therefore introduce a new tool to fit gamma-ray data called SkyFACT, or Sky Factorization with Adaptive Constrained Templates. Rather than starting from fixed predictions from cosmic-ray propagation codes and examining the residuals to understand the quality of fits and the presence of excesses, we introduce additional fine-grained variations in the templates that account for uncertainties in gas tracers and the small scale variations in the density of cosmic rays. This yields high-dimensional models with approximately 100,000 parameters. We combine techniques from image reconstruction and adaptive template fitting, and use a penalized Poisson likelihood with maximum entropy regularization, along with the BFGS fitting algorithm, to efficiently handle this large number of parameters. We present results of fits to the inner Galaxy, and highlight the potential of this tool to study puzzling aspects of the gamma-ray sky, such as the nature of the GeV excess.

Author: STORM, Emma (GRAPPA, University of Amsterdam)

Presenter: STORM, Emma (GRAPPA, University of Amsterdam)

Session Classification: Contributed talks - Cosmology & High-energy Astrophysics

Contribution ID: **28** Type: **not specified**

How to distinguish warm intergalactic medium from warm dark matter?

Monday, 16 October 2017 12:30 (15 minutes)

We reconsider the problem of determining the warmness of dark matter from the growth of large scale structures. In particular, we have re-analyzed the previous work of Viel et al 2013, based on high resolution Lyman-alpha forest spectra. In fact, the flux power spectrum exhibits a cut-off below ˜ 1.5 Mpc/h, this may be explained by the temperature of the intergalactic medium (IGM) or be due to the free-streaming of dark matter particles. We show that if the IGM temperature at high redshifts was low enough (rising at later times) then the data indeed prefer warm dark matter. Assuming this broader range of thermal histories, we find that mWDM >= 2.1 keV for thermal relic at 95% CL (mNRP >= 12 keV for non-resonantly produced sterile neutrino). We discuss an independent method that would allow to exclude the influence of WDM on observable small-scale structures, or would lead to the discovery of WDM. We also determine values of lepton asymmetry making resonantly produced 7 keV sterile neutrinos consistent with the data.

Authors: GARZILLI, Antonella; BOIARSKYI, Alexey (Leiden University (NL)); RUCHAYSKIY, Oleg (EPFL)

Presenter: GARZILLI, Antonella

Session Classification: Contributed talks - Dark Matter

Contribution ID: **29** Type: **not specified**

Searching for primordial black holes

Tuesday, 17 October 2017 12:15 (15 minutes)

The idea that primordial black holes (PBHs) of O(10) solar mass can account for all the dark matter has been recently reconsidered after the discovery of a gravitational wave signal.
We present a robust bound on this scenario based on a novel approach: We model in a conservative way the accretion of gas and the subsequent radio and X-ray emission originating by a population of PBHs in our Galaxy, exploiting well established empirical relations confirmed by current astronomical observations. We find a more reliable bound compared to the ones based on CMB spectrum and anisotropies, competitive with the dynamical ones.
We discuss in detail future developments of our study, aimed at searching either a subdominant population of PBHs that contribute to a fraction of the DM, or a population of astrophysical black holes, and the role of the forthcoming radio facilities data in this context.

Author: GAGGERO, Daniele

Presenter: GAGGERO, Daniele

Session Classification: Contributed talks - Cosmology & High-energy Astrophysics

Contribution ID: **30** Type: **not specified**

ANTARES highlights and KM3NET prospects

Wednesday, 18 October 2017 13:15 (15 minutes)

ANTARES, the deep-underwater Cherenkov neutrino telescope in the Northern hemisphere, has been taking data continuously since 2007. Its primary goal is the search for astrophysical neutrinos in the TeV-PeV range. After the discovery of a cosmic neutrino diffuse flux by the IceCube telescope, ANTARES has searched for neutrino sources in the Southern Sky at TeV energies and set constraints on the origin of the discovered cosmic neutrino flux. Thanks to its excellent angular resolution, ANTARES has performed dedicated searches for promising neutrino source candidates and several interesting regions like the Galactic Plane or the Fermi Bubbles have been explored, using for the first time its sample of cascade events with a median angular resolution of about 3 degrees.

ANTARES has also provided results on the searches for dark matter, the limits obtained for the spin-dependent WIMP-nucleon cross section surpassing those of current direct detection experiments.
The results on the indirect search for Dark Matter with the ANTARES detector, looking for neutrinos from the center of Galaxy, from the Sun and from the center of the Earth will be presented and discussed.
ANTARES is actively developing a manifold multi-messenger program: latest experimental results from searches of neutrinos from Gamma Ray Burst sources or neutrinos correlated with the recently discovered gravitational wave signals will be reported. So far no significant correlation with external observations has been detected.The high quality of the data provided by ANTARES and the competitiveness of the results achieved, despite the modest size of the detector if compared to IceCube, demonstrate the tremendous potential of the new, much larger array, KM3NeT. The status and the perspectives of the KM3NeT project will be reported.

Author: Prof. CAPONE, Antonio

Presenter: Prof. CAPONE, Antonio

Session Classification: Contributed talk - High-energy astrophysics