Digitala Astronomdagarna 2021

Report of Contributions

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Contribution ID: **2** Type: **Talk**

Probing neutron star magnetic fields using X-ray polarimetry

Friday 22 October 2021 11:25 (10 minutes)

X-ray polarisation is set to open a new window into highly energetic astronomical sources like neutron stars and black holes. The upcoming launches of IXPE (a satellite-based soft X-ray polarimeter) in late 2021 and XL-Calibur (a balloon-borne hard X-ray polarimeter) in 2022 will soon provide sensitive X-ray polarisation measurements. These measurements can be used to study the strong magnetic field around neutron stars. The polarisation of X-ray photons emitted from a neutron star is strongly influenced by plasma and possible vacuum birefringence effects. Both anisotropies are induced as a result of the large magnetic-field strength and depend on the relative direction of the polarisation vector and the local magnetic field. Consequently, a measurement of X-ray polarisation will provide strong constraints on the magnetic-field configuration around the star. In addition, polarisation can also give the long sought-after experimental confirmation for the presence of vacuum birefringence. This phenomenon is a long-standing prediction of quantum electrodynamics and results from vacuum fluctuations in external magnetic fields. In this presentation, I will highlight how X-ray polarimetry can be used to study neutron-star magnetic fields using the unique capabilities of XL-Calibur, during its balloon flight from Esrange, Sweden, in summer 2022

Primary author: IYER, Nirmal Kumar (KTH)

Presenter: IYER, Nirmal Kumar (KTH)

Session Classification: Stars

Contribution ID: **3** Type: **Talk**

Clues to galaxy evolution from chemical abundances of stars in the Galactic centre

Friday 22 October 2021 10:55 (10 minutes)

We present a detailed study of the composition of 20 M giants in the Galactic center with 15 of them confirmed to be in the nuclear star cluster. As a control sample we have also observed 7 M giants in the Milky Way disk with similar stellar parameters. All 27 stars are observed using the NIRSPEC spectrograph on the KECK II telescope in the K-band at a resolving power of R=23,000. We report the first silicon abundance trends versus [Fe/H] for stars in the Galactic center. While finding a disk/bulge like trend at subsolar metallicities, we find that [Si/Fe] is enhanced at supersolar metallicities. We speculate on possible enrichment scenarios to explain such a trend. Further, we present new results on high resolution spectroscopy performed on stars in the nuclear star clusters that have earlier been identified as young stars with ages below a few hundred million years.

Primary author: THORSBRO, Brian (Lund University)

Presenter: THORSBRO, Brian (Lund University)

Session Classification: Stars

Contribution ID: **4** Type: **Talk**

The dance of celestial bodies: Embodied astronomy learning

Thursday 21 October 2021 16:20 (10 minutes)

Explaining the dynamics of a binary star system can be a tricky task, especially for students that may not be confident in using the disciplinary discourse of physics and astronomy. In this talk, we examine video data of a pair of physics students, showing how they successfully reason about binary star motion without the terminology of Newtonian mechanics, but rather by recruiting their bodily intuition in an informal partnered dance. Our analysis of this case study reveals how, when given the space to do so, science students such as these can (an do) spontaneously coordinate a variety of non-disciplinary communicational resources (e.g., talk, gesture, body position, haptic-touch) to enact analogies that can be powerful for the learning of physics and astronomy.

Primary author: EULER, Elias (Lund University)

Co-authors: Mr RÅDAHL, Elmer (Dragonskolan); Dr GREGORCIC, Bor (Uppsala University)

Presenter: EULER, Elias (Lund University)

Session Classification: Astronomical Culture

Contribution ID: **5** Type: **Talk**

Magnetic fields of binary stars

Friday 22 October 2021 11:35 (10 minutes)

Investigation of the magnetic fields on stars is important because they affect many different properties of stars at multiple stages of their evolution. The magnetic field is also a key component in the interaction between the star and its surroundings, possibly affecting habitability. The study of binaries offers a unique opportunity due to the fact that the formation of the components are simultaneous and from the same protostellar cloud. This makes it possible to study the effects of magnetic fields while also reducing the effect other stellar parameters have on the result.

Magnetic fields on stars are studied over multiple spatial scales, giving insight into different properties of the magnetic field on the star. Investigations of the different spatial scales are performed with separate methods that utilize different ways the magnetic field affects stellar spectra. Zeeman Doppler Imaging (ZDI) can be used to investigate larger scales with spectropolarimetric observations. This provides a tomographic map of the surface magnetic field. To probe smaller scales, Zeeman broadening (or intensification) uses changes in shape and equivalent width of magnetically sensitive spectral lines to find the global average small-scale fields.

Here results of recent magnetic field studies on binaries are presented. These results include both investigations of small- and large-scale magnetic fields in order to build more complete pictures of stellar magnetic fields.

Primary author: HAHLIN, Axel (Uppsala University)

Presenter: HAHLIN, Axel (Uppsala University)

Session Classification: Stars

Contribution ID: **6** Type: **Talk**

The LMS-1 stream: A fossil remnant of the early formation of the Milky Way

Thursday 21 October 2021 13:10 (10 minutes)

As per the ΛCDM cosmological model, the halo of the Milky Way was built up by the merging of numerous progenitor galaxies, as these dwarf galaxies brought in their own stellar populations (in the form of stars and globular clusters). Over time, the dwarf galaxies were tidally stripped by the Galactic potential, eventually leading to the formation of "stellar streams". Therefore, stellar streams provide direct evidence of the hierarchical formation of our Galaxy.

Surprisingly, most of the known dwarf galaxy streams are dynamically-young systems that were only recently merged into our Galaxy (<˜3-6 Gyr ago). However, the hierarchical paradigm of galaxy formation suggests that several dwarf galaxies must have merged into the Milky Way at earlier times (>˜8–10 Gyr ago). These dynamically-old streams are likely to be discovered in the inner <˜10-20 kpc regions of the Galaxy, and they hold the key to unravel the early formation history of the Galactic Halo.

I will talk about the "LMS-1"stellar stream, that we detect by searching for wide streams in the ESA/Gaia EDR3 dataset using my STREAMFINDER algorithm. We detect LMS-1 as a 60° long stream to the north of the Galactic bulge, at a distance of ˜15 kpc from the Galactic center, together with additional components that suggest that the overall stream is completely wrapped around the inner Galaxy. Using spectroscopic measurements from LAMOST, SDSS and APOGEE, we infer that the stream is very metal poor (⟨[Fe/H]⟩=−2.1) with a significant metallicity dispersion (σ [Fe/H]=0.4), and it possesses a large radial velocity dispersion (σ_v = 20 ± 4 kms−1). These estimates together imply that LMS-1 is a dwarf galaxy stream. Both the orbit and metallicity of LMS-1 are remarkably similar to the globular clusters NGC˜5053, NGC˜5024 and another stellar stream "Indus". Even Pal˜5 cluster overlaps with LMS-1 in the dynamical energy-action (E,J) space. These findings make LMS-1 an important contributor to the stellar population of the inner Milky Way halo.

Primary author: Dr MALHAN, Khyati (Postdoc at Stockholm University)

Presenter: Dr MALHAN, Khyati (Postdoc at Stockholm University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **7** Type: **Poster**

Ådalen - a new Swedish meteorite fall

Thursday 21 October 2021 16:10 (10 minutes)

For the first time in over 60 years a meteorite was recovered in Sweden after an observed fall. The fall area was identified through a collaboration between the meteor camera networks in Norway, Finland, Denmark and Sweden. After a few weeks of searches, a 14-kg iron meteorite was found close to the small town of Ådalen (near Enköping). This meteorite is the first iron ever to be recovered from a known pre-atmospheric orbit. Because there are no earlier recoveries after iron falls, Ådalen will provide important feedback on the details of dark-flight simulations for iron meteoroids.

Primary author: STEMPELS, Eric (Uppsala University)

Presenter: STEMPELS, Eric (Uppsala University)

Session Classification: Planetary Systems

Contribution ID: **8** Type: **Talk**

Impact of the Mean Free Path on the Large Scale 21-cm Power Spectrum from Reionization

Thursday 21 October 2021 13:20 (10 minutes)

During the cosmic dark ages, the Universe primarily consisted of neutral hydrogen (HI), which emits radiation via the 21-cm hyperfine transition. Radio interferometers, such as the Low-Frequency Array (LOFAR) and the future Square Kilometre Array (SKA), are attempting to measure its spherically averaged 21-cm power spectrum from the Epoch Of Reionization (EoR). The statistic is not only a valuable source of information on the nature of the first sources of light, and their impact on the intergalactic medium (IGM), but also of the underlying cosmological density field itself. We base our study on the analysis of numerical simulations and focus on the largest detectable scales. In this talk, I will discuss how the decomposition of the 21-cm power spectrum into its constituting parts can help us understand its evolution and aid in extracting information about the impact of the sources and the density field. I address the significance of the value of the mean free path (MFP) for ionizing photons on the shape of the 21-cm power spectrum. Our findings indicate that the MFP constraint determines the scale that separates the astrophysical and cosmological parts of the power spectrum. A recent measurement of the mean free path from Becker et al. (2021) estimates a value of λ_{mfp}= 3.57/h cMpc at z = 6 from Quasi-Stellar Object (QSO) spectra. Through our analysis, we conclude that detection of the 21-cm signal with SKA on scales k < 0.38 Mpc-1 could be utilised as a potential cosmological probe.

Primary author: GEORGIEV, Ivelin (Stockholm University)

Co-author: Prof. MELLEMA, Garrelt (Department of Astronomy at Stockholm University, Oskar Klein Centre)

Presenter: GEORGIEV, Ivelin (Stockholm University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **9** Type: **Talk**

The '"Shocking" Interaction between Supernova Remnants and Molecular Clouds

Friday 22 October 2021 09:55 (10 minutes)

Despite the importance of massive stars and star clusters for the energy content, stellar population and evolution of galaxies, the mechanism that ignites their formation in molecular clouds is still poorly addressed. Infrared Dark Clouds (IRDCs) are a class of very massive and dense objects, likely to be the precursors of massive stars. Recent simulations have shown that interstellar shocks driven by HII regions and Supernova Remnants (SNRs), can efficiently form and compress IRDCs, initiating star formation within these clouds. It is thus important to understand the conditions of density and temperature set by large-scale shocks in IRDCs to constrain the ignition of star formation in these objects. In this talk, I will present the large scale shock triggered by the SNR W44 in the IRDC G034. I will show how the shock, probed by Silicon Monoxide (SiO) and observed with ALMA, enhances the density of the processed gas to values compatible with those required for massive star formation and has helped to shape the cloud. Thanks to the high resolution achieved by ALMA, the internal physical structure of the shock was resolved for the first time, providing a direct test to Magneto-Hydro-Dynamic (MHD) shock theories. Moved by these results, we have initiated the large single-dish observing program SHREC, aimed to observe SiO(2-1) emission in SNRs interacting with molecular clouds. During the talk, I will briefly introduce the aim and technical aspects of SHREC and present preliminary results obtained toward the SNRs IC443 and W41.

Primary author: COSENTINO, Giuliana (Chalmers University of Technology)

Presenter: COSENTINO, Giuliana (Chalmers University of Technology)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **10** Type: **Talk**

Hunting for Fast Radio Bursts at Onsala Space Observatory

Thursday 21 October 2021 13:30 (10 minutes)

Fast radio bursts (FRBs) are extremely luminous, millisecond duration bursts of extragalactic origin. At this point, we have only seen them at radio frequencies, i.e. between 120 MHz and 8 GHz. Despite more than 600 known bursts we still do not know the source of the emission or the physical emission mechanism. Keys to understanding FRBs are the type of host galaxies they are generated in and their individual temporal spectro-polarimetic properties.
In this talk I will discuss the various activities undertaken at Onsala Space Observatory (OSO) that aim at solving the FRB-puzzle. Besides localisation efforts involving regular ad-hoc interferometric observations with the 25m telescope at OSO, we also run single dish high-cadence, long term monitoring campaigns on the few FRBs that have been seen to burst repeatedly. Our efforts have lead to three new localisations and the detection of some of the brightest FRBs ever detected.

Primary author: KIRSTEN, Franz

Presenter: KIRSTEN, Franz

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **11** Type: **Talk**

The VASCO project: the 2021 update

Thursday 21 October 2021 16:30 (10 minutes)

The "Vanishing & Appearing Sources during a Century of Observations"(VASCO) project uses existing survey data to search for exceptional/unknown astrophysical transients (see Villarroel et al. 2020) that might occur during a 70 years of time baseline, in particular vanishing objects. The broad set of astrophysical goals range from searching for natural astrophysical objects e.g. Active Galactic Nuclei with a long-term variability, to searches for signatures of extra-terrestrial intelligence. I introduce the VASCO project to the community. I show the methodology, the new automatised VASCO target selection ran by the Spanish Virtual Observatory and the latest results herein. I update on the citizen science project that is led by institutes and amateur astronomy associations in Algeria, Nigeria and Cameroon and the findings. Finally, I demonstrate some very curious results arising from the VASCO project.

Primary author: Dr VILLARROEL, Beatriz (Nordita)

Presenter: Dr VILLARROEL, Beatriz (Nordita)

Session Classification: Astronomical Culture

Contribution ID: **12** Type: **Talk**

The discovery odyssey of TOI-1260 –a new TESS system of hot mini-Neptunes

Thursday 21 October 2021 15:40 (10 minutes)

Statistical studies of exoplanet populations have shown that planets in the 2-3 $R_\oplus$ size range, the so-called mini-Neptunes, are one of the most common types of planets.
In this talk I will highlight some of the challenges associated with the detection and characterisation of such planets in transit and radial velocity timeseries as illustrated by the case of the TOI-1260 system. TOI-1260 is a K6V star hosting two mini-Neptunes in tight orbits, and a likely outer planet of a similar size. The star is moderately active with a complex activity pattern, which necessitated the use of the relatively novel method of Gaussian process regression guided by suitable activity indicators to disentangle the stellar-induced signal from the planetary signals. The TOI-1260 planets are thus revealed to have bulk densities which do not allow for the planets'compositions to be uniquely determined, making these mini-Neptunes classic examples of the structure and composition degeneracy typical for the 2-3 R$R_\oplus$ range.

Primary author: GEORGIEVA, Iskra (Chalmers University of Technology)

Presenter: GEORGIEVA, Iskra (Chalmers University of Technology)

Session Classification: Planetary Systems

Contribution ID: **13** Type: **Talk**

Let there be light: Illuminating neutron star mergers with radiative transfer simulations

Friday 22 October 2021 09:05 (10 minutes)

The detection of an electromagnetic counterpart to the gravitational-wave source GW170817 marked year zero of the multi-messenger gravitational-wave era. This event was generated by the merger of two neutron stars and gave rise to an electromagnetic transient, dubbed a "kilonova", which was intensively monitored with all the main ground-based and space-borne facilities. In this talk, I will show how radiative transfer simulations can illuminate neutron star mergers and provide a natural connection between models and observational data. I will highlight how kilonova synthetic observables - as light curves, spectra and polarization - can be used to interpret data, place constraints on models and guide future follow-up campaigns of gravitational-wave events.

Primary author: BULLA, Mattia (Stockholm University)

Presenter: BULLA, Mattia (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **14** Type: **Talk**

Not alone in solitude: a look into the surprising world of TOI-1130

Thursday 21 October 2021 15:30 (10 minutes)

After the detection of numerous planetary systems outside of our own Solar System which tend to be extremely diverse and which show a wide range of evolutionary states, the focus is now shifting to a characterization of their formation and evolution, as well as to the architecture of planetary systems and planet habitability.

One of the astonishing discoveries in exoplanet research has been the detection of Jupiter-like planets (in size and mass) that orbit their host star within 10 days. These so-called hot Jupiters are found to be lonely objects that are rarely accompanied by smaller close-in companions. TOI-1130 is one of very these rare systems. It hosts two transiting planets: a hot Jupiter and an inner Neptune-sized planet that are near to the 2:1 period commensurability.

Planetary systems with transiting planets are markedly well-suited for a detailed characterization, since they allow the measurement of the planetary radius, which is essential to constrain the planet' s evolution and migration history, as well as to characterize the internal structure of the planet. The second fundamental parameter for the characterization is the planetary mass, that together with the radius allows the bulk density of a planet to be estimated, thereby constraining its composition.

In order to find out the history and future evolution of exoplanet systems, a complete knowledge of all orbital and planetary parameters with a high accuracy is crucial. However, precise measurements of the planetary mass are difficult to obtain, in particular for small planets. If there are multiple planets in a system close to a period commensurability, as is the case for TOI-1130, the planetary masses can be determined using the gravitational interactions leading to measurable transit timing variations.

In this talk, I will present the results from a photodynamical joint modelling of high-precision radial velocities, TESS, and ground-based transit photometry. I will show that TOI-1130 is an excellent laboratory to test planet formation theories that I will investigate thanks to our precise planetary parameters.

Primary author: KORTH, Judith (Chalmers University of Technology)

Presenter: KORTH, Judith (Chalmers University of Technology)

Session Classification: Planetary Systems

Contribution ID: **15** Type: **Talk**

Outreach for sustainability, science capital and a future in space at Onsala Space Observatory's new visitor centre

Friday 22 October 2021 11:45 (10 minutes)

Space and astronomy offer important opportunities for helping young people to increase their science capital. Motivated also by the UN's sustainability goals and the challenge of Earth's changing climate, Chalmers is building a new visitor centre and exhibition covering space and astronomy technology at Onsala Space Observatory, with kids in years 2-9 as a main target audience. We present progress on the centre, and on a new cluster of initiatives connected to it. Among these are the student network Upprymd, the high school hands-on project Rymdskolan, and upgrades to our small SALSA radio telescopes. All are aimed at making science accessible to young people and their communities in West Sweden.

Primary author: CUMMING, Robert (Onsala Space Observatory, Chalmers University of Technology)

Presenter: CUMMING, Robert (Onsala Space Observatory, Chalmers University of Technology)

Session Classification: Astronomical Culture

Contribution ID: **16** Type: **Talk**

SNR 0540-69.3: continuum emission of the pulsar and its nebula based on X-shooter and MUSE observations

Friday 22 October 2021 09:25 (10 minutes)

SNR 0540-69.3 is a ˜1000 year-old-supernova remnant (SNR) located in the Large Magellanic Cloud. This remnant is associated with an active pulsar and a pulsar-wind nebula (PWN) and also possesses an oxygen-rich ejecta. Oftentimes, SNR 0540 is referred to as the Crab's twin due to their similar properties, including the millisecond pulsar and PWN.
We study the continuum emission of the remnant's pulsar and PWN. This emission sheds light on the emission mechanism and the complex particle distributions near the pulsar. However, previous studies have yielded conflicting results regarding the shape of the spectra.
We use data from the X-shooter spectrograph as well as MUSE (an integral-field spectrograph), both mounted on the VLT. These data provide the first NIR spectrum of this source along with the most complete coverage of the UV and optical range. With these data, we are also able to investigate the spatial differences in the spectral shape of the nebula spectrum.
In this talk, I present the preliminary results of the continuum emission analysis.

Primary authors: TENHU, Linda (KTH Royal Institute of Technology); LARSSON, Josefin (KTH Royal Institute of Technology)

Presenter: TENHU, Linda (KTH Royal Institute of Technology)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **17** Type: **Talk**

Forward Modelling of Ground Based SST Telescope Images

Thursday 21 October 2021 15:20 (10 minutes)

Space debris is becoming an increased threat to the future use of space orbits. In order to counteract this threat, the field of Space Situational Awareness (SSA), and the sub-field Space Surveillance and Tracking (SST), have been developed to gather knowledge about the space debris and satellites surrounding Earth. The orbit of a satellite can be determined by acquiring images of the satellite using a telescope and a sensor. During this thesis project, a tool has been programmed in Python. This tool can simulate these types of images of satellite passes, at a given time and location. The simulator takes the system parameters of the telescope and camera sensor into account, together with several different types of disturbances which affect these images. The project has been carried out at the Swedish Space Corporation (SSC), which recently launched an SSA initiative. They plan to use these images to learn more about their upcoming observations, and possibly to test an orbit determination software.

Primary author: HIDALGO LARSSON, Anna (KTH)

Presenter: HIDALGO LARSSON, Anna (KTH)

Session Classification: Planetary Systems

Contribution ID: **18** Type: **Talk**

A low-frequency radio view of supernovae with LOFAR

Friday 22 October 2021 09:45 (10 minutes)

Supernovae are the end stages of stellar evolution, resulting in enormous energy release. They have a great impact on their environment, help us understand stellar and galactic evolution, shock physics and radiative processes, and are linked to life on earth. In the radio, synchrotron radiation from the interaction of the supernova ejecta with the dense circumstellar material is visible. Supernovae have not yet been studied at the low radio frequencies probed by Low Frequency ARray (LOFAR; van Haarlem et al. 2013), and this opens up uncharted territory, including new physics that might dominate low frequency radio emission from supernovae. With Morabito et al. 2021 (soon to be published), LOFAR enters a regime where sub-arcsecond imaging with the International LOFAR Telescope could become routine. In this talk, we present ongoing work of supernovae studies with the LOFAR-VLBI strategy.

Primary author: VENKATTU, Deepika (Stockholm University)

Co-authors: Prof. LUNDQVIST, Peter (Stockholm University); Dr PÉREZ-TORRES, Miguel (IAA-CSIC)

Presenter: VENKATTU, Deepika (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **19** Type: **Poster**

Model grids of C-type AGB stars and the effect of dust opacities on wind properties

Friday 22 October 2021 11:05 (10 minutes)

Stars on the asymptotic giant branch (AGB) lose a substantial part of their mass through stellar winds. Pulsations induce shock waves throughout the stellar atmosphere which compresses and elevates gas to cooler regions where dust can form. The newly formed dust particles are accelerated outwards by radiation pressure, dragging gas along, resulting in a wind. Dynamical atmosphere and wind models are used to explore the wind driving mechanism and include descriptions of complicated physical processes such as the formation and destruction of dust. In this work we generate and compare two grids of models for C-type AGB stars where the optical properties of dust are varied. The grids are computed using the DARWIN code and consist of models with masses from 0.75 $M_{\odot}$ to 2 $M_{\odot}$, luminosities from 3500 $L_{\odot}$ to 10000 $L_{\odot}$, and effective temperatures from 2400 K to 3200 K. The pulsation amplitude and carbon excess are also varied for each model.
The results show that there is an overall trend in the wind properties that is directly related to the dust opacity. The differences in grain sizes are fully consistent, resulting in either smaller or larger particles for the entire grid. For the model grid with more opaque and smaller dust particles, the mass loss rates and wind velocities are in general higher, which is in better agreement with observations. The dust condensation and dust-to-gas ratios are also generally higher in this case. Some models deviate from the trend and require further analysis.

Primary author: SIDERUD, Emelie (Uppsala University)

Co-authors: HÖFNER, Susanne (Uppsala University); BLADH, Sara (Uppsala University); ERIKSSON, Kjell (Uppsala University)

Presenter: SIDERUD, Emelie (Uppsala University)

Session Classification: Stars

Contribution ID: **20** Type: **Talk**

Molecules in stripped-envelope supernovae

Friday 22 October 2021 09:35 (10 minutes)

Core collapse supernovae (CC-SNe) are the violent and bright explosions that end the lives of massive stars (M>8$M_\odot$), leaving behind exotic remnants such as black holes and neutron stars. A currently unsolved question in supernova research is the origin of Type Ib and Ic SNe, which lack hydrogen, or hydrogen and helium, spectral signatures respectively, indicating that the outer stellar envelope has been stripped during its evolution. The mechanism for this is not well understood, and two main scenarios have been proposed: that the progenitors of Type Ibc SNe are very massive (M>25$M_\odot$), and lost their outer layers to a strong stellar wind; or that the progenitors are of somewhat lower mass (M<20$M_\odot$) and had their envelopes stripped through interaction with a companion. To disentangle the two scenarios, measurements of nucleosynthesis yields via Type Ibc SNe observations can be used to infer their progenitor masses. However, the interpretation of observations depends on the adopted spectral models. A previously missing ingredient has been the inclusion of molecular effects, which can be significant.

We here present state-of-the-art spectral synthesis models of nebular-phase SNe, for the first time including the coupling between the molecular formation, molecular cooling effects, and radiative transfer. This self-consistent approach is key, as molecules will cool the gas, while in turn, their formation depends on the temperature. We show that in type Ic models ro-vibrational line emission from the most abundant molecules (CO, SiO, SiS) dominate the infra-red (IR) region. Molecules also impart indirect effects on the spectra: material is locked up in molecules, and even a small molecular abundance can effectively cool the surroundings by several thousand degrees; both effects resulting in weaker emission of monatomic species. To accurately determine nucleosynthesis yields from observations it is, therefore, crucial to include molecules in spectral synthesis calculations. Once complemented with observations from the next generation of telescopes, e.g. JWST, these models will help us understand the fates of the most massive stars.

Primary author: Dr LILJEGREN, Sofie (Stockholm University)

Presenter: Dr LILJEGREN, Sofie (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **21** Type: **Talk**

CON-quest: dense molecular gas properties in moderately luminous infrared galaxies

Thursday 21 October 2021 13:40 (10 minutes)

The growing phase of supermassive black holes (SMBHs) in galaxies is one of the debated topics in modern astronomy.
Recent observations reveal that a fraction of (ultra) luminous infrared galaxies; (U)LIRGs host extremely compact and dusty nuclei.
Such compact obscured nuclei (CONs) are only realised in an environment with extremely high column density of materials surrounding the SMBH, and thus suggests rapid evolution.
A systematic search for CONs (CON-quest) evidently detected CONs in 20-25% of (U)LIRGs, and 0% in its less luminous sample (subLIRGs).

We present ALMA band 6 ˜100pc resolution observations of 15 subLIRGs, that are a complete sample of galaxies within 15Mpc distance with their FIR luminosity between 10ˆ10 L_solar and 10ˆ11 L_solar.
The spectral range covers the HCN and HCO+ emission line that allows us to estimate the dense molecular gas structure and its kinematic properties.
We compare the dense gas properties to the estimated SMBH mass and X-ray luminosity to see the correlation, and also discuss the existence of inflow that will possibly build up CON-like environment in the future.

Primary author: Dr ONISHI, Kyoko (Chalmers University of Technology)

Co-authors: Ms SATO, Mamiko (Chalmers University of Technology); Dr GORSKI, Mark (Chalmers University of Technology); Dr KÖNIG, Sabine (Chalmers University of Technology); Prof. AALTO, Susanne (Chalmers University of Technology)

Presenter: Dr ONISHI, Kyoko (Chalmers University of Technology)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **22** Type: **Talk**

SN 2018bsz: significant dust formation in a nearby superluminous supernova

Friday 22 October 2021 08:55 (10 minutes)

We investigate the thermal emission and extinction from dust associated with a nearby superluminous supernova (SLSN) at $z = 0.0267$, SN˜2018bsz, in order to determine its nature. We use the 7-channel imager GROND to extensively monitor the photometric evolution of SN˜2018bsz. This is the first dataset with daily cadence and simultaneous optical and near-infrared (NIR) coverage for a SLSN. At $+230$ days, the SN is not detected in the optical and shows significant NIR excess, with $r - J > 3$ mag and $r - K_{\rm s} > 5$ mag. We use the *Spitzer Space Telescope* to detect the SN at late-times between $+384$ and $+535$ days in 3.6 and 4.5 μm images. In addition, we recover NEOWISE detections at 3.4 and 4.6 μm for SN˜2018bsz between $+68$ and $+423$ days. The time evolution of the IR lightcurve enables us to investigate whether the mid-infrared emission is from newly formed dust inside the SN ejecta or from a pre-existing circumstellar envelope or interstellar material heated by the radiation from the SN. We find the later two scenarios can be ruled out, and a scenario where new dust is forming at epochs > 200 days can self-consistently reproduce the evolution of the SN flux. We can fit the spectral energy distribution well between $+230$ and $+380$ days with 5×10^{-4} $M_\odot$ of carbon dust, subsequently a higher dust mass of 10^{-2} $M_\odot$ is required. SN˜2018bsz is the first SLSN showing evidence for dust formation within the SN ejecta, and it could potentially provide an analog for dust formation in the early Universe.

Primary author: CHEN, Janet Ting-Wan (Stockholm University)

Presenter: CHEN, Janet Ting-Wan (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **23** Type: **Talk**

Fitting a radiation mediated shock model to prompt gamma-ray burst data

Thursday 21 October 2021 13:50 (10 minutes)

The roles of radiation-mediated shocks (RMSs) in the prompt emission of gamma-ray bursts (GRBs) have been thoroughly investigated theoretically. However, so far, no such model has been fitted to data due to the computational complexity of simulating RMSs from first principles. We aim to bridge this gap between theory and observation. In this talk, I will present an approximate model called the Kompaneets RMS approximation (KRA) that we have developed for this purpose, which is based on the similar evolution of the photon spectrum in an RMS and in repeated Compton scatterings with high-energy, thermal electrons. With this analogy we can accurately replicate spectra generated by a full-scale RMS simulation using a fraction of the computing time, allowing us to probe a large enough parameter space to fit the model to data. Finally, I illustrate the capabilities of the KRA by performing a fit to a non-thermal spectrum in GRB 150314. With the KRA, we can deduce properties of the original RMS, which allow us to get a better understanding of the dynamics below the photosphere.

Primary author: SAMUELSSON, Filip (KTH Royal Institute of Technology)

Co-authors: RYDE, Felix (KTH); Dr LUNDMAN, Christoffer (Stockholm University)

Presenter: SAMUELSSON, Filip (KTH Royal Institute of Technology)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **24** Type: **Talk**

Revealing Dynamics, Three-Dimensional Stratification, and Chemical Inhomogeneities in the Atmosphere of an Ultra-Hot Jupiter

Thursday 21 October 2021 16:00 (10 minutes)

The discovery of planets around other stars (exoplanets) has fundamentally changed our view of the possible types of planets. With the discovery of a diverse population of planets, a class of highly irradiated gas giants has emerged that are unlike any planet in our solar system.

Ultra-hot Jupiters offer the opportunity to learn about the chemistry, thermal structure and dynamics in atmospheres at high temperatures: They are particularly amenable to transmission spectroscopy because they are in close orbits around their host stars with periods of only a few days, which in turn causes high equilibrium temperatures and simplifies the chemistry. Expected to enter tidal synchronisation soon after their formation (Rasio et al. 1996; Showman & Guillot 2002), the atmospheres of ultra-hot Jupiters are divided into a permanently irradiated hot day side and a cooler permanently dark night side, causing extreme temperature and chemical fluctuations, so that the thermal dissociation of molecules, partial thermal ionisation of atomic species and thermal inversions induced by metals or their oxides become important (Lothringer et al. 2018; Kitzmann et al. 2018; Parmentier et al. 2018; Arcangeli et al. 2018).

Thanks to high-resolution transmission spectroscopy, we are able to study atmospheric composition and routinely detect metals, revealing dynamics and atmospheric stratification as well as chemical inhomogeneities in the atmospheres of ultra-hot Jupiters as predicted by theoretical studies (Wardenier et al. 2021). The dynamics as represented by super-rotational winds and the presence or absence of certain species contribute to a broader picture of the atmospheres of these exoplanets.

During my talk, I will present the analysis of a transmission spectrum of an ultra-hot Jupiter, focusing on how the aforementioned effects are visible in our detections and what they tell us about the chemical and dynamical properties of the atmosphere.

Primary author: PRINOTH, Bibiana (Lund University)

Co-authors: HOEIJMAKERS, Jens (Lund University); BORSATO, Nicholas (Lund University); THORSBRO, Brian (Lund University); SANDVIK, Elin (Lund University)

Presenter: PRINOTH, Bibiana (Lund University)

Session Classification: Planetary Systems

Contribution ID: **25** Type: **Poster**

Non-LTE effects in M dwarfs

Friday 22 October 2021 11:15 (10 minutes)

M dwarfs have become an increasingly interesting target in the search for exoplanets. This is due to their small radii and low temperature which makes finding planets via both radial and transit methods easier. M dwarfs are however know to be tricky targets. The best option we have to characterise their atmospheres is using spectroscopy. This is not an easy task. M dwarf spectra are filled with molecular lines due to molecules formed in the cool atmosphere. Many spectroscopic surveys of M dwarfs are under way or are planned. Improving models used in spectroscopy of M dwarfs is therefore vital.

One assumption often made in models is Local Thermodynamical Equilibrium (LTE). This assumption does not always hold. Deviations from LTE (non-LTE) has been investigated for multiple elements for FGK stars but not for M dwarfs. We present non-LTE results in the parameter range of M dwarfs for potassium and iron. This was done by generating synthetic spectra in LTE and non-LTE using a grid of departure coefficients and compare these. We find an insignificant difference for iron and a difference for potassium corresponding to a difference in abundance of up to 0.2 dex. Work on other elements are in progress.

Primary author: Ms OLANDER, Terese (Uppsala Universitet)

Co-authors: Dr HEITER, Ulrike (Uppsala University); Prof. KOCHUKHOV, Oleg (Uppsala University)

Presenter: Ms OLANDER, Terese (Uppsala Universitet)

Session Classification: Stars

Contribution ID: **26** Type: **Talk**

Linking 3D Climate Models with Transit Spectroscopy from CRIRES+

Thursday 21 October 2021 15:50 (10 minutes)

The Planetary Spectrum Generator (PSG) is an online tool that synthesizes spectra of planetary atmospheres for a broad range of wavelengths (10nm to 100mm) simulating several space- or ground-based observatories/instruments. The 3D GlobES application of PSG allows us to synthesize observations of exoplanets based on different 3D General Circulation Models (GCM). In particular, we use GlobES to synthesize transmission spectra of exoplanets as observed with CRIRES+, the newly upgraded and refurbished high-resolution spectrograph on the Very Large Telescope (VLT), using the existing 3D GCM models of our potential targets as inputs. We will then use the simulations to assess the feasibility of detecting atmospheres of hot Jupiters and super Earths and to guide us with interpretation of spectral features when CRIRES+ makes positive detections. The combination of advanced observational and theoretical tools will allow us to investigate planetary atmospheres without a priori assumptions about their properties and chemical composition thus providing unbiased insight into their origin, evolution, and habitability.

Primary authors: Dr GRECO, Jennifer (Uppsala University/Swedish Collegium for Advanced Study); Dr NIKOLAI, Piskunov (Uppsala University)

Presenter: Dr GRECO, Jennifer (Uppsala University/Swedish Collegium for Advanced Study)

Session Classification: Planetary Systems

Contribution ID: **27** Type: **Talk**

Evolution of Lya halos between low and high redshift: possible sign of changes in the CGM.

Thursday 21 October 2021 14:20 (10 minutes)

Through recent efforts using narrowband observations and integral field spectrographs, high redshift (3<z<6) Lyman alpha (Lya) emitting galaxies have been found to almost ubiquitously have spatially extended Lya emission, known as a Lya halo, extending significantly further out than their star formation (as traced by UV emission). At these redshifts, Lya is the highest surface brightness tracer of gas around star-forming galaxies and understanding this gas and its Lya emission is crucial to understanding how galaxies interact with their surroundings. The Lyman Alpha Reference Sample (LARS) survey has shown that z ˜0 galaxies appear to have significantly smaller Lya halo extents than their high redshift counterparts. In order to determine if this is a true physical evolution between z˜0 and z˜3, we received 55 orbits of HST time to observe the Lya emission of seven intermediate (0.23<z<0.3) redshift galaxies selected to be similar to galaxies observed at high redshift and where the redshift window was optimized for low contamination Lya observations. We are now able to present the first preliminary results from this project. Our imaging shows relatively small Lya halo extents consistent with those of LARS but that do not seem consistent with halos found at high redshift. This has profound implications since it means that some dramatic change has occurred in the properties of the circumgalactic media of starforming galaxies between the local universe and z˜3, which we do not yet understand.

Primary author: RUNNHOLM, Axel (Stockholm University)

Co-author: Prof. HAYES, Matthew

Presenter: RUNNHOLM, Axel (Stockholm University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **28** Type: **Talk**

Physical properties of a Fan-Shaped jet backlit by an X9.3 flare

Friday 22 October 2021 10:45 (10 minutes)

Fan-shaped jets can be observed above light bridges and are driven by reconnection of the vertical umbral field with the more horizontal field above the light bridges. Because these jets are not fully opaque in chromospheric lines, one cannot study their spectra without the highly complex considerations of radiative transfer in spectral lines from the atmosphere behind the fan.

We take advantage of a unique set of critically sampled polarimetric observations of the Halpha line along with the Ca II 8542 Å and Ca II K lines obtained with the CRISP instrument of the Swedish 1-m Solar Telescope to study the physical properties of a fan-shaped jet that was backlit by an X9.3 flare. The Halpha flare ribbon emission profiles from behind the fan are highly broadened and flattened, allowing us to investigate the fan with a single slab via Beckers' cloud model (Beckers 1964), as if it were backlit principally by continuous emission. Using this model we derived the opacity and velocity of material in the jet.

For what we believe to be the first time, we can report an estimate of the mass and density of material in a fan-shaped jet. Using inversions of Ca II 8542 Å emission via STiC (STockholm inversion Code) (STiC; de la Cruz Rodríguez et al. 2016; de la Cruz Rodríguez et al. 2019), we were also able to estimate temperature and cross-check the velocity of material in the jet.

Finally, we use the masses, plane of sky and line of sight velocities as functions of time to investigate the supply of momentum to the photosphere in the collapse of this jet, and evaluate it as a potential driver for a Sunquake beneath.

Primary author: PIETROW, Alexander (Stockholm University)

Presenter: PIETROW, Alexander (Stockholm University)

Session Classification: Stars

Contribution ID: **29** Type: **Talk**

How can we better support young researchers?

Friday 22 October 2021 11:55 (10 minutes)

I will present a handful of initiatives that we, the Swedish astronomical community, could choose to implement to support young researchers. In our current system, these groups (PhD students and postdocs) are the most vulnerable to exploitation, bullying, and general insecurity in their career situation.

Primary author: FREELAND, Emily (Stockholm University)

Presenter: FREELAND, Emily (Stockholm University)

Session Classification: Astronomical Culture

Contribution ID: **30** Type: **Talk**

GRB observations by H.E.S.S.

Thursday 21 October 2021 14:00 (10 minutes)

The most energetic explosions in the Universe after the Big Bang are Gamma-Ray Bursts (GRBs). They emit intense and brief flashes of gamma-rays initially during their prompt phase, followed by a long afterglow phase observed in all the wavelengths. Multi-wavelength observation of GRB afterglow provides some hints for the nature of the emission mechanism. However, the GRBs are not observed in very-high-energies (VHEs) until 2018. Currently, the High Energy Stereoscopic System (H.E.S.S.) at Namibia is the only imaging atmospheric Cherenkov telescope array in the Southern Hemisphere that observes VHE gamma-ray sources. Since the completion of its installation in 2004, H.E.S.S. has been actively searching for the GRBs in GeV-TeV energies. For the very first time, the GRBs are detected in VHE gamma-rays in recent years and H.E.S.S. has majorly contributed towards this discovery. In this talk, I will give an overview of GRB observations by H.E.S.S. and discuss its discovery of VHE gamma-rays from GRB180720B and GRB190829A.

Primary author: SENNIAPPAN, Mohanraj (Linnaeus University)

Presenter: SENNIAPPAN, Mohanraj (Linnaeus University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **31** Type: **Talk**

The Time Dependent Nebular Phase of Kilonovae

Friday 22 October 2021 09:15 (10 minutes)

The thermal transient following a binary neutron star merger, known as a kilonova (KNa), is expected to enter the steady state nebular phase several days to weeks after merge. In this state, the ejecta is optically thin and bolometric luminosity tracks instantaneous radioactive energy deposition. The steady-state phase is expected to last until reprocessing timescales become long, at which point the time dependent phase begins. Thermodynamic quantities such as temperature and ionisation, as well as luminosity, deviate from the steady state solutions during this transition and onwards. We study this effect on the temperature, ionisation and luminosity solutions of KNa ejecta in non-local thermodynamic equilibrium (NLTE), using the Monte Carlo spectral synthesis code SUMO. A simple single zone, spherically symmetric explosion model undergoing homologous expansion is investigated in a timespan ranging from 5 to 100 days after merge. In this talk, I will discuss the impact of time dependent effects, and their dependencies on ejecta parameters and energy deposition.

Primary author: Mr POGNAN, Quentin (Stockholm University)

Co-author: Dr ANDERS, Jerkstrand (Stockholm University, Department of Astronomy)

Presenter: Mr POGNAN, Quentin (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **32** Type: **Talk**

Effect of axion inclusion in CCSNe simulations

Friday 22 October 2021 10:05 (10 minutes)

Core-Collapse Supernovae (CCSNe) are important objects in the scope of global nucleosynthesis, neutrino and gravitational waves emissions, and even cosmology. However, the early stages of these processes are not observable through the classical electromagnetic radiations observations. This is why we rely on simulations to explore the possible mechanisms leading to the final explosion. One of the classical mechanism is the so called neutrino-driven supernovae, where neutrinos emitted from the cooling proto-neutron star will interact with the shock and give it sufficient energy to proceed to the final explosion. While axions are rarely considered in simulations due to their weak interactions with the matter, recent studies have highlighted their impact on the proto-neutron star cooling, as an energy sink term, and therefore on the neutrino emission and shock revival. In this talk, we will present new results showing the impact of axions inclusion in dynamical CCSN simulations.

Primary authors: BETRANHANDY, Aurore (Stockholm University); O'CONNOR, Evan (Stockholm University)

Presenter: BETRANHANDY, Aurore (Stockholm University)

Session Classification: Kilonovae, Supernovae and SNRs

Contribution ID: **33** Type: **Talk**

Follow-up gamma-ray observations of neutrino events with the H.E.S.S. imaging atmospheric Cherenkov telescope

Thursday 21 October 2021 14:10 (10 minutes)

While high-energy neutrinos have been detected by the IceCube neutrino observatory for more than a decade, their individual sources still remain unidentified. Some of the most prominent candidates for emission at such high energies are blazars, a type of Active Galactic Nuclei (AGNs) with powerful relativistic jets, and Gamma-ray Bursts (GRBs), both thought to be the birthing place of high-energy cosmic rays. As cosmic rays are accelerated, they interact with nearby gas or photons to produce high-energy neutrinos and gamma-rays. With both neutral tracers pointing back to their sources, it is possible to search for spatial and temporal coincidence of very-high-energy (VHE, >100 GeV) gamma-rays with imaging atmospheric Cherenkov telescopes and high-energy neutrino alerts shared by IceCube. We summarize the follow-up observation strategy performed by H.E.S.S., starting with the most promising correlation with blazar TXS 0506+056 observed in September 2017 and including observations performed until March 2021.

Primary author: KUKEC MEZEK, Gasper (Linnaeus University)

Presenter: KUKEC MEZEK, Gasper (Linnaeus University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **34** Type: **not specified**

Future challenges and new approaches in astrophysics at mm-wavelengths

Thursday 21 October 2021 14:30 (10 minutes)

The cosmic microwave background (CMB) has played a foundational role in the establishment of the standard model of cosmology. Driven by significant technological advances, future experiments endeavour to revolutionise our understanding of the infant universe via detection of primordial gravitational waves and neutrino properties through their role in structure formation. In this talk, I will introduce the key science goals of next-generation CMB experiments, present the flagship CMB experiments of this decade, including those with contributions from Sweden, and discuss how work at Stockholm University contributes to these efforts.

Primary author: Dr GUDMUNDSSON, Jón (Stockholm University)

Presenter: Dr GUDMUNDSSON, Jón (Stockholm University)

Session Classification: Cosmology and Extragalactic Astronomy

Contribution ID: **35** Type: **Talk**

Comparing neighborhoods of quasars and inactive galaxies with the Galaxy and Mass Assembly (GAMA) survey through Monte Carlo simulation

Thursday 21 October 2021 14:40 (10 minutes)

Active galactic nuclei (AGN) are galaxies which host active supermassive black holes (SMBHs) and present a crucial element in the evolution of galaxies. In this paper, we aim to contribute to the understanding of how the nuclear activity is related to its surrounding environment. We present results of an archival project, where we use the GAMA survey to compare the neighborhoods of quasars and inactive galaxies via Monte Carlo simulation. The GAMA survey project collected observations using the latest facilities for about 300,000 galaxies and provides a multi-wavelength photometric and spectroscopic data. For each seed-quasar or a comparison seed-galaxy, we select neighboring galaxies within a set volume. Our preliminary results show that there is no significant difference in any of the morphological or star formation properties between the neighbors of quasars and neighbors of inactive galaxies. This finding suggests that quasar activity is a phase in the life of a galaxy and is not dependent on its environment.

Primary author: STONE, Maria (University of Turku)

Presenter: STONE, Maria (University of Turku)

Session Classification: Cosmology and Extragalactic Astronomy