Astronomdagarna 2022
Chalmers, Göteborg

Contents

About

Astronomdagarna

Astronomdagarna is a conference for Swedish astronomers taking place every two years since 1999. It is not a conference on a specific theme, but it covers all themes in Swedish astronomy. There is a special focus in providing young researchers with a platform to present their research results. In 2022, the meeting will take place between October 6 to 8 at Chalmers University of Technology in the Kårhuset building. Conference talks and poster presentations will be given in person. Talks will be streamed (see information here).

Invited talks consist of 15 min presentation plus 5 min for questions. Contributed talks consist of 12 min presentation plus 3 min for questions.

If you have any questions about Astronomdagarna 2022, please e-mail the local organising committee at astronomdagarna2022@chalmers.se.

Scientific Organizing committee

Theo Khouri, Chalmers
Angela Adamo, SU
Thomas Bensby, LU
Sara Bladh, UU
Henrik Jönsson, MaU
Tanja Nymark, SAS
Evan O'Connor, SU
Gabriella Stenberg, IRF

Local Organizing committee

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Timetable

CT: Contributed Talk, IT: Invited Talk.

Thursday, 6 October

11:00–13:00	**Registration**[1]		
11:45–12:30	**Early Career Researcher flash presentation**[2]		
13:00–13:05	**Welcome remarks**		
13:05–13:10	**National committee intro**		
13:10–13:20	**SAS introduction**		
13:20–13:30	**ALMA ARC node**		
Chair: Thomas Bensby			
13:30–13:50	IT	**Terese Hansen** Stockholm University	The R-Process Alliance - mapping the r-process with stellar abundances
13:50–14:05	CT	**Sema Caliskan** Uppsala University	Kilonovae and the cosmic origin of r-process elements: atomic structure and processes of gold
14:05–14:20	CT	**Anamaria Gkini** Stockholm University	Study of superluminous supernova SN2020zbf
14:20–14:35	CT	**Adam Rains** Uppsala University	Data Driven Optical Cool Dwarf Metallicities and Ti Abundances, and the Giant Planet– [Fe/H] Correlation
14:35–14:50	CT	**Cis Lagae** Stockholm University	Modelling the Milky Way's most metal-poor star
14:50–15:05	CT	**Martin Sahlén** Uppsala University	Astronomy from the Moon
15:05–15:35	**Coffee break**[1]		
Chair: Sara Bladh			
15:35–15:55	IT	**Anish Amarsi** Uppsala University	The solar chemical composition
15:55–16:10	CT	**Jaime de la Cruz Rodriguez** Stockholm University	Spatially-resolved radiative losses in the solar chromosphere
16:10–16:25	CT	**Axel Hahlin** Uppsala University	Small-scale magnetic fields with CRIRES
16:25–16:40	CT	**Arief Ahmad** Uppsala University	Pulsation properties of evolved red giants from 3D models
16:40–17:00	IT	**Giuliana Cosentino** Chalmers	Stellar feedback from galactic bubbles and their impact on molecular clouds
17:00–17:15	CT	**Maya Petkova** Chalmers	The role of shear in shaping the Galactic Centre clouds
17:15–17:30	CT	**Rubén Fedriani** Chalmers	Near-Infrared view of massive star forming regions
17:30–18:30	**Poster viewing**[1]		
18:30–19:30	**Nordenmark Lecture presented by Dainis Dravins**[3]		
19:30–	**Early Career Researcher pub night**		

[1] Registration, coffee breaks, and poster viewing take place in the conference foyer.
[2] Only for early career researchers. Contact astronomdagarna2022@chalmers.se if interested. Location: conference hall
[3] Title: "PLANETER, PLANETER, PLANETER! Var i rymden finns drägliga förhållanden för liv?". Location: conference hall.

Friday, 7 October

08:30–09:00	**Registration**[1]		
Chair: Henrik Jönsson			
09:00-09:15	CT	**Gloria Canocchi** Stockholm University	Improving planetary atmosphere characterization by 3D NLTE modeling of the stellar centre-to-limb effect
09:15–09:30	CT	**Linn Boldt-Christmas** Uppsala University	Optimising Exoplanet Transit Spectroscopy Observations
09:30–09:45	CT	**Bibiana Prinoth** Lund University	What else is there to see? Revisiting the transmission spectrum of WASP-189b
09:45–10:00	CT	**Judith Korth** Chalmers	Not alone in solitude: a deeper look into the world of TOI-1130
10:00-10:20	IT	**Jens Hoeijmakers** Lund University	High-resolution spectroscopy of ultra-hot gas giant exoplanets
10:20–10:35	CT	**Gabriella Stenberg** IRF	Game-based learning at PhD-level in space physics
10:35–11:00	**Coffee break**[1]		
Chair: Tanja Nymark			
11:00–11:20	IT	**Cissi Askwall** Vetenskap & Allmänhet	Star spotting, space engagement and Swedish attitudes towards research
11:20–11:35	IT	**Robert Cumming** Chalmers	Who is doing astronomy outreach in Sweden, and why?
11:35–11:45	CT	**Cecilia Kozma** KTH/ESERO Sweden	ESERO Sweden - bringing the universe into the classroom
11:45–12:40	**Panel-led discussion**		
12:40–14:00	**Lunch**[4]		
14:00–14:10	**Poster prize and 2 min presentation talks**		
Chair: Jouni Kainulainen			
14:10–14:30	IT	**Hayley Williamson** IRF	Solar wind interactions with a changing comet ionosphere
14:30–14:45	CT	**Sebastián Rojas Mata** IRF	Exploring Venus' Magnetosheath through Plasma Ion Measurements
14:45–15:05	IT	**Paul McMillan** Lund University	Gaia and the disturbed Milky Way
15:05–15:20	CT	**Ulrike Heiter** Uppsala University	Stellar parameters in Gaia Data Release 3
15:20–15:35	CT	**Diane Feuillet** Lund University	Characterizing the Milky Way disc using age-metallicity distributions of GALAH and Gaia stars
15:35–15:50	CT	**Joseph Armstrong** Chalmers	Investigating the early evolution of star clusters via their 6D kinematics
15:50–16:20	**Coffee break**[1]		
Chair: Evan O'Connor			
16:20–16:35	CT	**John Conway** Chalmers	Square Kilometre Array - Status and Science Opportunities

[4] Restaurants can be found around the campus. For a list see https://www.chalmers.se/en/conference/astronomdagarna2022/Pages/Restaurants.aspx

16:35–16:55	IT	**Alexandra Le Reste** Stockholm University	Imaging neutral gas in high-redshift analog galaxies
16:55–17:10	CT	**Kiana Kade** Chalmers	The search for faint companions to massive galaxies at high-redshift: the case of AzTEC-3 and BRI0952
17:10–17:25	CT	**Clare Wethers** Chalmers	Investigating local CONs with MUSE
17:25–17:40	CT	**Nushkia Chamba** Stockholm University	The edges of galaxies: from dwarfs to giants
17:40–17:55	CT	**Álvaro Segovia Otero** Lund University	Cosmic phases of star formation in Milky Way-like galaxies
17:55–18:10	CT	**Yutong He** Nordita & Stockholm University	Modified propagation of gravitational waves from the early radiation era
18:10–18:20	**Closing remarks**		
18:45	**Conference Dinner**[5]		

Saturday, 8 October

8:30 - 12:00: Excursion to Onsala Space Observatory

(contact astronomdagarna2022@chalmers.se if interested).

[5] The dinner takes place in the restaurant Wijkanders (https://wijkanders.se/)

Remote connection

The presentations will be streamed using zoom webinar.

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Please click the link below to join the webinar:

https://chalmers.zoom.us/j/63747277839

Or One tap mobile :
    Sweden: +46850500829,,63747277839#  or +46850520017,,63747277839#
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Or an H.323/SIP room system:
    H.323: 109.105.112.236 or 109.105.112.235
    Meeting ID: 637 4727 7839
    SIP: 63747277839@109.105.112.236 or 63747277839@109.105.112.235
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Thursday, October 6

The R-Process Alliance - mapping the r-process with stellar abundances

Terese Hansen IT

Stockholm University

How to make gold and silver? The long-sought-after answer to this question remains one of the most challenging open problems that tie together nuclear physics with astronomy. Heavy elements like gold and silver are produced in the so-called rapid neutron-capture process (r-process). This process only occurs in rare explosive events in the Universe like supernovae (SNe) and neutron star mergers (NSMs), making it hard for astronomers to gather direct observations of the element creation. Likewise, it is difficult for nuclear physicists to recreate and study the nuclear process in the laboratory. These obstacles are why we today, six decades after the theoretical prediction of the r-process, still do not know how or where in the Universe gold and silver are made. However, in 2016 the R-Process Alliance (RPA) initiated a successful new search to uncover bright metal-poor halo stars with r-process element enhancements. These stars are excellent laboratories for studying the r-process as the gas from which these stars formed was polluted by at most a few enrichment events — perhaps even a single explosion. To date, the RPA has collected spectra of $\sim$2000 stars and discovered over 70 new highly r-process enhanced. I will report on RPA efforts over the past six years and plans for the future, including ways this stellar sample can help constrain the astrophysical site(s) of the r-process.

Kilonovae and the cosmic origin of r-process elements: atomic structure and processes of gold

Sema Caliskan **CT**

Uppsala University

The cosmic origin of elements beyond iron in the periodic table is a long-standing puzzle. As such, one of the main astrophysical highlights of the last decade is without doubt the indication of rapid neutron capture (r-process) nucleosynthesis of heavy elements in the kilonova (KN) ejecta following the neutron-star (NS) merger gravitational-wave event in 2017. This event is the first-ever observational argument that kilonovae are the main sites for the production of neutron-rich elements in the universe, but the extent of the contribution of these elements is still under debate. A careful analysis of KNe spectra based on reliable atomic parameters is crucial, not only to allow for direct element identifications in KN spectra, but also to determine fundamental parameters of the ejecta itself, and ultimately of the progenitor binary NS system. However, much of the atomic structure and radiative properties of the neutron-capture elements are unknown or poorly constrained - especially in the infrared spectral region, which is particularly prominent in KN spectra. A good representation for the complexity involved in calculations of atomic data for many of the neutron-capture elements, is neutral gold. Although the atom is a nominal one-electron system with a 5d(10) 6s ground configuration, representing the complete energy spectrum and transition properties comes with a range of theoretical challenges. In this contribution, we present new theoretical and experimental investigations of the atomic structure and radiative properties of gold, with a particular focus on the near-infrared spectral region. The calculations are mainly carried out with the relativistic atomic structure code GRASP2018. Furthermore, we use the case of gold as an example to discuss semi-empirical techniques via e.g. rescalings of matrix elements for improved accuracy of the calculated transition properties and KN expansion opacities. We argue that the development of such methods for ab initio atomic structure codes, such as GRASP, will be crucial for even more complex neutron-capture elements.

Study of superluminous supernova SN2020zbf

Anamaria Gkini **CT**

Stockholm University

Superluminous supernovae (SLSNe) is a class of intriguing transient objects, extremely bright with an absolute magnitude of $\mathrm{M} \sim -21$ and quite rare compared to the typical core-collapse SNe. Their extreme luminosities cannot be explained by conventional power sources, so alternative long-lived central engines such as magnetars or black hole accretion, interactions with dense circumstellar material (CSM), and radioactivity have been proposed. In this presentation, I will discuss the peculiar SLSN SN2020zbf, whose spectroscopic features appear unique even among SLSNe, initially leading to a redshift misclassification until we obtained a higher-quality spectrum through our X-shooter program. I will present analysis of the photometric and spectroscopic evolution of SN2020zbf, including putting it in context of other SLSNe, and our ongoing analysis of its unusual spectra.

Data Driven Optical Cool Dwarf Metallicities and Ti Abundances, and the Giant Planet–[Fe/H] Correlation

Adam Rains **CT**

Uppsala University

Detailed chemical studies of Solar-type stars have long been routine in stellar astrophysics, making possible studies in Galactic chemodynamics and exoplanet demographics. However, a similar understanding of the chemistry of M and late-K dwarfs—the most common stars in the Galaxy and most likely to host planets—has been greatly hampered by the complex molecular chemistry of their cool atmospheres. Here we present a new implementation of the Cannon, a data-driven model widely used in stellar astrophysics, developed for low–medium resolution optical (400–700nm) cool dwarf spectra. Our novel four parameter implementation in Teff, log g, [Fe/H], and [Ti/H] models both label uncertainties and missing labels, and is trained on 121 cool dwarf benchmarks—21 of which have literature elemental abundances measured from a warmer binary companion. Under leave-one-out cross-validation, we recover Teff, [Fe/H], and [Ti/H] with precisions of 2%, ±0.12 dex, and ±0.09 dex respectively, a precision which allows insight into the giant planet–[Fe/H] correlation for our sample of 65 TESS candidate planet hosts. Our work highlights the importance of precisely known benchmark systems; the promise of data-driven models for chemical analysis of the rich, but challenging to model, optical spectra of cool stars; and the utility of both in studying exoplanet demographics in the era of TESS and Gaia.

Modelling the Milky Way’s most metal-poor star

Cis Lagae **CT**

Stockholm University

Late-type ultra metal-poor stars are thought to be formed from interstellar gas enriched by only one to few supernovae. As such, their elemental abundances and total metal content are important in understanding the limits of star formation in the early universe and the chemical evolution of the Milky Way. In this talk, I will present an updated chemical abundance analysis of the most metal-poor star known to date (SDSS J102915+172927) using new stellar parameters from Gaia DR2 and a tailored 3D atmospheric model, first discussed by Caffau et al. (2011). This work showcases the advantages of state-of-the-art 3D atmospheric models and 3D NLTE radiative transfer compared to commonly used 1D LTE methods.

Astronomy from the Moon

Martin Sahlén **CT**

Uppsala University

Within this decade, astronomical telescopes on the Moon are likely to be a reality. I will outline some of the unique possibilities for astronomical investigations with lunar telescopes, from the origin of the Universe to biosignatures on exoplanets, and discuss prospects for Swedish participation.

The solar chemical composition

Anish Amarsi **IT**

Uppsala University

The composition of the solar photosphere is of fundamental importance in astronomy, as a basic input in models of solar and stellar structure and evolution, and as a yardstick with which to compare and understand other cosmic bodies. However, spectroscopic measurements remain hotly debated to this day, fuelled by lingering disagreements on the solar interior structure between what is predicted by theoretical models compared to what is found from helioseismic inversions (the solar modelling problem). I shall describe the state-of-the-art in solar abundance analyses, characterised by non-local thermodynamic equilibrium (non-LTE) radiative transfer in three spatial dimensions (3D), and compare our most recent photospheric estimates with measurements of the solar wind and of pristine meteorites. I shall also discuss the importance of atomic physics research in this context, with particular attention to data for carbon, nitrogen, and oxygen, the abundances of which are especially relevant to the solar modelling problem. Lastly I shall discuss our efforts to extend this "3D non-LTE" method to other FGK-type stars in the Galaxy.

Spatially-resolved radiative losses in the solar chromosphere

Jaime de la Cruz Rodriguez **CT**

Stockholm University

The solar atmosphere is hotter than predicted by assuming radiative equilibrium. This is most obviously evidenced by the high temperature of the solar corona, but the bulk of the energy deposition happens already down in the much cooler chromosphere. While in recent years we have gain detailed understanding of many important processes that must be at work in the chromosphere, also from numerical simulations, their exact contribution to the total energy budget remains unclear. Chromospheric heating or cooling can be estimated by calculating the radiative losses whenever a model atmosphere is available. Most comparisons between simulations and observations have used canonical values of radiative losses that have been derived from 1D models of spatio-temporal averages of solar spectra (e.g., FAL / VAL models). Such approach cannot capture the high complexity and fine structures that is observed in high resolution observations. In this talk, I will discuss the accuracy and challenges associated with the methods that we use to infer radiative losses from observations. I will also present our first spatially resolved maps of the radiative losses derived from very high spatial resolutions observations acquired with the Swedish 1-m Solar Telescope in the Ca II K, Ca II 8542 and Fe I 6301/6302 lines.

Small-scale magnetic fields with CRIRES

Axel Hahlin **CT**

Uppsala University

The upgraded high-resolution near-infrared spectrograph CRIRES at 8-m VLT began scientific operations last years. One of the instrument's key goal is to study the magnetic fields of stars. Here we present some early results, demonstrating CRIRES capability to perform magnetic field investigations. The instrument is capable of performing studies of both small- and large-scale fields. Here the first results are presented, we focus on the study of small-scale fields utilizing Zeeman broadening to detect the changing line shape that occurs when atoms are exposed to magnetic fields. The sample of observed stars is a collection of sun-like stars, most of which have been studied with other instruments at optical wavelengths. This also allows us to compare the performance of magnetic field studies at different wavelengths.

Pulsation properties of evolved red giants from 3D models

Arief Ahmad **CT**

Uppsala University

Evolved cool red giants such as Asymptotic Giant Branch (AGB) and red supergiant (RSG) stars have a dynamic atmosphere driven by pulsations. Deep and large convection cells play an important role in the excitation mechanism of the pulsations, though the interaction between convection and pulsation is complicated. Usage of full 3D radiation-hydrodynamical modelling is crucial in furthering our understanding of the properties of the pulsations, and the development of massive outflows associated with the AGB and RSG stars. Recent global simulations of the evolved cool red giants explore a wider range of stellar parameters than previously. The pulsations are self-excited and, thanks to the 3D nature of the simulations, we are able to carry out investigations associated with the pulsations throughout the stellar atmosphere. Important pulsation properties can be derived from the 3D models including the fundamental pulsation period. In this talk, I aim to present how the fundamental pulsation period may be extracted from the simulations as well as some of the difficulties involved in doing so due to the interplay between the convection and the pulsations. Furthermore, I will present recent analyses on correlations between the extracted pulsation properties and the stellar parameters of the simulated stars. The results from the analyses show good agreement with both observations and current theoretical understanding.

Stellar feedback from galactic bubbles and their impact on molecular clouds

Giuliana Cosentino **IT**

Chalmers University of Technology

Supernova remnants (SNRs) drive large-scale shocks that locally enhance the density of the surrounding material but also inject vast amounts of energy and momentum that largely perturb and disperse the Interstellar Medium (ISM). The interplay between these two effects is considered paramount in regulating the star formation efficiency in galaxies. However, how SNRs affect the physical conditions of the ISM is not well constrained from an observational point of view. In this talk, I will present our work aimed to address this question. I will show our study of the large scale shock triggered by the SNR W44 on the molecular cloud 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. I will also present our exploratory large single-dish observing program SHREC, aimed to observe the molecular shock tracer SiO(2-1) toward a sample of 30 SNRs known to be interacting with molecular clouds. I will introduce the aim and technical aspects of SHREC and present the first results obtained toward the SNRs IC443. IC443 is a well known SNR, expanding into and interacting with a nearby toroidal molecular cloud. Toward the major site of interaction, known as clump G, we estimate the mass of the shocked gas to be 100 Msun. The shock driven by IC443 into this material enhances its density by a factor >10, to value consistent with those required to ignite star formation. Finally, we estimate that between 35-50% of the momentum injected by IC443 is transferred to the nearby molecular material. Our work therefore indicates that the molecular ISM is an important carrier of the SNR momentum and that the SNR-molecular cloud interaction play a crucial role in the regulating star formation in galaxies.

The role of shear in shaping the Galactic Centre clouds

Maya Petkova **CT**

Chalmers University of Technology

The Central Molecular Zone (CMZ; the central ~ 500 pc of the Milky Way) hosts molecular clouds in an extreme environment of strong shear, high gas pressure and density, and complex chemistry. G0.253+0.016, also known as 'the Brick', is the densest, most compact and quiescent of these clouds. High-resolution observations with the Atacama Large Millimeter/submillimeter Array (ALMA) have revealed its complex, hierarchical structure. In this contribution I will compare the properties of recent hydrodynamical simulations of the Brick to those of the ALMA observations. To facilitate the comparison, we post-process the simulations and create synthetic ALMA maps of molecular line emission from eight molecules. We find excellent agreement in the kinematics of the simulated and the observed data in terms of the size-linewidth relation, the rotation of the cloud and its turbulent state. In addition, we characterise the spatial structure of the observed and simulated cloud using the density probability distribution function (PDF), spatial power spectrum, fractal dimension, and moments of inertia. While we find good agreement between the observed and simulated data in terms of power spectra and fractal dimensions, there are key differences in the density PDFs and moments of inertia, which we attribute to the omission of magnetic fields in the simulations. This demonstrates that the presence of the Galactic potential can reproduce global cloud properties, but additional physical processes are needed to explain the gas structure on smaller scales.

Near-Infrared view of massive star forming regions

Rubén Fedriani **CT**

Chalmers University of Technology

Massive stars play crucial roles in determining the physical and chemical evolution of galaxies. They shape their environments from early in their protostellar phase when they blast the surroundings with powerful jets, up until their violent deaths in the form of supernovae. The formation of massive protostars is still an open question and theories range from Core Accretion, i.e., a scaled-up version of low-mass star formation, to Competitive Accretion at the crowed centres of forming star clusters, to Stellar Collisions. In any case, they form deeply embedded in their parental clouds, making it challenging to directly observe these stars and their immediate environments. Notwithstanding, their massive outflows can extend several parsec and since accretion and ejection processes are intrinsically related, they can provide crucial information about the processes governing massive star formation very close to the central engine and reveal the elusive massive protostar. In this talk, I will walk you through an observational journey in massive star-forming regions, focusing on the infrared including data from the HST, VLT, LBT, Spitzer, SOFIA, and Herschel. I will present results from the SOFIA Massive (SOMA) Star Formation Survey that aims at understanding the basic formation mechanisms governing massive stellar birth through multi-wavelength observations and also through radiative transfer (RT) modelling of their spectral energy distributions (SEDs).

Friday, October 7

Improving planetary atmosphere characterization by 3D NLTE modeling of the stellar centre-to-limb effect

Gloria Canocchi **CT**

Stockholm University

The center-to-limb variation (CLV) of the stellar lines across the stellar disk is an important effect for planetary transit spectroscopy. Indeed the variation of spectral line profiles when the planet transits different part of the stellar disk can affect the determination of elemental abundances in the planetary atmospheres, as shown by Yan et al. (2017). Accurately modelling the CLV effect of planet-host stars is fundamental to better characterize the planetary transmission spectrum and to correctly detect and measure abundances of atmospheric species. However, we know that the commonly used 1D plane-parallel LTE atmosphere models fail to reproduce spatially resolved observations of the solar disk. 3D hydrodynamic models and non-LTE line formation is required for an accurate modelling of the CLV effect. So far, the best studied atomic lines in transit spectroscopy are the Na D lines and the NIR K resonance lines. In this talk I will present new results regarding the modelling of these lines in the Sun using 3D NLTE radiative transfer and discuss possible implications for transit spectroscopy.

Optimising Exoplanet Transit Spectroscopy Observations

Linn Boldt-Christmas **CT**

Uppsala University

Transiting exoplanets provide opportunities for us to observe their atmospheres and to analyse them using spectroscopy. As the characterisation of exoplanet atmospheres relies on the detection of spectrally resolved features, analysis can be improved with high signal-to-noise ratios (SNR) that are possible to obtain with modern spectrographs like CRIRES+ on VLT in Paranal, Chile. However, obtaining high SNR through adjusting exposure times comes with a trade-off. While a higher cadence minimises the spectral feature smearing that arises due to the continuously changing radial velocity of the planet, a lower cadence collects more photons with reduced overheads and readout noise, enhancing the signal-to- noise ratio (SNR) of each observation. As such, there is a need to establish what the optimal compromise is between the SNR and time resolution for a given target. In this presentation, we will discuss a new approach for establishing the optimal parameters for observing transiting exoplanets with spectroscopic instruments such as CRIRES+ using simulated spectra, cross-correlation, and other statistical methods. This will be particularly relevant for planning ground-based observational studies to characterise atmospheres for objects around cooler stars with more complex stellar spectra.

What else is there to see? Revisiting the transmission spectrum of WASP-189b

Bibiana Prinoth **CT**

Lund University

The ultra-hot Jupiter WASP-189 b has recently made the leap into the family of attractive targets for studying ultra-hot atmospheres. Although it has not yet been studied as intensively as its slightly colder siblings, the dynamical effects and richness of this planet's transmission spectrum make it very interesting, but also puzzling. This raises the question: What else is there to see? In January of this year, we published our study of WASP-189 b in Nature Astronomy, in which we discovered nine chemical species, including titanium oxide - a molecule thought to cause temperature inversions on ultra-hot Jupiters, similar to ozone in Earth's atmosphere. Our detections further provide direct observational evidence for dynamical effects in the planetary atmosphere. Ultimately, such planets are three-dimensional, and one might have suspected that such three-dimensional variations would also be observed in the terminator regions as different parts of the atmosphere rotate into view during transit. Thus, it has become necessary to consider the three-dimensional nature of these planets when modelling their atmospheres from scratch in order to interpret observations. We have conducted further observations using other spectrographs at high spectral resolution to obtain a complete measurement of the chemical inventory of this gas giant planet. In this talk, we present the results of our study and draw a comparison with theoretical predictions.

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

Judith Korth **CT**

Chalmers University of Technology

Hot Jupiters, exoplanet giant planets that orbit their host stars within 10 days, are rarely accompanied by smaller close-in companions. TOI-1130 is one of very these rare systems. In this talk, I will present the results from a photodynamical joint modelling of high-precision radial velocities, and transit photometry from the Transiting Exoplanet Survey Satellite (TESS) and the TESS Follow-up Observing Program. We determine the planetary and orbital parameters and find that the two planets orbit with small eccentricities in a 2:1 resonant configuration. This is the first known system with a hot Jupiter and an inner lower mass planet locked in a mean-motion resonance. TOI-1130 belongs to the small yet increasing population of hot Jupiters with an inner low-mass planet that challenges the pathway for hot Jupiter formation.

High-resolution spectroscopy of ultra-hot gas giant exoplanets

Jens Hoeijmakers IT

Lund University

Ultra-hot Jupiters form a new and exciting class of exoplanets that tend to orbit hot early type stars in short period, resulting in temperatures much exceeding 2000 K on their day sides. This extreme temperature leads to unique chemical characteristics: All but the most strongly bound molecules are dissociated into atoms, and a significant fraction of the atomic gas may be thermally ionised. Line absorption by metals and some molecules are the dominant sources of short-wave opacity, causing strong thermal inversions that results in observable emission lines of a wide variety of atoms that can be observed with high-resolution spectrographs. In this talk, I will share our latest results analysing the emission spectrum of the ultra-hot Jupiter WASP-121 b observed with ESPRESSO, and show how we can use these to constrain the chemistry of titanium and other metals around the globe.

Game-based learning at PhD-level in space physics

Gabriella Stenberg CT

Institutet för rymdfysik

This talk discusses the introduction of a game-based learning activity into a PhD-level course given at the Swedish Institute for Space Physics. The new activity is created to further develop the link to reality and to increase the collaboration between the students. The talk discusses the reasoning behind, the design and implementation, and finally the evaluation and conclusions drawn from the effort.

Star spotting, space engagement and Swedish attitudes towards research

Cissi Askwall IT

Vetenskap & Allmänhet

Despite fears of increasing fact resistance and false news, Swedes' confidence and interest in research is strong and surprisingly stable. One important factor that positively influences attitudes towards science is proximity. To be enrolled in higher education, to personally know researchers or to participate in science-related activities all contribute to boosting people's attitudes towards research and building their science capital. Space has always amazed people. Star spotting is a fascinating activity but gazing at the stars can also be a way to measure light pollution. Learn more about the international star spotting experiment as well as other ways of involving and engaging the public in space research.

Who is doing astronomy outreach in Sweden, and why?

Robert Cumming IT

Chalmers University of Technology

The world's astronomers really like to communicate with the public, and the public like astronomers to communicate with them. That's a big global generalisation; what do we actually know about the ground truth in Sweden? I'll survey the astronomy outreach landscape in Sweden, and think aloud about what we need to do in the new era of JWST, the SKA, satellite constellations and ever brighter skies.

ESERO Sweden - bringing the universe into the classroom

Cecilia Kozma CT

KTH, ESERO Sweden

Young people's fascination for space is an excellent starting point to inspire and increase knowledge in all STEM subjects. Current challenges in society concerning climate change and long-term sustainability require increased knowledge in science and technology, and the ability to think critically and creatively is becoming increasingly important in an uncertain world. With the aim to increase interest and knowledge in the STEM subjects by using space as a context and to encourage careers in space related fields the European Space Agency ESA has started up European Space Education Resource Offices (ESERO) in member states. Today there are twenty ESERO offices spread throughout Europe making it possible to support schools and teachers in different countries with specific educational system, school curriculum and language. ESERO Sweden started in the end of 2021 and is an initiative of ESA and the Swedish Space Agency. ESERO Sweden is run by KTH in collaboration with the Wisdome project's five science centers. ESERO Sweden has a large network of collaborators consisting of universities, the space industry, science centers, national resource centers, and other educational actors and space-related associations. Together we reach out to teachers and students nationally to inspire and increase knowledge. In order to support schools and teachers ESERO Sweden arranges teacher trainings in various space topics, produces educational materials and coordinates several ESA school projects. Activities and material are based on the Swedish curriculum and on teachers' needs and experiences to be a support in teaching within STEM.

Solar wind interactions with a changing comet ionosphere

Hayley Williamson IT

Institutet för rymdfysik

Comets are a group of small, icy solar system bodies with highly eccentric orbits. While comets at aphelion have little atmosphere, they begin to outgas as they approach perihelion, creating a coma. The neutral gas in the coma is then ionized by solar EUV into a comet ionosphere. The solar wind then shapes the ionosphere into the defining feature of a comet, a tail that extends up to a few AU long. A comet ionosphere is diffuse and gravitationally unbound, unlike that of a planet, but nevertheless its interaction with the solar wind can resemble a planet magnetosphere. A key feature of comets is their variability in outgassing, both between comets and with heliocentric distance. For example, comet 1P/Halley is a high activity comet, with a coma diameter of a few million kilometers and a fully-formed bow shock during its last perihelion. Comet 67P/Churyumov-Gerasimenko, visited by the Rosetta spacecraft from 2014 to 2016, is considered a low-activity comet, with a coma of a few hundred to a few thousand kilometers and little evidence of a bow shock. However, the Rosetta observations of a comet throughout much of its orbit allow us to understand how solar wind interaction processes such as ion pickup and mass loading change as the comet ionosphere changes. In this talk, we discuss the various in situ observations of comet ionospheres, as well as the changes in the ionosphere of comet 67P observed by the Rosetta plasma instruments.

Exploring Venus' Magnetosheath through Plasma Ion Measurements

Sebastián Rojas Mata CT

Institutet för rymdfysik

Venus is a prime target for studying how magnetized plasma flows interact with unmagnetized atmospheric bodies in our Solar System or around other stars. Its thick atmosphere and lack of an intrinsic magnetic field differentiate Venus' coupling to the solar wind from that of airless bodies (like Mercury or the Moon) or magnetized planets (like Earth or Jupiter). We can learn about this special interaction by analyzing long-term in-situ ion measurements to explore how Venus' plasma environment varies as a function of space or time, providing us insight into the relevant plasma physics of planetary magnetospheres. We overview recent characterizations of Venus' plasma environment based on data taken by the Ion Mass Analyser (IMA) instrument, a particle mass-energy spectrometer onboard ESA's Venus Express (VEX) mission which operated between 2006 and 2014. We discuss differences in proton temperature anisotropies between solar minimum and maximum and how these affect a particular plasma wave known as the mirror mode in the magnetosheath. We also compare proton parameters between different electromagnetic hemispheres of the magnetosheath to uncover asymmetries in the plasma environment and their possible causes. We compare the results to similar studies at Earth and Mars to draw broader conclusions in the context of comparative planetology.

Gaia and the disturbed Milky Way

Paul McMillan **IT**

Lund University

One of the most striking things that we have learned about the Milky Way from Gaia data is the extent to which it is disturbed. It is now clear that the Milky Way's disc is rippling up and down, seemingly because of the Sagittarius dwarf galaxy shaking it as it passed the disc some time ago. This has been best studied in the solar neighbourhood, where a clear 'phase spiral' has been observed: a strong dependence of typical rotational velocity around the galactic centre as a function of a stars height above the plane and vertical velocity. In this talk I will focus instead on the outer Milky Way disc, and show that a disturbance can be seen here too. This is a bifurcation of the velocity distribution into two clumps: one rotating slower around the galactic centre and moving downwards, and one rotating faster and moving upwards. I will show that this is also produced in simulations of the impact of the Sagittarius dwarf on the Milky Way disc, and argue that these disturbances will allow us to conduct 'Galactic-seismology' and determine the structure and history of the Milky Way with new clarity.

Stellar parameters in Gaia Data Release 3

Ulrike Heiter **CT**

Uppsala University

Gaia Data Release 3 (DR3) contains a wealth of new data products for the astronomical community. Astrophysical parameters are a major component of this release. They were produced by the Astrophysical parameters inference system (Apsis) within the Gaia Data Processing and Analysis Consortium, based on the astrometry, photometry, spectrophotometry, and spectroscopic data obtained by Gaia. This presentation gives an overview of the stellar atmospheric and evolutionary parameters contained in Gaia DR3 for up to 470 million sources. It describes where they can be found in the Gaia archive and how they were produced, and gives best practice usage advice. Selected examples from the Gaia DR3 performance verification papers are also presented, in which stellar parameters are analysed to illustrate the science potential of these data products.

Characterizing the Milky Way disc using age-metallicity distributions of GALAH and Gaia stars

Diane Feuillet **CT**

Lund Observatory

The age-metallicity relation of a galaxy is predicted to reflect its star formation history, providing significant insight into the galaxy's evolution. However, the observed age-metallicity relation of the Milky Way disk has historically been confusingly featureless, showing little correlation between the age and metallicity of stars. Recently, larger datasets and new statistical analysis methods have revealed significant detail and complexity in the age-metallicity relation of the Milky Way disk. We present a detailed map of the ages and metallicities of turn-off stars in the Milky Way disk based on data from GALAH DR3 and Gaia EDR3. From this map, we identify previously undetected features in the age-metallicity distribution of disc stars and interpret these results as indicating a three-phase formation history of the Milky Way. We also present an analysis of Gaia DR3 turn-off stars using the same method applied to Gaia spectroscopic parameters.

Investigating the early evolution of star clusters via their 6D kinematics

Joseph Armstrong **CT**

Chalmers University of Technology

Most stars form in clusters or associations but only a small number of these groups remain bound for longer than ~ 50 Myr. Once star formation has ended and the molecular gas around young stellar objects has been expelled via feedback processes, the majority of initially bound young clusters lose most of their binding mass and begin to disperse into the galactic field (Gutermuth et al. 2009). Other processes, such as ejection of cluster members via dynamical interactions and tidal shearing, can also influence the subsequent evolution of groups of young stars. Using Gaia eDR3 5-parameter astrometry (Gaia Collaboration et al. 2021a) in combination with radial velocities from large scale surveys such as Gaia, APOGEE, GALAH, LAMOST, Gaia-ESO and RAVE (calibrated by Tsantaki et al. 2022), as well as original spectroscopic observations of the nearby (~ 410 pc; de Zeeuw et al. 1999) Vela OB2 association (Armstrong et al. 2022), we analyze the 6D kinematics of a large sample of nearby young clusters and associations, calculating velocity dispersions, rates of expansion and rotation, and kinematic ages to probe their formation history and identify the key processes responsible for their subsequent evolution. In particular, we find significantly anisotropic expansion trends for more than 30 clusters younger than ~ 100 Myr within 1kpc and we determine the direction of maximum expansion for each cluster.

Square Kilometre Array - Status and Science Opportunities

John Conway CT

Chalmers University of Technology

The Square Kilometre Array (SKA) radio telescope array who elements are currently being constructed in Australia and South Africa will be the next next huge step in centimetre and metre wavelength radio astronomy. The SKA is designed to be a cornerstone within 21st century astronomy working together with other major instruments such as the ELT, Vera Rubin telescope, JWST, ALMA, NgVLA, X-ray and other satelite missions. The main science goals of the SKA will be presented, focussing on areas of special interest to Swedish astronomers. Funding for Sweden's full participation and scientific access to the SKA is confirmed. National efforts for preparing for SKA in Sweden, including the establishment of a Swedish node of the globally distributed data processing and archiving network will be described. The SKA is expected to be fully constructed by 2028 but with Science Verification proposals to use the partial SKA already due by March 2026. In addition several SKA Pathfinder/Precursor telescopes are already fully operational and producing outstanding results; the opportunities and support available for Swedish astronomers to use these precursor facilities will be described.

Imaging neutral gas in high-redshift analog galaxies

Alexandra Le Reste IT

Stockholm University

Reionization is the last major phase transition of the Universe, during which the intergalactic medium went from primarily neutral to ionized. Primeval star forming galaxies are currently the favored candidate sources for the ionizing continuum radiation (Lyman Continuum, LyC) that reionized the Universe. However, processes allowing the escape of LyC emission out of the interstellar medium of galaxies are still poorly understood, due to the limits of high redshift observations. Haro 11 is the closest (z 0.02) confirmed LyC leaking galaxy. It is considered an analog of high-redshift galaxies, and has been used for years as a laboratory to understand and observationally constrain the processes that enable LyC radiation to escape into the intergalactic medium. Neutral gas (HI) absorbs ionizing photons and is thus the primary component of galaxies hindering LyC escape. It is best observed with the 21cm line of Hydrogen which is a direct tracer of HI. However, the two previous 21cm observations of the Haro 11 have yielded puzzling results. Very different line profiles were detected in each observation, and the emission in the galaxy could never be resolved, leaving major uncertainties on the neutral gas distribution enabling the escape of LyC photons from this galaxy. Our MeerKAT observations of Haro 11 have enabled the first imaging of HI emission in a LyC leaking galaxy and reconcile the two previous 21cm observations. We find that in Haro 11, merger interactions have facilitated the escape of ionizing photons to the intergalactic medium. I will discuss how galaxy mergers can contribute to LyC escape from galaxies and the reionization of the Universe.

The search for faint companions to massive galaxies at high-redshift: the case of AzTEC-3 and BRI0952

Kiana Kade **CT**

Chalmers Univerity of Technology

The rapid build-up of stellar mass during intense starbursts at high redshifts represents an important evolutionary state for massive galaxies. Many questions remain open about this extreme phase, for example: what is the role of and impact on the environment of companion sources around these galaxies, and how does feedback affect their starburst phase? We present deep, high-resolution ALMA band 7 [CII] observations of BRI0952-0115, a lensed quasar at z~ 4.4, and AzTEC-3, a submillimeter galaxy (SMG) at z~ 5.3. We detect companion sources bright in [CII] emission surrounding both objects within a radius of 3 arcseconds (~ 19 kpc) of the central sources. The [CII] line structure for both sources exhibit complex broad emission line profiles, indicating the possible presence of outflows. Additionally, we present evidence of a 'gas bridge' between the SMG and one companion source and tentative evidence of a velocity gradient between the SMG and another companion. Extrapolated star-formation rates from the central sources indicate both contain starbursts of $\gtrsim 1000$ solar masses per year, suggesting the possibility of the faint companions as gas suppliers to their massive counterparts. These results provide additional evidence in support of the hypothesis that massive galaxies form in over-dense regions, growing through minor or major mergers with companion sources.

Investigating local CONs with MUSE

Clare Wethers **CT**

Chalmers University of Technology

(Ultra-) luminous infrared galaxies (U)LIRGs host the most extreme starbursts in the local Universe and have been shown to commonly exhibit outflows. Such outflows distribute material and inject energy into the ISM, regulating both star formation in the galaxy and accretion onto the central supermassive black hole. In recent years, a significant fraction ($\sim 20-40\%$) of local (U)LIRGs have been shown to host compact (r<100 pc) obscured nuclei (CONs) with extreme nuclear column densities, $N_{\mathrm{H}_2} >> 10^{24}\,cm^2$. While the nature of CONs remains unclear, with both an AGN and/or starburst activity suggested as potential nuclear power sources, it is possible that CONs play a critical role in galaxy evolution, marking an early obscured phase of starburst galaxies and AGN. Due to their increased star formation and high gas column densities, CONs provide ideal laboratories in which to study star formation and quenching in extreme ISM conditions. Here, I present new, targeted integral field unit (IFU) observations from the Multi-unit Spectroscopic Explorer (MUSE) for several local CONs. Based on kinematic measurements, we reveal the presence of centrally concentrated optical outflows. We explore the potential driving mechanism(s) behind these outflows and comment on the impact of such outflows on the CON hosts, particularly in terms of fuelling and/or quenching star formation in the galaxy.

The edges of galaxies: from dwarfs to giants

Nushkia Chamba **CT**

Stockholm University

The outskirts of galaxies have been studied from multiple perspectives for the past few decades. However, it is still unknown if all galaxies have clear-cut edges like everyday objects. In this contribution, we present physically motivated criteria to define the edges of galaxies, based on the gas density threshold required for either past or ongoing in-situ star formation. We will discuss the analysis of 1000 nearby galaxies using ultra-deep optical imaging and how the radial location of their edges ($R_{\rm edge}$) depends on galaxy morphology and global stellar mass. Remarkably, the stellar mass-size relation using R_{edge} as a physically motivated galaxy size measure has a very narrow intrinsic scatter (< 0.06 dex) over nearly four orders of magnitude in stellar mass. We will discuss the implication of our findings on the growth and evolution of galaxies.

Cosmic phases of star formation in Milky Way-like galaxies

Álvaro Segovia Otero **CT**

Lund University

Star formation histories result from a combination of the evolving cosmological environment as well as the internal processes in the galaxy. To bring some undertanding into this topic I use VINTERGATAN, a 20 pc cosmological hydrodynamical zoom-in simulation, to explain how different phases of star formation are triggered across cosmic time. I demonstrate how morphological transformations along with a merger-driven environment trigger multiple starburst episodes, seen as sharp changes in gas depletion times and local star formation efficiencies. My work puts VINTERGATAN, a simulation with Milky Way-like properties (e.g. chemical dichotomy, last major merger, rotational velocity and stellar surface profiles), into the context of the current paradigm of extragalactic star formation (cf. the PHIBSS survey): galaxies spend most of their lives in the main sequence of star formation, with outliers explained by rapid transitions between the different modes of star formation.

Modified propagation of gravitational waves from the early radiation era

Yutong He **CT**

Nordita & Stockholm University

We propagate an initial spectrum of gravitational waves (GWs) typical of a magnetohydrodynamic source from the early radiation era till the present day. Compared to the standard solution in general relativity, we study the effects that modified GW parameters, such as the run rate of the effective Planck mass α_{M} and the tensor speed excess α_{T}, can have on the present-day GW spectrum. Numerical solutions indicate that α_{M} can introduce an enhancement or suppression to the energy spectrum in the infrared regime or across all scales, depending on the values and parameterization choices of α_{M}. In comparison, α_{T} introduces relatively more modest changes, especially given that its value is tightly constrained at the present day. We also note a few shortcomings of the corresponding WKB approximation, and discuss the observational implications in light of the Hubble tension and future detectors such as LISA and SKA.

Posters

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5	Gayathri Viswanath	Imaging pursuit of an elusive planet, epsilon Indi Ab, in the near to mid-infrared
6	Joachim Wiegert	Radiative transfer simulations of dust around AGB-stars
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13	Terese Olander	Atmospheric parameters of M dwarfs for PLATO
14	Chi Yan (Paul) Law	Polarised emissions from IRDCs: a tale of two clouds
15	Andri Spilker	Bird's eye view of molecular clouds in the Milky Way: connecting small scale star formation to galactic scales
16	Govind Nandakumar	The Galactic Chemical Evolution of phosphorus observed with IGRINS
17	Santiago del Palacio	Non-thermal emission from the colliding-wind binary "Apep"
18	Kyoko Onishi	CON-quest: dynamical properties of dense molecular gas in galaxies with moderate infrared luminosities
19	Shilpa Bijavara Seshashayana	Determining Fluorine abundance of cool giants in open clusters
20	Brandt Gaches	The Impact of Cosmic-Ray Attenuation on the Carbon Cycle Emission in Molecular Clouds
21	Carina Persson	TOI-2196 b: Rare planet in the hot Neptune desert transiting a G-type star

22	Lars Mattsson	Multiphase modelling of dust-driven AGB winds including drift and full-spectrum grain-size dependence
23	Chia-Jung Hsu	Chemistry and Cores in Cloud Collisions
24	Sofia Feltzing	An Old, Metal-rich Accreted Stellar Component in the Milky Way Stellar Disk
25	Johan Kärnfelt	”Excellentissimo tubo Dollondiana”: The 10-foot achromatic refractor of the Royal Swedish Academy of Sciences
26	Dan Kiselman	The European Solar Telescope
27	Dan Kiselman	The Institute for Solar Physics and the SST
28	Urban Eriksson	Traversing the powers of 10: Students’ experiences of spatial scales
29	Holly Andrews	The complex circumstellar environment of the red supergiant NML Cyg
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32	Iskra Georgieva	Testing the limits of multi-dimensional Gaussian processes in characterising RV stellar and planetary signals
34	Madeleine Burheim	Experimental spectroscopic investigation of Zr II
35	Tanja Nymark	Astronomy activities for schools and the general public at the Stockholm House of Science
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Posters abstracts

1 - Studying Extragalactic Star Clusters Using Wide-field Surveys

Christopher Usher

Stockholm University

Since their observed properties today reflect both the physics of their formation and their survival, star clusters are powerful probes of how galaxies form and evolve. The deep multi-band imaging provided over a wide area of the sky by upcoming surveys such as LSST carried out by Rubin Observatory will allow us to study the star cluster populations of an unprecedented number of galaxies. I will discuss how we will use Rubin data to identify and study the physical properties - age, mass and metallicity - of star clusters. I will also talk about what the populations of star clusters can tell us about how their host galaxies formed and assembled and what the star clusters can tell us about the dark matter content of galaxies.

2 - Exoplanet Results with CRIRES+

Ansgar Wehrhahn

Uppsala University

Since the first exoplanet detection we have been fascinated with their properties, but still little is known about their atmospheres, especially for low-mass planets like sub-neptunes and super-earths. In this study, transit spectroscopy was used to probe the atmospheres of several promising targets with the new CRIRES+ spectrograph at the VLT. This high-resolution near-infrared instrument is ideal for such observations and produces the excellent SNR spectra required to extract the small atmosphere signal from the observations. In this talk we present our first results of the atmosphere characterization with well-established cross-correlation techniques as well as newly developed methods to extract the transmission spectrum of the exoplanet atmosphere.

3 - Hot Jupiters, Cold Kinematics

Alexander Mustill

Lund University

The properties of a planetary system may be influenced by properties of the host star, such as its birth environment or age. Recently, a link has been found between a star's local phase space density in the Galaxy and the presence of a hot Jupiter, with hot Jupiters preferentially found around stars with higher local phase space densities. These densities are derived from both the positions and the velocities of the star of interest and its neighbours, and hence convey more information than the spatial density based on position alone. Using astrometric and radial-velocity data for exoplanet hosts and their neighbours from Gaia EDR3, we show that the phase space density is primarily determined by a star's Galactic kinematics – notably, its orbital velocity around the Galactic centre relative to a circular orbit. Stars on kinematically "colder", near-circular, orbits have higher local phase space densities than stars on kinematically "hotter", less-circular, orbits. Once this kinematic effect is accounted for, we find no evidence that the hosts of hot Jupiters are in higher-density regions of phase space than other stars. Because younger stars are on average on colder orbits, we argue that the preference for hot Jupiter hosts to be in high-density regions reflects an age bias: hot Jupiters are more common around younger stars, before their population is reduced by tidal inspiral and engulfment of the planets. This study highlights a synergy between observations of exoplanets and Galactic dynamics, made possible by Gaia. This work is published in A&A https://ui.adsabs.harvard.edu/abs/2022A%26A...658A.199M/abstract

4 - Polarization in the ELAIS-N1 LOFAR deep field: Probing the sub-mJy regime of polarized extragalactic sources

Sara Piras

Chalmers University of Technology

We present a polarimetric study at 114.9–177.4 MHz of the ELAIS-N1 deep field, one of the deepest of the LoTSS Deep Fields so far. An area of 25 deg^2 was imaged at 6”-resolution in the Stokes Q,U parameters. A 1σ sensitivity of 17 μJy/beam was reached in the central part by aligning the polarization angles and stacking datasets from 19 eight-hour-long epochs taken in two different observing cycles. A search for polarization was carried out in the final stacked dataset and the properties of the detected sources were examined, resulting in the deepest and highest-resolution polarization study at 150 MHz to date. 26 polarized sources were detected, of which 5 were not detected at any other radio frequency before. The sources are weakly polarized, with a median degree of polarization of 1.85%. Most of them are FRII radio galaxies. The depolarization of sources known to be polarized at 1.4 GHz was quantified and used to constrain models of polarized source counts at 150 MHz.

5 - Imaging pursuit of an elusive planet, epsilon Indi Ab, in the near to mid-infrared

Gayathri Viswanath

Stockholm University

Developments in theoretical knowledge as well as instrumentation have, in the past decade, pushed the boundaries of what high-contrast imaging can achieve, both in terms of detection sensitivity and constraining planet properties. Direct imaging surveys in the near-infrared (NIR) and longward wavelengths have proven particularly useful in detecting younger giant planets at wide orbital separations. The scientific work outlined in this talk is one such result of an imaging pursuit of a young giant planet which has long eluded NIR imaging surveys in the past, yet revealing its existence via radial velocity trends and astrometry of its Sun-like, parent star, epsilon Ind A, which is near enough to be visible to the naked eye in the night sky. I present results from its observations using both the NaCo (L') and NEAR (10–12.5 microns) instruments at VLT, derive brightness limits from the non-detection of the companion with both instruments, and interpret the corresponding sensitivity in mass based on both cloudy and cloud-free atmospheric and evolutionary models. We arrive at unprecedented sensitivities close to the bright star (200-300 K) and constrain the age of the system to at least 2 Gyr from our analysis. NaCo offers the highest sensitivity to the planetary companion but the combination with NEAR wavelength range adds a considerable degree of robustness against uncertainties in the atmospheric models. This underlines the benefits of including a broad set of wavelengths for the detection and characterisation of exoplanets in direct imaging studies. The new constraints for epsilon Indi Ab derived in this work set a firm foundation for further MIR imaging surveys for the planet, especially with upcoming more sensitive, advanced instruments in the latter half of the decade, giving hope for a possible detection of this elusive giant in the near future.

6 - Radiative transfer simulations of dust around AGB-stars

Joachim Wiegert

Uppsala University

Three-dimensional radiative transfer simulations are useful tools to connect theory and observations. To simulate emitted and scattered light from circumstellar dust, I use RADMC-3D, which is a versatile Monte-Carlo based 3D radiative transfer simulator for dusty media and is written by Dullemond et al. (2012). I will present a short summary on dust around Asymptotic Giant Branch (AGB) stars and work I have done with RADMC-3D on such dust. This includes comparisons of observable differences between various parametrised dust distributions and preliminary results from using radiation-hydrodynamical simulated data from CO5BOLD as input to RADMC-3D simulations.

7 - Deep Search for Glycine in the Barnard 5 Methanol Hotspot

Tadeus Carl

Chalmers University of Technology

Glycine (NH2CH2COOH) is the simplest amino acid used by terrestrial lifeforms. In astrobiology/-chemistry, it is a common hypothesis that the prebiotic materials necessary for the development of life on Earth could originate from interstellar space (e.g., Ehrenfreund & Charnley 2000). To test this hypothesis, astronomers searched for glycine in different interstellar environments for more than four decades (e.g., Brown et al. 1979, Kuan et al. 2003). However, no clear detection has been made to this day. Observational searches have focused largely on warm protostellar sources, because (1) many complex organic molecules (COMs) have been identified in those sources, and (2) it has long been assumed that the formation of glycine could only happen by means of energetic irradiation of interstellar ices (e.g., Lee et al. 2009). However, more recent observations have shown that COMs are also present in dark clouds (e.g., Bacmann et al. 2012, Taquet et al. 2017). In addition, recent experimental and theoretical work shows that glycine can form even in the absence of energetic irradiation at low temperatures (Ioppolo et al. 2021). In our study, we used the Onsala 20m telescope to search for glycine in the so-called methanol hotspot in Perseus' Barnard 5 region. The methanol hotspot is a cold source (Tex ~ 7.5 K) with yet large COM abundances (Taquet et al. 2017). With a total observation time of approx. 150 h, we were not able to detect glycine, but we derived upper limit column densities of both glycine conformers I and II of $7.46 \times 10^{11} \mathrm{cm}^{-2}$ and $3.57 \times 10^{10} \mathrm{cm}^{-2}$, respectively.

8 - Astronomdagarna

Dan Kiselman

Stockholm University

The classic poster on the history of the Astronomdagarna event will be brought up to date.

9 - Svenska astronomiska sällskapet/Swedish Astronomical Society

Dan Kiselman

Svenska astronomiska sällskapet

The Swedish Astronomical Society was funded in 1919. Its past, present, and future will be presented in a poster.

10 - The collimation and acceleration zone of double-sided AGN jets

Anne-Kathrin Baczko

Max Planck institute for radio astronomy

Besides decades of observational studies the formation and collimation of relativistic jets in Active Galactic Nuclei is not yet fully understood. Observations of strongly relativistically boosted Blazar jets suggest a change from a confined, accelerating jet with a parabolic geometry to a freely expanding jet with a conical geometry at distances of 10 000 to 1 000 000 Schwarzschild radii. This is in accordance with theoretical expectations for the transition region from a magnetically to a kinetically dominated jet. On the basis of the nearby LINER NGC 1052 I will discuss the unusual cylindrical geometry and continuum spectrum of a double-sided jet with multi-frequency VLBI observations. By comparison with GRMHD simulations this cylindrical structure can be explained by the contribution from an accretion disk wind, which is expected to be reduced with increasing frequency. Indeed, our measurements at millimeter wavelengths suggest a deviation from the cylindrical profile at distances of a few hundred Schwarzschild radii closer to the central engine, implying a second geometry break.

11 - Ladder of methanol formation on dust icy mantels

Anna Punanova

Ural Federal University / Chalmers University of Technology

Methanol is very important for the growth of molecular complexity in the interstellar medium since it is a key precursor for many organic and prebiotic molecules found in regions of star- and planet formation. Methanol is widely observed at the earliest stages of star-formation, towards cold dense prestellar cores, where it is supposed to be formed in a sequence of ice surface reactions of CO hydrogenation. The chemical models predict that gas-phase methanol is expected to be abundant at the edge of the CO-depletion zone, where surface of dust icy mantles is rich with CO, actively adsorbed from gas. The freeze-out rate of methanol there does not overcome its production rate, and thus correlate with visual extinction. In this work, we test the chemical model MONACO against a homogeneous observational set of methanol, formaldehyde, CO (observed with the IRAM 30 m antenna) and Av maps (based on the Herschel/SPIRE observations) towards seven dense cores in L1495 in Taurus. We also try to disentangle the HCO emission that comes from HCO formed in the gas phase and on the ice surface and reconcile the model with the observational results for core B10-1/L1495.

12 - Dust evolution in photon dominated regions

Thiébaut Schirmer

Chalmers University of Technology

Dust plays a crucial role in numerous physical and chemical processes in the interstellar medium (ISM). Variations of physical conditions in the ISM trigger evolution of the dust properties which strongly impact the gas (Schirmer et al. 2021). It is therefore important to understand how dust evolves with the local environment. We study dust evolution through its emission in nearby photon-dominated regions (PDRs) where the physical conditions vary widely but can be spatially resolved. We focus on the Horsehead Nebula, IC63, and the Orion Bar, three well-known PDRs which have been extensively studied. To model the dust emission and scattering across these PDRs, we use the THEMIS dust model (Jones et al. 2013, 2017). A 3D continuum radiative transfer code, SOC (Juvela 2019), is then used to assess dust emission at different positions inside these PDRs. We constrain dust properties in the Horsehead (Schirmer et al. 2020), IC63 and the Orion Bar (Schirmer et al. 2022, submitted) and we find that regardless of the PDR, the nano-grains are depleted and that their minimum size is larger than in the diffuse ISM. The evolution of the nano-grain dust-to-gas mass ratio with both the intensity and temperature of illuminating stars indicates a competition between the nano-grain formation through the fragmentation of larger grains and the nano-grain photo-destruction. We model dust collisions driven by radiative pressure with a classical 1D approach to show that this is a viable scenario to explain the nano-grain formation through fragmentation and therefore the variation in nano-grain dust-to-gas mass ratio from one PDR to another.

13 - Atmospheric parameters of M dwarfs for PLATO

Terese Olander

Uppsala Universitet

M dwarfs are an important target in the search for Earth-like exoplanets and they are part of the target sample of the future space telescope PLATO. PLATO's mission is to look for habitable exoplanets around cool stars and at least 5000 M dwarfs are in its target sample. In order to fully characterise exoplanets the host star first needs to be well-understood. For this purpose a pipeline has been developed within the PLATO project that will be applied to the target sample. The pipeline uses Bayesian inference to combine spectroscopy, photometry, and asteroseismology. It has been developed and tested on FGK stars, and we have modified this pipeline to work on M dwarfs in the H-band. Observing in the near-infrared is beneficial for M dwarfs because there are less molecular lines and we have more flux. The main part of the pipeline for M dwarfs is the spectroscopic module. This module is based on the artificial neural network; "The Payne" and fits a model to an observed spectrum. From this we get effective temperature, metallicity, and chemical abundances of various elements. We use Basti isochrones to fix the surface gravity in order to break degeneracies. We tested the modified pipeline on a sample of stars with spectra from the APOGEE survey. Binaries and stars with interferometric observations are included in the sample. We found a good agreement between our derived values and literature values. Teff agrees within 100 K, log g within 0.1 dex and [Fe/H] within 0.1 dex.

14 - Polarised emissions from IRDCs: a tale of two clouds

Chi Yan (Paul) Law

Chalmers University of Technology

Observations of polarized dust emission indicate that B-fields play an important role in massive star and cluster formation. Here we study polarized dust emissions from two Infrared Dark Clouds (IRDCs) using SOFIA-HAWC+. First, in IRDC G38.9-0.74, we find relatively ordered polarization vectors, likely implying the presence of an ordered large-scale B-field. We have observed this IRDC with GBT-Argus in 13CO(1-0) from which we estimate B-field orientation via the velocity gradient technique (VGT). However, we do not find any significant correlation between B-field direction inferred from dust polarization and from the VGT, perhaps due to effects of gravity or feedback shocks. Second, in IRDC G28.2-0-05, which hosts a mass protostar forming in relative isolation, we observe a flip in polarization angles at 53um compared to 214um. We interpret this as due to dichroic extinction at 53um, consistent with predictions of core accretion models of massive star formation.

15 - Bird’s eye view of molecular clouds in the Milky Way: connecting small scale star formation to galactic scales

Andri Spilker

Chalmers University of Technology

A crucial aspect in interpreting the scaling relations relevant for star formation - the Kennicutt-Schmidt relation and Larson’s relations - is how they depend on size-scale. This is especially so when comparing relations derived from unresolved, extra-Galactic data to those derived from resolved, Galactic data. We present an experiment in which the Solar neighbourhood (distance < 2 kpc) is examined from the outside, with the aim to unveil the connection between the true, “resolved” properties of star-forming regions and their beam-averaged, “unresolved" properties. To do so, we examine the density, velocity and star formation statistics in the Solar neighbourhood clouds and determine how they appear when viewed through apertures of various sizes. The experiment results in a census of gas clouds within 2 kpc and a description of their column density distributions and velocity dispersions. We show how these diagnostics combine to form aperture-averaged diagnostics and describe their scale-dependency. Finally, we show how the density structures of individual clouds give rise to a kpc-scale Kennicutt-Schmidt-like relationship as a combination of sampling effects and blending of different galactic environments. This represents an important step in linking together Galactic and extra-Galactic knowledge on star formation.

16 - The Galactic Chemical Evolution of phosphorus observed with IGRINS

Govind Nandakumar

Lund University

Phosphorus (P) is considered to be one of the key elements for life, making it an important element to look for in the abundance analysis of spectra of stellar systems. Yet, there exists only a handful of spectroscopic studies to estimate the P abundances and investigate its trend across a range of metallicities. This is due to the lack of good P lines in the optical wavelength region and the requirement of careful manual analysis of the blended P lines in near infrared H band spectra. We determine P abundances for 37 K giants stars by fitting CO blended phosphorus line at 16482.92 Å in their IGRINS HK band spectra. We have reliable stellar parameters estimated using optical FIES spectra obtained in a previous study of a set of stars called Giants in the Local Disk (GILD). I will present [P/Fe] vs [Fe/H] trend for these stars in the metallicity range of -1.2 dex < [Fe/H] < 0.4 dex. We find that our trend matches well with the compiled literature sample but slightly higher than the theoretical chemical evolution trend in Cescutti et al. (2012) resulting from core collapse supernova (type II) of massive stars with the P yields from Kobayashi et al. (2006) arbitrarily increased by a factor of 2.75. Thus the enhancement factor might need to be a bit higher to match our trend. We also find an empirically determined primary behaviour for phosphorus. Furthermore, the phosphorus abundance is found to be elevated in the s-enriched stars.

17 - Non-thermal emission from the colliding-wind binary "Apep"

Santiago del Palacio

Chalmers University of Technology

Massive stars launch powerful, hypersonic outflows in the form of winds. In massive binary systems, these stellar winds collide and give rise to strong shocks capable of accelerating relativistic particles. Here we present an overview of the physics behind the non-thermal emission from colliding-wind binaries. In particular, we show how a combination of theoretical modelling and multi-wavelength observations allow us to investigate the cosmic-ray acceleration and magnetic field intensity in the wind-collision region. We emphasize the great synergy between observations at radio frequencies and high-energies (X-rays and gamma-rays) for studying relativistic processes in systems such as the Wolf-Rayet binary "Apep".

18 - CON-quest: dynamical properties of dense molecular gas in galaxies with moderate infrared luminosities

Kyoko Onishi

Chalmers university of Technology

Recent observations towards luminous infrared galaxies (LIRGs) discovered a population of galaxy nuclei that seem to be undergoing intensive growth. Such a nucleus is called a compact obscured nucleus (CONs), and one of the key points of CONs is the extreme environment indicated by it's compactness (<100pc) and large column density ($N_{H_2} > 10^{25}/\mathrm{cm}^2$). A survey for CONs (Falstad et al. 2021; CON-quest) showed that CONs exists primarily in (U)LIRGs, and galaxies with moderate infrared luminosity (subLIRGs) do not seem to have CONs. We searched for a dynamical evidence for such disappearance of CONs in subLIRG sample. We discuss non-circular dynamical features in each galaxy and seek for relations with nuclear activities.

19 - Determining Fluorine abundance of cool giants in open clusters

Shilpa Bijavara Seshashayana

Malmö University

Fluorine is an astrophysically intriguing element: not only is it highly reactive and it is the most electronegative element, but its cosmic origin remains unclear with five possible sources being suggested over the years: core-collapse supernovae, low-mass asymptotic giant branch (AGB) stars, Wolf-Rayet stars during the early He-burning phase, rapidly rotating low-metallicity high-mass stars, and/or novae. Determining the F-abundances in "simple" populations of open clusters might help narrow down the possible sources. In this poster, I will present a work in progress where we determine the abundances of Fluorine in 20 stars in seven open clusters; King 11, NGC 6791, NGC 7044, NGC 7789, NGC 6819, Ruprecht 171, and Trumpler 5. The stellar spectra come from the GIANO-spectrometer on the TNG-telescope and the F-abundance is determined from the HF molecular line in the K band around 2.3 microns using the PySME-code.

20 - The Impact of Cosmic-Ray Attenuation on the Carbon Cycle Emission in Molecular Clouds

Brandt Gaches

University of Cologne/Chalmers University of Technology

Emission from carbon cycle species (C+, C, CO) is commonly used to infer gas properties in the interstellar medium but this type of analysis is sensitive to the assumed cosmic-ray ionisation rate. As cosmic rays propagate through molecular clouds, they lose energy, leading to the formation of an ionisation gradient. However, astrochemical models typically utilize a constant ionisation rate. I will present a post-processed chemical model of a simulated diffuse and dense cloud where the chemistry includes a three-dimensional prescription for cosmic-ray attenuation. The clouds exhibit a correlation between the cosmic-ray ionisation rate and gas density, which is explained by an average column density-density relation. The abundances and column densities of carbon cycle species are significantly impacted by the chosen cosmic-ray ionisation rate model: no single constant ionisation rate can reproduce the attenuated cosmic-ray model. I will show that constant ionisation rate models fail to simultaneously reproduce the integrated emission of the lines we consider, and their deviations from a physically derived cosmic-ray attenuation model are too complex to be simply corrected. Finally, I will conclude by providing a number of implementation recommendations for CR ionisation rates in astrochemical models.

21 - TOI-2196 b: Rare planet in the hot Neptune desert transiting a G-type star

Carina Persson

Chalmers University of Technology

Highly irradiated planets in the hot Neptune desert are usually either small (R < 2 $R_{\mathrm{E}arth}$) and rocky or they are gas giants with radii of >1 Rjup. Here, we report on the intermediate-sized planet TOI-2196 on a 1.2 day orbit around a G-type star. We collected 42 radial velocity measurements with the HARPS spectrograph to determine the mass. The radius of TOI-2196 b is 3.51 +/- 0.15 $R_{\mathrm{E}arth}$, which, combined with the mass of 26.0 +/- 1.3 $M_{\mathrm{E}arth}$, results in a bulk density of 3.31+0.51-0.43 g/cm3. A significant trend in the HARPS radial velocities points to the presence of a distant companion with a lower limit on the period and mass of 220 days and 0.65 Mjup, respectively, assuming zero eccentricity. The short period of planet b implies a high equilibrium temperature of 1860 +/- 20 K, for zero albedo and isotropic emission. This places the planet in the hot Neptune desert, joining a group of very few planets in this parameter space discovered in recent years. These planets suggest that the hot Neptune desert may be divided in two parts for planets with equilibrium temperatures of > 1800 K: a hot sub-Neptune desert devoid of planets with radii of 1.8-3 $R_{\mathrm{E}arth}$ and a sub-Jovian desert for radii of 5-12 $R_{\mathrm{E}arth}$. Planetary interior structure models of TOI-2196 b are consistent with a H/He atmosphere mass fraction between 0.4 % and 3 %, with a mean value of 0.7 % on top of a rocky interior.

22 - Multiphase modelling of dust-driven AGB winds including drift and full-spectrum grain-size dependence

Lars Mattsson

Nordita

We present first results from a project aiming at producing the first ever multiphase models of O-rich as well as C-rich dust-driven AGB winds including drift and full-spectrum grain-size dependence. Our earlier (T-800) models are either based on a one-fluid approach (position coupling between gas and dust) or a two-fluid approach including drift. In the latter case, having more than one dust type requires an (n + 1)-fluid, where n is the number of dust types. However, this still requires that each dust type/component is represented by a characteristic grain size, which turns out to be a questionable approach. We therefore explore the effects of including a spectrum of grain-sizes, so that we have an (n*i + 1)-fluid model, where i is the number of grain-size bins considered. We note that drift, size-spectrum effects and assumptions regarding dust-growth efficiency (the sticking probability, in particular) are dependent on each other and the physical effects cannot easily be disentangled. We show that differences between two-fluid models and multi-fluid models are sometimes very significant. Correct modelling of dust-driven winds is thus a huge computational effort requiring of the order 100 dust-fluid components with independent dynamics (drift) with high spatial resolution. Models of dust-driven AGB winds has in the last few years gone from something one could run on any modern PC to a challenging HPC problem, requiring state-of-the-art computing clusters.

23 - Chemistry and Cores in Cloud Collisions

Chia-Jung Hsu

Chalmers University of Technology

The collisions between giant molecular clouds is a promising mechanism to form massive stars and star cluster. To find the evidence of cloud collision, we coupled the cloud collision simulation with a modified network from UCLCHEM to follow the chemical evolution. We studied the correlation between the projected density and the projected chemical abundances. We examined the CO depletion factor to compare with the observational data from IRDC and found that low cosmic-ray ionization rate is needed for certain cloud. In addition, we performed high resolution simulations to study the prestellar cores formed in the cloud collision. We furthermore utilise CASA post-processing the surface density maps to generate their ALMA 1.3mm synthetic observation results. We then use dendrogram to identify cores from the simulations and their corresponding synthetic observations. The derived CMFs are compared with observational data. We also did virial analysis to each cores and found that half of cores from the colliding case are supervirial.

24 - An Old, Metal-rich Accreted Stellar Component in the Milky Way Stellar Disk

Sofia Feltzing

Lund University

Galaxies are understood to form in a hierarchical manner, where smaller units merge into larger ones. The merger history of the Milky Way is particularly easy to study in the stellar halo. The ESA astrometric satellite Gaia has enabled the detection of completely new structures in the halo such as the Gaia-Enceladus-Sausage. However, simulations show that mergers may be important also for the build-up of the cool stellar disks. Combining elemental abundances for stars from APOGEE DR17 and astrometric data from Gaia we use elemental abundance ratios to identify an hitherto unknown, old stellar component in the cool stellar disk in the Milky Way. A tentative association of RR Lyrae variable stars with this component shows that it is an exclusively old component. In this contribution we will present recently developed techniques that use the Mg-Mn-Al-Fe-plane to identify accreted stellar components. We will discuss how these techniques, combined with kinematic data enabled by Gaia, opens new possibilities for studying the assembly history of the Milky Way galaxy.

25 - "Excellentissimo tubo Dollondiana": The 10-foot achromatic refractor of the Royal Swedish Academy of Sciences

Johan Kärnfelt

Gothenburg University

In 1764 the Royal Swedish Academy of Sciences in Stockholm acquired for its observatory a 10-foot achromatic refractor built by John Dollond in London. The double lens technology had first been mastered by Dollond – at the time it was just a few years old – and the Stockholm refractor was one of the most powerful instruments yet to come out of his workshop. Together with a transit circle by John Bird, the refractor was to become the main instrument of operations at the observatory and was used well into the 19th century. In this paper I will discuss the background of the achromatic lens, including the contribution of Uppsala mathematician Samuel Klingenstierna, and trace the shifting uses the telescope had during its 60 plus years of service.

26 - The European Solar Telescope

Dan Kiselman

Stockholm University

The European Solar Telescope (EST) is a planned 4-m solar telescope with multi-conjugate adaptive optics, an innovative optical design with polarization compensation and a minimum of reflections in the optical train, and an impressive suite of instrumentation optimised for studies of the magnetic coupling of the solar atmosphere. Its location has been decided to the immediate vicinity of the Swedish 1-m Solar Telescope on La Palma. We will review the status and prospects of the EST.

27 - The Institute for Solar Physics and the SST

Dan Kiselman

Stockholm University

The Institute for Solar Physics of Stockholm University is supported by the Swedish Research Council as an research infrastructure of national interest. It operates the Swedish 1-m Solar Telescope (SST) on La Palma. The SST features superb image quality and state-of-the art instrumentation. We will review new developments and plans at the SST and discuss how Swedish researchers can be supported with observational data and other services.

28 - Traversing the powers of 10: Students' experiences of spatial scales

Urban Eriksson

Lund University

This talk reports on the preliminary data and initial findings of a pilot study from a larger project investigating the teaching and learning of spatial/temporal scales in science. We video-recorded pre-service science teachers from physics and biology while completing a ranking task for objects ranging in size from the scale of a proton to the scale of the Universe. From this data, a phenomenographic analysis was carried out to determine the qualitatively different ways in which science students experience spatial scales.

29 - The complex circumstellar environment of the red supergiant NML Cyg

Holly Andrews

Chalmers University of Technology

Massive stars are responsible for a number of important chemical and mechanical feedback processes in the universe, providing a key source of gas and dust through the stellar feedback of their winds and enhanced outflows during their evolved stages. One of the crucial post-main sequence phases for massive stars is the red supergiant (RSG) stage, where mass-loss rates can reach up to 10^{-3} solar masses per year through strong episodic outflows. In this Poster I aim to summarise and highlight the complex molecular outflows of the RSG NML Cyg, showcasing results from the NOEMA interferometer, taken over the frequency range 214- 238 GHz. Images have revealed complex morphologies for many of these species including filamentary structure, arcs, and multiple clumps present in the wider circumstellar region around the star, as traced by CO, ^{13}CO, SO_2 and SO. I will also present observations of the multiple dust continuum emission components that are present around NML Cyg, detected for the first time at millimetre wavelengths. This study shows that there is a clear need for a systematic study of other red supergiant and evolved massive stellar stars in the radio regime to fully understand the complexity of the extended circumstellar environments around these stars.

30 - DEATHSTAR: Better constrained envelope sizes and distances for AGB stars

Miora Andriantsaralaza

Uppsala University

The asymptotic giant branch (AGB) is an important late stage of evolution of low- and intermediate-mass stars, when the material formed in the star is ejected towards the interstellar medium through massive stellar winds. DEATHSTAR is a large project aimed at improving the accuracy of stellar wind-parameter measurements of AGB stars. This poster will present the current status and first results of the DEATHSTAR project. Significant uncertainty is related to assumptions made regarding the size and shape of the circumstellar envelope created by the wind. Constraining the size and the degree of sphericity of the CO-emitting circumstellar envelope is therefore the first step of the DEATHSTAR project. This was done by directly mapping the CO envelopes of nearby AGB stars with the Atacama Compact Array of ALMA. Our results show that two thirds of the sources in our sample likely have spherical envelopes. Another important source of uncertainty in the mass-loss rate derivation is the adopted distances. Estimating the distances to AGB stars using optical measurements of their parallaxes, with e.g. Gaia, is a complex task due to the large uncertainties introduced by their dusty envelopes, their large angular sizes, and their surface brightness variability. We assessed the reliability of, and corrected, the Gaia DR3 parallax for AGB stars. In addition, we derived a new bolometric period-luminosity relation as an alternative tool to determine the distances to Mira variables. We compiled the best distance estimates derived for the sources in the DEATHSTAR sample in a new distance catalogue.

31 - Simulating the End of Cosmic Reionisation

Ivelin Georgiev

Stockholm University

The Epoch of Reionisation (EoR) was the period of the Universe during which the neutral hydrogen (HI) present in the intergalactic medium (IGM) was ionised by Ultraviolet radiation from sources inside early galaxies. There has been significant progress in modelling cosmic reionisation through numeric and semi-numeric codes, primarily focused on the 21-cm signal from HI as a probe of the EoR. Despite this, the end of reionisation (EndoR) has been less studied because the standard simulation techniques struggle to model it. In radiative transfer simulations, the opacity of the ionised IGM for ionising photons becomes important during the EndoR, and there exists quite a bit of uncertainty about this quantity. While measurements of the UVB at z = 6 exist (Calverley et al. 2011; Wyithe Bolton 2011), many simulations struggle to reproduce this number and report higher UVB values. Moreover, the 21-cm signal will be weaker during the EndoR and more difficult to observe. Nevertheless, the last HI islands during the EndoR do retain information about the sources of reionisation, which for example can be probed by tomographic images from the prospective Square Kilometre Array (Giri et al. 2021). In this poster, I address how the final stages of reionisation depend on assumptions about the sources, the clumping of the intergalactic medium and the presence of small-scale absorbers (so-called Lyman Limit Systems). In large-scale simulations of the EoR, the latter are often modelled through a parameter to account for the mean free path of ionising photons in the IGM. We find that a shorter MFP, more consistent with current measurements from Becker et al. 2021, not only extends the EndoR but regulates the UVB and IGM opacity. Moreover, we show how the numerical implementation of MFP impacts the evolution of the UVB.

32 - Testing the limits of multi-dimensional Gaussian processes in characterising RV stellar and planetary signals

Iskra Georgieva

Chalmers University of Technology

Active regions on stellar surfaces generate induced radial velocity variations that can mimic or bury induced planet signals. A common approach to dealing with stellar activity in radial velocity data is to model the stellar signal as a stochastic Gaussian Process (GP). We test the detectability of single planets orbiting stars exhibiting different levels of activity by employing two-dimensional GP regression on simulated radial velocity and activity indicator data sets. We show some practical examples of how this approach can be used to detect planet signals in active stars. We investigate the interaction between the planet- and stellar-induced signals by analysing the effects the different Keplerians have on constraining any combination of the tested GP hyperparameters, and thus on our ability to characterise the stellar behaviour. We explore the detectability of planets using different observational sampling scenarios and determine a 3-sigma detection threshold for a set of discrete semi-amplitudes and diagnose certain edge cases.

33 - Experimental spectroscopic investigation of Zr II

Madeleine Burheim

Malmö University/ Lund University

Recent advances in resolution and spectral range of ground-based and space-based astronomical spectrographs, call for accurate atomic data in order to reliably interpret and model astrophysical spectra. Correctly interpreted, stellar spectra allow for precise abundance analysis which, in turn, makes it possible to study the Galactic formation and evolution. To meet this demand, we study the complex atomic system of singly ionised zirconium, Zr II. Zirconium is predominantly found in cool giants and sub-dwarfs, as well as in kilonova spectra, providing a way to study the s-process and r-process elements. In this project we report experimental branching fractions and oscillator strengths (f-values) for high lying levels of Zr II. The analysis has been carried out using a hollow cathode discharge lamp (HCL) as a light source and a Fourier transform spectrometer (FTS), to record the high resolution spectra. The radiative lifetimes used in the project have been measured at the Lund High Power Laser Facility at Lund University.

34 - Astronomy activities for schools and the general public at the Stockholm House of Science

Tanja Nymark

KTH / Vetenskapens Hus

The Stockholm House of Science is a science education center owned jointly by KTH and Stockholm University, with schools as our primary target group. Our goal is to increase the interest in science and technology among children and young adults. Astronomy is well suited for this purpose since it is a subject that fascinates almost all children. Astronomy exercises have therefore been included in our program from the start. We offer hands on activities for school classes, more advanced projects for high school students and open activities for the general public during special events. Recently we have also purchased a portable planetarium dome which we will bring to schools, with the purpose of raising the awareness of the night sky among city children who rarely see a completely dark sky and to help them visualize the universe through an immersive experience of the solar system. In this poster presentation I will give a brief overview of the various hands-on astronomy activities that we offer in our laboratories, our plans for new school programs with the planetarium, as well as the challenges that we foresee.

35 - Gradual Fe-enrichment of silicate dust in AGB star winds

Susanne Höfner

Uppsala University

The cool massive winds of AGB stars are generally assumed to be driven by radiation pressure on dust. Magnesium-iron silicates are good candidates for driving the winds of M-type AGB stars, considering the abundances of relevant elements (Si, Mg, Fe, O) and the prominent mid-IR silicate features observed in circumstellar dust shells. Earlier DARWIN models of winds driven by photon scattering on large Fe-free silicate grains produce realistic mass-loss rates and wind velocities, and the resulting visual-to-near-IR spectra compare well with observations. However, their synthetic spectra show no mid-IR silicate features due to low grain temperatures. Here we present new DARWIN models that allow for the growth of silicate grains with a variable Fe/Mg ratio, which is set by a self-regulating feedback between grain composition and corresponding radiative heating. The resulting values of Fe/Mg are low, typically a few percent. Nevertheless, the new models show distinct silicate features around 10 and 18 microns. The gradual Fe-enrichment of silicate grains in the inner wind region should produce observable signatures in mid-IR spectro-interferometrical measurements. It is important to note that the enrichment of the silicate dust with Fe is a secondary process, taking place in the stellar wind, on the surface of large Fe-free grains that have initiated the outflow. Therefore, the mass-loss rates are basically unaffected, and results of existing DARWIN models can be applied to stellar evolution models.

36 - CO5BOLD star-and-wind-in-a-box models of cool giant stars with dust-driven winds

Bernd Freytag

Uppsala University

Convection and mass loss by stellar winds are two dynamical processes that shape AGB (Asymptotic Giant Branch) stars and their evolution. Observations indicate that giant convection cells cause high-contrast surface intensity patterns, and contribute to the origin of clumpy dust clouds. We study the formation and resulting properties of dust-driven winds from AGB stars, using new global 3D radiation-hydrodynamics (RHD) simulations. The dynamical stellar interiors, atmospheres and wind acceleration zones of two M-type AGB stars were modelled with the CO5BOLD code. These first global 3D simulations are based on frequency-dependent gas opacities, and they feature time-dependent condensation and evaporation of silicate grains. Convection and pulsations emerge self-consistently, allowing us to derive wind properties (mass loss rates, outflow velocities, etc.), without relying on parameterized descriptions of these processes. In contrast to 1D models with purely radial pulsations, the shocks induced by convection and pulsation in the 3D models cover large parts but not the entity of the sphere, leading to a patchy, non-spherical structure of the atmosphere. Since the efficiency of dust condensation depends critically on gas density, new dust clouds form mostly in the dense wakes of atmospheric shocks. The resulting clumpy distribution of newly-formed dust leads to a complex 3D morphology of the extended atmosphere and wind acceleration zone, with simultaneous in-fall and out- flow regions close to the star. Conclusions: A global 3D approach is essential to make progress in understanding dynamical processes in AGB stars, and, in particular, to solve long-standing problems regarding mass loss.

37 - Laboratory Atomic Astrophysics for near-infrared Stellar Spectroscopy

Henrik Hartman

Malmö university

Astronomical infrared observations are of increasing importance for stellar spectroscopy. The analysis of element abundance relies on high-quality observations, stellar models, and ultimately on accurate atomic data. With the growing number of near-IR astronomical observations and surveys, the absence of high accuracy data is becoming apparent and a limiting factor. We run a program to take up the task to provide evaluated, high-accuracy atomic data for important transitions in the near-infrared spectral region, mainly 1-5 microns. A combination of both experimental and theoretical techniques is used, to provide complete sets of data with a low uncertainty. FTS measurements of a discharge are combined with laser induced fluorescence techniques, and GRASP2k and ATSP2k atomic structure calculations for the theoretical values.

38 - (Sub)millimetre maser line observations towards evolved stars

Ka Tat Wong

Uppsala University

H2O and HCN are among the most abundant molecules in the circumstellar envelopes of oxygen-rich and carbon-rich evolved stars, respectively. Recent ALMA observations reveal widespread presence of H2O emission at 268.149 GHz and 262.898 GHz in vibrationally excited states among O-rich AGB stars and supergiants. In some objects, these H2O line emission shows signs of maser emission. In carbon-rich AGB stars, there are also two commonly detected maser lines near 805 and 891 GHz. These highly excited, submillimetre masers show intense emission in ALMA Band 10 observations, allowing us to self-calibrate the interferometric data and produce high-fidelity detailed images of the inner wind regions. We will present the spectra and images from ALMA observations of H2O and HCN lines in evolved stars and study the inner-wind kinematics traced by these transitions.

39 - Multiwavelength observations of extended atmospheres of Asymptotic Giant Branch stars

Behzad Bojnordi Arbab

Chalmers University of Technology

Stars in the asymptotic giant branch (AGB) evolve into luminous, giant stars, undergoing a heavy mass loss. The AGB stars produce metals and dust, enriching the interstellar medium (ISM) from which new stars and planets form. In our current understanding, mass loss occurs through dust-driven winds: When the material has reached the cooler regions away from the star (extended atmosphere) so that sufficient dust can form, radiation pressure on the dust will drag the gas along and inject the elements processed in the AGB star into the ISM. Our understanding of the extended atmospheres of AGB stars, where the conditions of the winds and mass-loss are set but before the dust is available to drive the wind, is still poorly understood. State-of-the-art simulations show that large convective cells play an important role, but recent observations at milliarcsecond resolution with ALMA have shown that the conditions in the extended atmospheres might be different than predicted by the models. In this poster, I will introduce the subject, the current status of the field, and the challenges in observation and theoretical modeling.

40 - Probing the IGM physics during the Cosmic Dawn through the 21-cm signal bispectrum

Mohd Kamran

Uppsala University

The redshifted 21-cm signal from the Cosmic Dawn (CD) carries information about the underlying different complex astrophysical processes during this phase, e.g., Lyman-alpha coupling, X-ray heating, and ionization of the gas in the Inter-Galactic Medium (IGM). Upcoming interferometric 21-cm experiments e.g. the SKA, targeting high redshifts (z $\gtrsim 9$) would be sensitive enough to probe these processes through the various statistical measures. However, the theoretical understanding of these physical processes through any of the popular and conventional statistical measures e.g. the power spectrum is limited. In this work, we explore the extent to which one of the higher order statistics of the signal, the bispectrum, can probe the IGM physics during the CD. Compared to the well studied 21-cm power spectrum, which only captures the evolution of the amplitude of the signal fluctuations, the 21-cm bispectrum captures the evolution of the fluctuations in the signal and the associated IGM physics through the evolution of its magnitude and sign. The size and shape of the triangles in the Fourier space (aka k-triangle) for which bispectra are being estimated determines what characteristics of the signal will be probed by that specific bispectrum. The evolution of the bispectra with cosmic time thus has the potential to provide us insight about the IGM physics. This work is the first of its kind to probe the IGM physics during the CD by estimating the bispectra for all possible unique k-triangles with the help of a suite of radiative transfer simulations for the signal. We observe that the bispectrum sign and magnitude strongly depend on the competition between the three main processes i.e. Lyman-alpha coupling, X-ray heating, and the ionization of the gas in the IGM.

41 - Interstellar Probe: Where Space Plasma Meets Astronomy. A NASA Pragmatic Proposal and European Contribution

Stas Barabash

Swedish Institute of Space Physics

NASA is considering an Interstellar Probe (ISP) as a large strategic mission candidate. An ISP mission is realistic and can be designed, built, and launched by 2036 using available-now technology. Traveling with a speed of 7.0 au/year ISP would reach 350 au during its nominal 50-year life-time to explore never studied in-depth or visited domains and boundaries of our astrosphere and characterize very local interstellar medium. ISP will make possible to look to our Sun as we observe other stars! Starting as a space plasma mission ISP inevitably offers ground breaking discoveries across astrophysics and planetary science. ISP would fly-by by at least one KBO and provide an unprecedented view of the circumsolar dust disk, critical for understanding the planetary formation in young dust disks. ISP is more than just a space mission. It is a great scientific undertaking of the importance for the whole humanity. Europe should and will contribute to this first journey to interstellar space. We present this mission and describe what and how Europe and Sweden can contribute to it.

42 - Populär Astronomi

Katrin Ros

Populär Astronomi/Lund University

Populär Astronomi is Sweden's leading magazine about astronomy and space travel. In this contribution I will give an overview of the magazine and how we aim to spread knowledge and excitement about astronomy to the general public.

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All participants and organizers of the meeting must uphold the Code of Conduct. The conference is a welcoming and inclusive environment that will allow free expression and the exchange of scientific results.

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Covid-19 Recommendations

In the interest of safety for one's and others health, we ask all participants to follow all current recommendations in place in Sweden to combat the spread of Covid-19 and other diseases, including washing hands, staying at home if you feel unwell, etc. More information on those guidelines can be found here. Measures taken by the conference organisers include the recommendation that attendees aim to spread out when sat in the conference room attending talks, and make sure to take advantage of the well-spaced coffee break tables and posters, with the aim of avoiding crowding.

We welcome people to wear masks if they feel that crowding or closeness cannot be avoided to a satisfactory level. Masks will be provided at the venue for those who do not have their own and wish to wear them. We would also suggest participants to engage in self-testing if they develop the symptoms of Covid-19, and to alert the conference organizers if they test positive so that other conference attendees can be made aware. Antigen tests can be found at any Apoteket throughout Göteborg.