Astronomdagarna 2015

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Abstracts for talks

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Session 1

The young star clusters perspective of star formation

Angela Adamo (Stockholm University)

Gravitationally bound young stellar clusters appear to be a commune product of star formation. There are tantalizing similarities between young star clusters and globular clusters, the latter formed by gravitationally bound ancient stellar populations. In my contribution, I will discuss the latest results produced with the analysis of the young cluster populations in several nearby galaxies. The use of new statistical methods, the link with dense gas fueling star formation, the access to homogenous datasets show, for the first time, clear evidence of the influence of the galactic environment in shaping the properties of young star cluster populations. In particular we observe that the cluster formation efficiency and the upper-mass end of the cluster mass function are correlated to the local and global properties of their host galaxies. These findings are of paramount importance to determine the stellar feedback impact of an increasing clustered star formation on the local and galactic scale interstellar medium. Moreover, these two essential empirical relations describing fundamental behaviours of star formation lay the fundamental groundwork needed to link young star clusters to globular clusters. Cosmological simulations that include these relations have, indeed, been successful in reproducing observational features of the observed globular cluster populations, providing potentially the key to reconstruct the assembly history of galaxies.

An AGN-blown Nuclear Bubble in a Face-on Analogue to Our Own Milky Way

Emily Freeland (Stockholm)

Bipolar bubbles, bright in gamma rays and polarized radio emission, extend to nearly 10 kpc above and below the plane of the Milky Way. Many questions remain as to the conditions in the Galactic Center and how they power and shape the observed structure. Here we show evidence that the nucleus of a nearby face-on spiral galaxy has a magnetically-draped bubble similar to those seen emerging from the nucleus of the Milky Way. The power source is unambiguously the central black hole, although it is not currently active, and the bubble formed within the last few tens of million years. The bubble is cinched by a ring of cold neutral and molecular gas. Star formation, as evidenced by high mass x-ray binaries, has been triggered in this ring of cold gas by the black hole activity and in the region surrounding the base of the bubble. We consider the nucleus of this galaxy to be a direct analogue to that of our own Galactic Center.

The destruction of the circumstellar ring of SN 1987A

Katia Migotto (Stockholm)

The circumstellar ring of supernova 1987A first became visible a few months after the explosion due to photoionisation by the supernova flash. From 1995 hotspots appeared in the ring and their brightness increased nearly exponentially as a result of interaction with the supernova blast wave. Imaging and spectroscopic observation now show that both the shocked and unshocked emissions from the ring have been decreasing since ∼2009. In addition, the most recent images reveal the brightening of new spots outside the ring. These observations indicate that the hotspots are being dissolved by the shocks and that the blast wave is now expanding and interacting with dense clumps beyond the ring. Based on the currently observed decay we predict that the ring will be destroyed by ∼2025, while the blast wave will reveal the distribution of gas as it expands outside the ring, thus tracing the mass-loss history of the supernova progenitor. (Fransson et al 2015)

Finding the Missing Metals - Circumgalactic O VI seen in Emission

Matthew Hayes (Stockholm)

I will present possible empirical closure to the problems of missing baryonic matter and metals in the nearby universe. This result is based upon the detection of O VI in emission from the circumgalactic medium of a nearby galaxy, and is the first of its kind. This detected line emission comes from gas with a temperature of around 300,000 K, which is extremely challenging to probe observationally; hence the phase represents some of the most sought-after matter in contemporary astrophysics. To detect it we have had to develop a novel observational method, and obtain some of the deepest ultraviolet imaging ever taken with the Hubble Space Telescope. I will present the implications of this detection for the missing baryons problem, the metal enrichment of the intergalactic medium, and the the shaping of several galaxy scaling relations.

Teaching and Learning in Astronomy Education – a Spiral Approach to Reading the Sky

Urban Eriksson (Kristianstad)

Teaching and learning astronomy is known to be both exciting and challenging. However, learning astronomy at university level is a demanding task for many students. The learning process involves not only disciplinary knowledge, but also the ability to discern affordances from disciplinary specific representations used within the astronomy discourse, which we call disciplinary discernment (Eriksson, Linder, Airey, & Redfors, 2014a) and ability to think spatially, which we refer to as extrapolating three-dimensionality from a two dimensional input (Eriksson, Linder, Airey, & Redfors, 2014b). Disciplinary knowledge involves all the knowledge that constitutes the discipline, disciplinary discernment involves discernment of the affordances of disciplinary-specific representations, and extrapolating three-dimensionality involves the ability to visualize in ones mind how a three-dimensional astronomical object may look from a two-dimensional input (image or simulation). In this paper we argue that these abilities are intertwined and to learn astronomy at any level demands becoming fluent in all three abilities. A framework is presented for how these abilities can be described and combined as a new and innovative way to frame teaching and learning in astronomy at university level for optimizing the learning outcome of students - what we refer to as developing the ability of Reading the Sky (Eriksson, 2014). We conclude that this is a vital competency needed for learning astronomy and suggest strategies for how to implement this to improve astronomy education. References: Eriksson, Urban. (2014). Reading the Sky - From Starspots to Spotting Stars. (Doctor of Philosophy), Uppsala University, Uppsala. Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-234636. Eriksson, Urban, Linder, Cedric, Airey, John, & Redfors, Andreas. (2014a). Introducing the Anatomy of Disciplinary Discernment - An example for Astronomy. European Journal of Science and Mathematics Education, 2(3), 167-182. Eriksson, Urban, Linder, Cedric, Airey, John, & Redfors, Andreas. (2014b). Who needs 3D when the Universe is flat? Science Education, 98(3), 31.

Session 2

Observations and simulations of the solar chromosphere

Jorrit Leenaarts (ISP, Stockholm)

The solar chromosphere is arguably the most difficult and least understood part of the Sun. The dynamics are changing from gas-pressure dominated to magnetic field dominated forces, radiation escape is in non-LTE, the equation-of-state is far out of thermodynamic equilibrium and the ionisation state changes from almost neutral to fully ionised. I will present recent modelling efforts that try to describe this complexity and compare with observations from the Swedish 1-m Solar Telescope and the Interface Region Imaging Spectrograph satellite.

Coronal magnetic-field measurements based on accidental degeneracy of quantum states

Jon Grumer (Lund)

Magnetic fields play a crucial role in numerous astrophysical and experimental plasma, such as solar protuberances, tokamaks, ion traps and storage rings. It is well-known that external fields affects ions by breaking the spherical symmetry, resulting in non-degenerate magnetic sublevels. A more intriguing consequence is that the field may introduce new exotic radiative decay channels through mixing of quantum states. We call these Magnetic-field Induced Transitions (MITs) and their rates are proportional to the strength of the magnetic field. This exotic class of radiation could have a significant impact on the spectrum under investigation, especially for systems containing close degeneracies or when otherwise strictly forbidden one-photon channels are opened up. These transitions have attracted new attention recently due to the development of accurate and systematic methods for calculations of their rates [1,2,3] and the possible application as a tool for measuring plasma magnetic fields in cases when conventional methods are beyond reach (eg. the Solar corona). We are currently developing a general method to determine MIT rates [4] based on wave- functions and transition properties calculated with the well-established relativistic multiconfiguration Dirac-Hartree-Fock program package grasp2k [5]. In order to do space-weather forecasts it is necessary to follow the evolution of solar events, such as flares. This requires continuous observations of the magnetic fields which fuels much of the solar activity. We have recently found a unique MIT candidate [6] applicable to measurements of these fields. In this talk we will outline this novel method in some detail and explain how it can be applied in measurements of fields in the solar corona. Finally we will discuss the remaining challenges and the way forward. [1] J Li, J Grumer, W Li, M Andersson, T Brage, R Hutton, P Jönsson, Y Yang and Y Zou, Phys. Rev. A 88, 013416, (2013). [2] J Grumer, W Li, D Bernhardt, J Li, S Schippers, T Brage, P Jönsson, R Hutton and Y Zou, Phys. Rev. A 88, 022513 (2013). [3] J Grumer, T Brage, M Andersson, J Li, P Jönsson, W Li, Y Yang, R Hutton and Y Zou Phys. Scr. 89 114002 (2014). [4] J Grumer et al., to be submitted to Comput. Phys. Commun. [5] P Jönsson, G Gaigalas, J Bieron, C F Fischer, and I P Grant, Comput. Phys. Commun. 184, 2197 (2013). [6] W Li, J Grumer, Y Yang, T Brage, K Yao, C Chen, T Watanabe, P Jönsson, H Lundstedt, R Hutton and Y Zou, accepted for publication in The Astrophysical Journal (2015).

Exploring the diagnostic value of Helium I D3 in the solar chromosphere

Tine Libbrecht (Stockholm)

We present high-resolution observations of the chromospheric He I D3 line at 5876 Å, with SST/TRIPPEL and SST/CRISP. The SST observations have the highest spatial resolution for He I D3 up till date, and our goal is to explore its diagnostic value in the upper chromosphere. The lower level of D3 gets populated via the photoionization-recombination mechanism. Therefore, the line intensity is sensitive to EUV-radiation from the corona and from the transition region. We investigate the He I D3 line behaviour for different targets on the sun: flares, active regions, plages, off-limb, ... and we interprete the spectra in context of space-borne co-observations with IRIS and SDO. Moreover, the He I D3 line is magnetically sensitive and allows for high-resolution spectro-polarimetric observations with SST/CRISP. We will present preliminary results of inversions of the He I D3 line with the inversion code HAZEL, to obtain magnetic field information in the upper chromosphere.

Session 3

Studies of circumstellar disks and planets with SPHERE

Markus Janson (Stockholm University)

SPHERE is a high-contrast imager at the VLT, which was commissioned in the latter half of 2014 and has been in scientific operation since the beginning of this year. The new generation of Extreme Adaptive Optics (ExAO) systems such as SPHERE allow for better contrast close to bright stars than has been previously achievable, which opens up for much deeper studies of the circumstellar environment, enabling the discovery and characterization of directly imaged planets and disks at high spatial resolution. In this talk, I will present some recent results from the SPHERE GTO program, including the atmospheric characterisation of several exoplanets, and unexpected morphological features in young circumstellar disks.

Planet formation via pebble accretion

Bertram Bitsch (Lund University)

In this talk, we will present a new model for time evolving accretion discs (Bitsch et al. 2015) and its influence on the formation of planets. The formation of dust, pebbles, planetesimals and planetary embryos is influenced by the structure of the underlying protoplanetary disc, in particular the profiles of temperature, gas scale height and density. The formation of gas giants is tied to the lifetime of the protoplanetary disc, which is expected to be several Myr. During this time the disc looses mass and changes its structure. The evolution of the disc over several Myr is studied in 2D hydrodynamical simulations featuring viscous and stellar heating as well as radiative cooling (Bitsch et al. 2015). Planetesimals can accrete pebbles efficiently and thus grow on short timescales (a few 100kyr) to a few Earth masses (Lambrechts & Johansen, 2014). The process of pebble accretion itself depends also crucially on the pressure gradients within the protoplanetary disc, which changes as the disc evolves. By coupling the simulations of the evolving disc with the pebble accretion process, we can form planetary cores in a realistic environment. These planetary cores can then accrete gas and form giant planets. We investigate in detail how to explain the planetary mass / orbital distance relationship of observed exoplanets.

Hot Jupiters and Super-Earths

Alexander J Mustill (Lund University)

There are as yet no detections of super-Earths in systems containing hot Jupiters, despite low-mass planets being otherwise extremely common. It is unclear how hot Jupiters migrate so close to their star, and we propose that the lack of close-in super-Earths in hot Jupiter systems helps to discriminate between different mechanisms of migration. We present N-body simulations of dynamical migration scenarios where proto-hot Jupiters are excited to high eccentricities prior to tidal circularisation and orbital decay. We show that in this scenario, the eccentric giant planet typically destroys planets in the inner system, in agreement with the observed lack of close super-Earth companions to hot Jupiters. We explore the effects of varying the configuration of the outer system forcing the proto-hot Jupiter's eccentricity, such as scenarios leading to planet–planet scattering or Kozai perturbations.

Characterizing the physical structure on small scales in young solar analogs.

Magnus V. Persson (Leiden)

In deeply-embedded low-mass protostars (i.e. Class 0), the density and temperature distribution in the inner few hundred AU's are poorly constrained. Disk around Class 0 and Class I sources have been identified using C18O lines; however, constraining the various disk characteristics turns out to be difficult even toward the more evolved Class I sources with less envelope emission. Continuum and molecular line observations of optically thin tracers at very high sensitivity and resolution are needed to constrain the density, temperature and kinematics. Ultimately the assumed structure affects the determination of molecular abundances.We are attempting to model high-resolution (sub-1") dust continuum radio-interferometric observations of a few deeply-embedded low-mass protostars with a power-law disk model embedded in a spherical infalling envelope. We model the interferometric visibilities taken with either the Plateau de Bure Interferometer or ALMA, probing scales down to a few tens of AU in some cases. Given the assumptions, the study shows disk sizes in the deeply-embedded phase that could be slightly larger than typical found in the more evolved Class I sources. The fitting also highlights that models for the physical structure of the disk-to-envelope interface, on 500-1000 AU scales, needs to be improved. While the method can constrain the radius of any compact structure and the radial density profile (given reasonable assumptions), it cannot constrain the temperature profile or vertical variations to any significant degree. Future high sensitivity line and multi-wavelength continuum interferometric observations will be able to constrain radial (and possibly vertical) density and temperature structures.

Magnetic fields of young solar-like stars

Lisa Rosén (Uppsala)

Magnetic fields can be found almost everywhere in the universe, including in most stars. They will strongly influence the evolution of the star and its surroundings. A stellar magnetic field will cause an increased mass loss, an increased emission of high-energy radiation and particles, and slow down the rotation of the star. The rotation rate is an important parameter for a cool star magnetic field since one of the driving mechanisms is a dynamo, i.e. the interplay between rotation and convection. The field will, generally, be stronger the faster the star rotates. This implies that both the rotation rate and the magnetic field strength of a cool star will decrease as the star ages. We have studied the magnetic activities of a sample of stars similar to the Sun but with ages of only a few 100 Myr in order to investigate the activity of the young Sun. We have used time series of high-resolution spectropolarimetry observations in order to reconstruct the magnetic field topology of the stars using the Zeeman Doppler imaging technique. Our first results imply that the global magnetic field of the young Sun was indeed stronger and had a different topology compared to today.

Magnetic Fields, Starspots, and the Interior Structure of Young Low-Mass Stars

Gregory Feiden (Uppsala)

Young low-mass stars appear to all possess strong magnetic fields, as evidenced by high levels of magnetic activity in the form of starspots, as well as chromospheric and coronal emission. Despite their omnipresence, magnetic fields are routinely neglected in stellar interior structure and evolution models, threatening to compromise the accuracy of stellar model predictions and erode our confidence in ages derived for young stellar populations. In this talk, I will highlight efforts designed to understand whether magnetic fields and/or starspots are actively altering the interior structure of young low-mass stars and how these effects may bias young stellar ages.

Session 4

Human Capacity Development and Outreach in South Africa

Kurt van der Heyden (University of Cape Town)

Based on South Africa's astronomy geographic advantage the South African government is making key investments in astronomy infrastructure. To capitalize on these investments there is a need to develop associated human capacity to exploit these facilities, drive innovation and technology, and build scientific capacity. A major challenge to developing this human capacity is the lack of a critical mass of astronomers at teaching and research institutions around the country. I will describe some of the initiatives in place for both scientific capacity development and general public outreach.

DESIREE – A unique instrument to study positive/negative ion interactions

Henning Schmidt (Stockholm University)

At Stockholm University, we have built a unique double electrostatic ion-ring experiment (DESIREE). Ion beams of opposite charge-polarity are stored in two electrostatic ion-storage rings sharing a common straight section where the two beams can be merged allowing for studying interactions at sub-eV center-of.mass energies while the laboratory energies are of tens of keV. The instrument is cryogenic (T=13K) which helps to provide an extraordinarily high vacuum with about 10 hydrogen molecules per mm3 being the dominant residual-gas component. Results of initial single-ring experiments are presented as are test experiment results for the study of mutual neutralization processes, the process for which the instrument is primarily developed. In the future we will be able to measure absolute rates for mutual neutralization processes of importance for understanding stellar atmospheres and for interstellar chemistry.

Laboratory Astrophysics for near-infrared Spectroscopy

Henrik Hartman (Malmö University and Lund Observatory)

Astronomical infrared observations are of increasing importance for stellar spectroscopy. The analysis of element abundance relies on high-quality observations, stellar models, but ultimately on reliable atomic data. With the growing number of near-IR astronomical observations and surveys, the absence of high-accuracy data is becoming apparent. Since a few years we are running a program to take up the task to provide evaluated, high-accuracy atomic data for the important transitions in the near-infrared spectral region, mainly 1-5 microns. In this presentation, we will review the current status of near-infrared data and the current efforts. An important aspect is the uncertainty of the atomic data, since the quality of abundance determinations utterly depends on the input parameters. We will discuss the limitations and challenges in the experiments and how these are handled.

Laboratory study of neutral scandium for infrared spectroscopy

Asli Pehlivan (Malmö, Lund)

Atomic data is crucial for astrophysical investigations. By analysing the observed spectrum of stars, we can understand the formation and evolution of our Galaxy. These analyses require information about the atomic data, e.g. wavelengths and oscillator strengths. However, atomic data of some elements are scarce, particularly in the infrared region, which in turn makes it difficult to analyse a stellar spectrum. We have studied neutral scandium, and combined experimental branching fractions with radiative lifetimes to derive oscillator strengths. A hollow cathode discharge lamp is used as a light source to produce scandium atoms in the plasma and Fourier transform spectrometer is used to record the high resolution spectra. We used the recorded spectra to derive oscillator strengths for infrared Sc I lines with uncertainties varying from 5% to 20%.

Session 5

The Swedish Astronomical Society

Jesper Sollerman (Stockholm)

A short introduction to Svenska Astronomiska Sällskapet.

Titanium dioxide around the red supergiant VY CMa

Elvire De Beck (Department of Earth and Space Sciences, Chalmers University of Technology, Onsala Space Observatory (OSO))

Titanium dioxide, TiO2, is a refractory species that could play a crucial role in the dust-condensation sequence around oxygen-rich evolved stars. To date, gas phase TiO2 has been detected only in the complex environment of the red supergiant VY CMa. I will present and discuss the continuum maps, and the spectra and channel maps of TiO2 around VY CMa obtained with ALMA and APEX/SEPIA during science verification operations. We detect 16 transitions of TiO2, spatially resolve the emission for the first time, and detect it with a single-dish facility for the first time. The ALMA maps demonstrate a highly clumpy, anisotropic outflow in which the TiO2 emission likely traces gas exposed to the stellar radiation field. We find an accelerating bipolar-like structure, oriented roughly east-west, of which the blue component runs into and breaks up around a solid continuum component. A distinct tail to the south-west is seen for some transitions, consistent with features seen in the optical and near-infrared. We find that a significant fraction of TiO2 remains in the gas phase outside the dust-formation zone and suggest that this species might play only a minor role in the dust-condensation process around extreme oxygen-rich evolved stars like VY CMa.

ALMA observations of the not-so-detached shell around the AGB star R Scl

Matthias Maercker (Chalmers)

danilI will present our ALMA Cycle 0 observations of the CO emission around the carbon AGB star R Sculptoris. The observations show the detached shell and circumstellar medium around this star in unprecedented detail. Together with the observed spiral shape, we for the first time observationally constrain the evolution of the wind properties during the thermal pulse cycle. The observations confirm a formation of the shell during a thermal pulse about 2300 years ago. However, it is clear that the shell around R Scl in fact is entirely filled with molecular gas, and hence not as detached as previously thought. This has implications for the mass-loss rate evolution immediately after the pulse, indicating a much higher mass-loss rate than previously assumed. A significant increase of mass lost during the thermal pulse cycle affects the chemical evolution of the star, its lifetime on the AGB, and the return of heavy elements to the ISM. Compared to our optical observations of polarised, dust scattered light, we further show that the distributions of the dust and gas coincide almost perfectly, implying a common evolution of the dust and gas, and constraining the wind-driving mechanism. The results usher in a new paradigm in our understanding of this fundamental period of stellar evolution, and the implications it has for the chemical evolution of evolved stars, the ISM, and galaxies.

Sulphur molecules in the AGB star R Doradus

Taïssa Danilovich (Chalmers)

We present new observations of the sulphur molecules SO and SO2 towards the M-type AGB star R Dor. Combining spectral scan observations from Herschel/HIFI and APEX, we have 17 and 100 lines detected from SO and SO2, respectively. This allows us to put good constraints on the SO and SO2 abundances and their line-emitting regions in the circumstellar envelope of R Dor. We present our new observations and results from radiative transfer modelling. We find relatively small and abundant envelopes of SO and SO2, which seem to account for most of the sulphur around R Dor. We also present results from other M-type AGB stars and discuss their different sulphur distributions.

Session 6

Rosetta observations of the near-nucleus coma of comet 67P

Anders Eriksson (Swedish Institute of Space Physics - Uppsala)

We present results from the European Space Agency's Rosetta mission, currently in orbit around comet 67P/Churyumov-Gerasimenko. After an initial 10-year cruise phase in the solar system Rosetta has now followed comet 67P closely for more than a year, from a heliocentric distance of 4.1 AU to 1.25 AU (at perihelion). Meanwhile, the numerous scientific instruments on Rosetta have monitored the physical properties of the cometary nucleus and the coma in situ. Here we will focus on the results from measurements concerning the composition and structure of the coma. Since arrival, Rosetta has mainly orbited the comet at 10-250 km from the nucleus mass-centre and observed how the near nucleus coma is built-up and how it evolves with time, season and heliocentric distance. When the comet is heated by sunlight, sublimation of surface and subsurface material acts to produce gas, which fills the cometary coma. As the comet gets closer to the Sun the sublimation increases and the coma grows. The outgassing material also acts to lift up significant amounts of dust from the surface. The gas and dust eventually leads to the formation of an enormous comet tail trailing the comet nucleus in interplanetary space. Near the nucleus, the neutral cometary gas (mainly H2O, CO and CO2) has been observed to be quite inhomogeneous around the oddly duck-shaped comet 67P. Highest amounts of gas are found above the neck region, i.e. the region between the two main lobes of the comet. The neutral gas is being partly ionized by the solar EUV radiation and forms a cometary ionsphere, which in turn initiates a complex interaction with the solar wind, which will also be discussed.

Highlights of the environmental discoveries on Mars from Curiosity Rover

Javier Martin-Torres (Division of Space Technology, Department of Computer Science, Electrical and Space Engineering, Luleå University of Technology, Kiruna, Sweden)

The Mars Science Laboratory (MSL) was targeted to the Gale Crater, a 154 km diameter formation located in the NE portion of the Aeolis quadrangle, on the boundary between the southern-cratered highlands and the lowlands of Elysium Planitia. The crater's central peak, Mount Sharp, rises about 5.5 km above the floor of the crater. MSL landed on 6 August 2012, onto the crater floor NW of Mount Sharp, at 4.6S, at 137.4E, and at 4.5 km below the datum. The landing season was few sols after the middle of the southern winter at areocentric longitude of Ls 151. Since the beginning of operations on Mars more than 3-years ago, Curiosity measurements are being analyzed carefully, and they are revealing a number of discoveries from both technical and scientific sides that will mark a before and after in Martian meteorology and environmental studies and our understanding of Martian atmosphere, as well as the use of meteorological stations in rover platforms on Mars. I will review several discoveries on Mars based in Curiosity data where the Atmospheric Science group at LTU is involved. In particular I will present the science findings that in my opinion will open a new window for future studies of Mars atmosphere and environment.

Was paleo Venus the first habitable world of our solar system?

Michael Way (NASA/GISS & Uppsala)

A great deal of effort in the search for life off-Earth in the past 20+ years has focused on Mars via a plethora of space and ground based missions. While there is good evidence that surface liquid water existed on Mars in substantial quantities, it is not clear how long such water existed. Most studies point to this water existing billions of years ago. However, those familiar with the "Faint Young Sun" hypothesis for Earth will quickly realize that this problem is even more pronounced for Mars. In this context recent simulations have been completed with the GISS 3-D GCM (1) of paleo Venus (approx. 3 billion years ago) when the sun was approx. 25% less luminous than today. A combination of a less luminous Sun and a slow rotation rate reveal that Venus could have had conditions on its surface amenable to surface liquid water. Previous work has also provided bounds on how much water Venus could have had using measured D/H ratios. It is possible that less assumptions have to be made to make Venus an early habitable world than have to be made for Mars, even though Venus is a much tougher world on which to confirm this hypothesis. (1) GISS=Goddard Institute for Space Studies, GCM=General Circulation Model.

Stories about the stars: astronomy and the Swedish media

Anna Davour (Populär Astronomi)

There seems to be a general appeal in stories related to outer space and astronomical phenomena, which make them more accessible to most people than many other scientific topics. Astronomy in Swedish mainstream media often comes in the form of news articles from the national wire service (TT). Those who are really interested in astronomy can seek out the astronomy and science magazines. There are also some notable websites, and a few interesting things going on in alternative media, such as independent podcasts. Media companies that employ specialized science reporters cover astronomy among other scientific topics. In addition to this, it's interesting to note that astronomy is not only science, but also culture. This means that astronomical themes appear in sometimes unexpected contexts.

Session 7

The accuracy of stellar metallicities

Karin Lind (Uppsala University)

The spectra of cool stars are filled with lines of atomic iron, to the extent that the stellar [Fe/H] is often used as a proxy for the entire metal content of stars. Furthermore, the excitation and ionisation balance of neutral and singly ionised iron can be utilised for determination of reddening-free stellar parameters. Together this makes [Fe/H] arguably the most important parameter for unravelling the formation and evolution of the Milky-Way with Galactic archaeology. Recent years have seen parallel developments of atomic data, stellar atmospheric modelling, and spectrum synthesis, so that we are now at the point where the iron abundance analysis no longer requires calibration of free parameters. I will discuss the implications.

Radiation-hydrodynamics simulations of AGB and RSG stars with CO5BOLD

Bernd Freytag (Uppsala)

Convective surface structures of red-supergiant and AGB stars show violent dynamical processes on huge scales due to the low gravity and corresponding large pressure scale heights. This allows to model these structures in global numerical simulations that solve the coupled equations of non-local radiation transport and hydrodynamics in the presence of a gravity field. Recent results will be presented including a study of the influence of different stellar parameters on the shock generation in AGB-star atmospheres, magneto-hydrodynamics models of a red supergiant displaying self-generated fields, and first attempts to account for stellar rotation.

Stellar Spectroscopy during Exoplanet Transits: Dissecting fine structure across stellar surfaces

Dainis Dravins (Lund)

Differential spectroscopy during exoplanet transits permits to reconstruct spectra of small stellar surface portions that successively become hidden behind the planet. The center-to-limb behavior of stellar line shapes, asymmetries and wavelength shifts enable detailed tests of 3-dimensional hydrodynamic models of stellar atmospheres, such that are required for any precise determination of abundances or seismic properties. Although very high quality spectra are required, already current data permit reconstructions of line profiles in the brightest transit host stars; http://arxiv.org/abs/1408.1402 .

The artificial Skyglow above Stockholm and Why we care about it

Johannes Puschnig (Stockholm University)

The introduction of artificial light brought many human benefits, most importantly extending the hours available for productive work and social activity. But this gain has come at some cost: daily, seasonal and lunar cycles of light are dramatically altered, which has significant negative impacts for wildlife, ecosystems, human health and well-being. We first discuss some of these aspects on a general basis and show how light pollution can be minimized. Subsequently, we present zenithal night sky brightness measurements performed in Stockholm using a Sky Quality Meter. Since December 2014 our measurements are carried out every night, yielding a luminance value every seven seconds and thus delivering a large amount of data. In this talk, the analysis of this data is presented for the very first time in a systematic way. We discuss the influence of different environmental conditions on the night sky brightness and show that the circalunar rhythm of nightsky brightness is almost extinguished in central Stockholm due to light pollution. Furthermore, we show that the level of light pollution in Stockholm is enhanced compared to other European cities such as Vienna or Berlin.

Session 8

Recent results from the International LOFAR telescope

Eskil Varenius (Chalmers / Onsala Space observatory)

The International LOFAR telescope can be used to obtain high-resolution images, spectra and time series of the universe at meter wavelengths. I will discuss several recent LOFAR results, focusing on projects where the Swedish LOFAR station at Onsala Space Observatory is involved. In particular, I will present images of the galaxies M 82 and NGC 3079. These are examples of objects where LOFAR can be used to probe, in great detail, environments of intense star formation and possible AGN activity

Chemical Evolution of the Galactic Centre

Nils Ryde (Lund)

The evolutionary history of the Milky Way is not known. Studying the central major structure of the galaxy, the Bulge, offers a unique possibility to investigate the role and time scales of different processes and structures in the formation history. The Galactic centre and the region within 300pc of the supermassive blackhole is obscured by massive amount of dust and this inner Bulge region has therefore escaped a detail chemical evolution study. Recently, we have published a series of papers on the chemical evolution of the centre region. These are the first papers in a Very Large Telescope campaign, where we are mapping the abundance trends and metallicity gradients of the inner Bulge region with high spectral resolution spectra of approximately 60 red giants in the near-IR. Together with tailored theoretical chemical evolution models, the data sets published are producing interesting results of this region and are imposing constraints on the formation history. I will review our findings and put them into context.

Unveiling the diversity of the Milky Way stellar clusters

Sami Dib (Copenhagen)

I will present the resusilklts from two complementary studies that investigate the universality of the IMF among Galactic stellar clusters. In the first study, the universality of the IMF is directly tested using a sample of eight young stellar clusters (IC 348, ONC, NGC 2024, NGC 6611, NGC 2264, ρ Ophiuchi, Chameleon I, and Taurus). I will show that the posterior probability distribution functions of the IMF parameters, inferred using Bayesian statistics techniques, do not overlap within the 1-sigma uncertainty limit as well as with the value of the parameters for the Galactic field IMF. In the second study, I will show that the high mass star content of a larger survey of Galactic clusters can be used to further test the universality of the IMF. In addition to confirming the IMF is not universal, the results of this study put strong constraints on the shape of the Galactic cluster mass function and seem to rule out the existence of a cluster mass-maximum stellar mass relation

Extragalactic accelerators with HESS, CTA and ALTO

Yvonne Becherini (Linnéuniversitetet)

Extra-galactic accelerators give the opportunity to work with a complete laboratory of cosmic-ray physics, astrophysics and fundamental physics, far from the possible local effects which may be present in our Galaxy and which could possibly confuse the understanding of the underlying mechanisms. Active Galactic Nuclei are the most abundant type of source in the extra-galactic sky at high and very-high gamma-ray energies and thus constitute the optimal and natural investigation target. The Very-High-Energy gamma-ray group at Linnéuniversitetet works on both experimental and phenomenological aspects related to extra-galactic astronomy and astrophysics, with a strong focus on hardware development, data analysis at all wavelengths, and their interpretation. An overview of the activities in the HESS experiment, in the CTA project and in the new ALTO project will be presented.

Cosmic rays – making the invisible visible

Tanja Nymark (Vetenskapens Hus)

Project works ("gymnasiearbeten") in the final year of high-school studies provide an excellent opportunity to inspire students and offer the possibility for students to be introduced to interesting research questions and learn how to work scientifically. For the past 8 years Stockholm House of Science and the department of physics at KTH have offered projects which give student the opportunity to study cosmic rays with the purpose of bringing the intellectual and technical challenge of scientific research to high-school students. Cosmic rays are high-energy subatomic particles (mostly protons) which continually rain down on the earth's atmosphere from space. They interact with atomic nuclei in the atmosphere producing 'showers' of short-lived particles. Of particular interest to us are the muons, which have a lifetime long enough to reach the ground, where they can be detected. At the start of the project the students pose their own research questions concerning for example the influence of different parameters on the observable muon flux. They test their hypotheses using one or more of our muon detectors. We have three different kinds of muon detectors which are available for the students to borrow. For the next round of the project we plan on changing the focus to a study of cosmic radiation in the atmosphere, by flying light-weight detectors on two weather balloons to an altitude of 25-30 km. The flight itself is planned to take place during "Astronomins dag och natt" on October 10th. The participating students will take part in the pre-flight planning, as well as data analysis following the flight thus giving them experience in working with advanced instrumentation to produce scientific data. We will describe how these projects are conducted, show examples of completed projects, and present the outcome of the two balloon flights. We will also discuss the impact of the projects as shown in student evaluations.