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Abstract book

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Talks / Friday October 21

AMATEUR CONTRIBUTIONS TO ASTRONOMICAL RESEARCH

Johan Warell

Uppsala Astronomical Observatory

A1

The last decade or so has seen an increasing number of amateur astronomers contributing to astronomical research in different ways. This is partly due to decreasing prices and increased availability of appropriate CCD cameras and telescopes, as well as to rapid dissimination of professional research data on the internet. Also, a number of amateur-professional observational projects have been initiated where active collaboration is taking place. Within this context, I will present current projects, discuss how dedicated amateur astronomers are able to contribute to astronomical research, and how professionals may benefit from amateur contributions.

NEW OBSERVATORY IN CENTRAL UMEÅ, VISIONS AND GOALS.

Gabriella Stenberg[1], Tommy Jonsson[2], Tord Oscarsson[3]

1 Swedish Institute of Space Physics - UmeåUniversity
2 Tommy Jonsson, GaTel, Umeå
3 Tord Oscarsson, Department of Physics, UmeåUniversity

A2

An observatory is rising close to the city centre of Umeå. It is designed with the primary goal of increasing the interest for natural science among young people. We hope that the observatory will develop into a meeting place, where elementary schools, university, companies and public can interact. Plans and visions for this project is presented.

ASTRONOMICAL QUANTUM OPTICS WITH EXTREMELY LARGE TELESCOPES

D. Dravins[1], C. Barbieri[2], V. da Deppo[3], D. Faria[1], S. Fornasier[2], R. A. E. Fosbury[4], L. Lindegren[1], G. Naletto[3], R. Nilsson[1], T. Occhipinti[3], F. Tamburini[2], H. Uthas[1], L. Zampieri[5],

1 Lund Observatory
2 Dept. of Astronomy, University of Padova
3 Dept. of Information Engineering, Univ. of Padova
4 ESO, Garching bei München
5 Astronomical Observatory of Padova

Extremely Large Telescopes will offer *enormously* increased sensitivity for studying astrophysical variability on timescales of milli-, micro-, and nanoseconds. Here, one expects phenomena such as instabilities of photon-gas bubbles in accretion flows, p-mode oscillations in neutron stars, or quantum-optical photon bunching. Precise timescales are both unknown and variable, and studies must be of photon-stream statistics, e.g., power spectra or autocorrelations. Such functions increase with at least the *square* of the *intensity*: doubling the telescope diameter increases the signal by at least a factor of 16!

A design study has been made of QUANTEYE, the highest time-resolution instrument for ESO:s planned OWL telescope. An array of photon-counting avalanche photodiodes will record photon arrival times with sub-nanosecond precision. Not only will this permit exact astrophysics on the shortest "classical" timescales, but should reveal quantum phenomena in light from astronomical sources.

Although photons from given directions with given wavelengths produce identical images and spectra, they may obey different photon statistics. In maximum-entropy black-body radiation this is "random" (Bose-Einstein distribution, with certain photon "bunching" in time), but could be "non-random" for radiation originating in stimulated emission, or scattered on its way to the observer.

Using concepts related to the [spatial] intensity interferometer pioneered by Hanbury Brown & Twiss, photon-correlation spectroscopy with QUANTEYE will reach a spectral resolution of 100 million, as needed to resolve, e.g., known optical laser emission around Eta Carinae. The observability of more complex photon statistics in astronomical sources could well be enabled by ELTs, opening up quantum optics as a fundamentally new information channel from the Universe.

A3

THE FORMATION AND EVOLUTION OF THICK DISKS IN SPIRAL GALAXIES – THE LOCAL PERSPECTIVE

Sofia Feltzing

Lund Observatory

B1 I will review our current observational knowledge of the thick disk in the Milky Way with special emphasis on the elemental abundance trends as observed in dwarf stars in the local solar neighbourhood. The selection of stars representative of the thick disk will be discussed. The abundance trends found for the thick disk stars will be discussed in the context of the formation of thick disks in spiral galaxies in general. I will also present new results for carbon and manganese for a large sample of thin and thick disk stars and discuss how our differential studies may help us to further our understanding of where these elements are formed.

WHAT DO WE KNOW ABOUT THE GALACTIC BULGE

Nils Ryde

Uppsala Astronomical Observatory

B2 Bulges are crucial for the understanding of the formation and evolution of galaxies. However, even the origin, age, and chemical properties of the Galactic Bulge remain poorly understood, and the classification of this Bulge is ambiguous. Here, I will review our current picture of the Galactic Bulge, put it in relation to extragalactic bulges, and discuss what we can find out from abundance ratios in bulge stars.

CARBON STARS IN LOCAL GROUP DWARF GALAXIES: C & O ABUNDANCES

Wahlin, R.[1], Eriksson, K.[1], Gustafsson, B.[1], Hinkle, K. H.[2], Lambert, D. L.[3], Ryde, N.[1], Westerlund, B.[1],

1 Uppsala Astronomical Observatory
2 National Optical Astronomy Observatory, Tucson, USA
3 McDonald Observatory and Department of Astronomy, University of Texas, USA

B3

We will present abundances of carbon and oxygen as well as abundance ratios $^{12}C/^{13}C$ for a sample of carbon stars in the LMC, SMC, Carina, Sculptor and Fornax dwarf galaxies.
The overall metallicities in these dwarf galaxies are lower than in the galactic disc. The observations cover most of the AGB and we discuss the abundance patterns in different regions along the AGB. We find that the oxygen abundance is decreasing with decreasing overall metallicity of the system while the C/O ratio at a given evolutionary phase is increasing. We also find a radial abundance gradient in the LMC.
The abundances are determined from infrared spectra obtained with the ISAAC spectrometer on VLT (R=1500) and the Phoenix spectrometer on Gemini South (R=50000). The synthetic spectra used in the analysis are computed with the MARCS model atmosphere code, originally presented in Gustafsson et al. (1975).

THE RED HALO PHENOMENON

Erik Zackrisson[1], Nils Bergvall[1], Göran Östlin[2], Genoveva Micheva[1], Maria Leksell[1], Thomas Marquart[1]

1 Uppsala Astronomical Observatory
2 Stockholm Observatory

B4

Integrated photometry of the faint halos surrounding both disk galaxies and blue compact galaxies have revealed a very red spectral energy distribution which cannot easily be reconciled with any normal, metal-poor stellar population like that in the halo of the Milky Way. Here, we report on our ongoing observational and modelling efforts to find an explanation for this red excess. At the current time, a halo population overabundant in low-mass stars – possibly contributing substantially to the baryonic dark matter in galaxies – appears to be one of the most promising options.

GRAVITATIONAL-WAVE ASTRONOMY

Nils Andersson

University of Southampton, UK

C1

One of the outstanding predictions of Einstein's general theory of relativity is the existence of gravitational waves, tiny ripples in spacetime generated when large masses are accelerated. In this talk I will describe the current effort to detect these waves. The hope is that we will soon be able to open this new window on the Universe, and obtain unprecedented information about black holes, neutron stars and cosmology.

QUASI-THERMAL EMISSION IN GAMMA-RAY BURSTS

Felix Ryde[1]

Stockholm Observatory

C2

I will discuss the interpretation of the prompt phase in gamma-ray bursts as being dominated by quasi-thermal emission, rather than by synchrotron emission. Such an interpretation gives a more natural explanation of (i) the observed variety of spectral shape and spectral evolution, (ii) the observed narrowness of the distribution of peak energies, as well as (iii) the observed correlations between peak energy and luminosity. However, the physical setting that could produce such a scenario is not yet clear.
I will also shortly report on the Swedish involvement in the high-energy Astrophysics missions GLAST and PoGO.

MASS TRANSFER IN ECCENTRIC BINARIES

Johann Dischler[1], Melvyn B. Davies[1], Tim Adams[2]

1 Lund Observatory, Sweden
2 Dept of Physics and Astronomy, University of Leicester

C3 In many binaries, one star will fill its Roche lobe at some point in its life, resulting in the flow of gas onto the companion. The mass transfer rate is, though very low in comparison with the stellar mass, very important for the evolution of the binary. In order to model such a flow accurately, a new version of a SPH-code has been developed to model the stellar gas as two phases: The interior and the atmosphere. The atmosphere will be transferred to the companion. This will be used to study the a priori assumptions of co-rotation and circular orbit in the Roche lobe radius that is commonly used.

ASTROPHYSICAL LASERS

Sveneric Johansson[1], Vladilen Letokhov[1,2]

1 Lund Observatory
2 Vladilen Letokhov, Russia

C4 Astrophysical masers at cm wavelengths have been known for half a century. We have now detected astrophysical lasers (APL) at 1 micron in gas blobs close to the massive LBV star η Carinae. "Pseudo-metastable" states of Fe II at 7 eV experience an inverted population in a closed radiative cycle involving four levels. An effective H Lyα pump excites the uppermost levels resonantly. We also show that H Lyβ pumped O I levels decay by stimulated emission of radiation in the 8446 Å triplet.

FLUORESCENCE PROCESSES IN SYMBIOTIC STARS

M. Eriksson[1,2], H. Veenhuizen[1], G.M. Wahlgren[2], S. Johansson[2]

1 University College of Kalmar
2 Lund Observatory

Emission lines are used for determination of plasma parameters, such as electron density, temperature and velocity structure etc., in nebulae. The line profile, position and intensity ratio are the most common properties used in emission-line diagnostics.
In order to study the nature of planetary nebulae and symbiotic stars the formation of emission lines needs to be well understood. Thus, the population mechanisms responsible for the emission line formation must be modeled with reliable atomic data and all relevant physical processes included.
Strong Fe II lines in spectra of symbiotic stars are formed by PAR (Photoexcitation by Accidental Resonance) processes, (Eriksson et al., 2004, IAU Coll. 191, 132). For example, more than 100 of the Fe II lines in RR Tel and AG Peg can be explained by this process.
To date, we have detected Fe II fluorescence lines caused by PAR in 13 symbiotic stars. Also, the most famous PAR process, the Bowen mechanism, is shown to be active in almost all of the symbiotic stars leading to strong O III lines.
The N III lines (corresponding to the 3s-3p and 3p-3d transitions) are observed in symbiotic stars. They are quite mysterious in the sense that they are difficult to explain in terms of population mechanism. For RR Tel and AG Peg no single mechanism can explain their relative strengths, and the 3d population must be a combined effect of PAR, radiative recombination and perhaps also charge transfer with neutral hydrogen (Eriksson et al., 2005, A&A 434, 397). The N III lines are now analyzed in two more systems, V1016 Cyg and RW Hya.

C5

MOONS AND MAGNETOSPHERE OF SATURN - LATEST RESULTS FROM CASSINI/HUYGENS

D1

Jan-Erik Wahlund

Institutet för Rymdfysik – Uppsala / Inst. för Astronomi och Rymdfysik, Uppsala Universitet

TBD

RESTORATION OF SEEING-DEGRADED SOLAR IMAGES

Mats Löfdahl

Institute for Solar Physics

D2

Solar observations differ from night-time astronomy in that there are enough photons that almost all observations can be made with exposure times that are short with respect to the time scale of atmospheric turbulence. In good seeing or with adaptive optics, short exposures have high-resolution information, that can be recovered using clever data acquisition and mathematical tools. In this presentation I will try to popularize the type of methods used and developed at the Institute for Solar Physics. In combination with the use of Adaptive Optics, these methods are the reason we have been able to produce such beautiful movies from the world's premier high-resolution solar telescope, the Swedish 1-meter Solar Telescope on La Palma. Great movies and excellent snapshots will be shown during the talk, many of which have lead to new insights about the workings of the solar atmosphere.

3D HYDRODYNAMICAL MODEL STELLAR ATMOSPHERES OF METAL-POOR RED GIANTS

R. Collet[1], M. Asplund[2], R. Trampedach[2]

1 Uppsala Astronomical Observatory
2 Australian National University

D3

Recently 3D hydrodynamical simulations of stellar surface convection have become achievable thanks to advances in computer technology and efficient numerical algorithms. In this contribution we investigate the main differences between static 1D and 3D time-dependent model stellar atmospheres of red giants at very low metallicities. We focus in particular on the impact of 3D LTE spectral line formation on the derivation of elemental abundances for the extremely metal-poor ([Fe/H] ≈ -5.3) red giant HE 0107-5240 (Christlieb et al. 2002)

GRAVITATIONAL SETTLING IN SOLAR-TYPE STARS – NEW CONSTRAINTS

Andreas Korn[1], Paul Barklem[1], Frank Grundahl[2], Bengt Gustafsson[1], Nikolai Piskunov[1]

1 Uppsala Astronomical Observatory
2 Arhus University, Denmark

D4

We report on an observational program to constrain the extent to which photospheric abundances in cool, solar-type stars are altered by atomic processes like diffusion and levitation over long timescales. If such processes result in a net effect on abundances (referred to as "gravitational settling"), they would have far-reaching consequences for the interpretation of stellar abundances, especially for the halo phase and lithium as a relic of Big Bang nucleosynthesis.
We have recently acquired spectroscopic data on stars in the metal-poor globular cluster NGC 6397 using the multi-object spectrograph FLAMES on the VLT. This data is of unprecedented quality and allows us to revisit earlier claims on the extent of gravitational settling.

HYDRODYNAMICAL SIMULATIONS OF HELIUM SHELL FLASH CONVECTION

Bernd Freytag[1,2], Falk Herwig[2], Robert M. Hueckstaedt[2]

1 Uppsala Astronomical Observatory
2 Los Alamos National Laboratory

D5 Typical time-scales for stellar evolution are millions or even billions of years, many orders of magnitude larger than convective time-scales. The details of convective flows are therefore ignored in stellar evolution calculations, and convective mixing is described as diffusion process.
However, in a Helium shell flash convection zone (the most important nuclear production site in low-mass stars) the time-scales of convection, overshoot, mixing, and burning become comparable. Their interaction can only described by detailed hydrodynamical models. First results derived with the RAGE code will be presented.

Talks / Saturday October 22

CHEMISTRY AND STAR FORMATION IN ACTIVE GALAXIES

S. Aalto

Onsala Rymdobservatorium

E1 I will discuss recent results on the chemistry and physical conditions of the nuclear and extended molecular interstellar medium in starburst galaxies and active galactic nuclei (AGNs).
Chemistry of the molecular ISM can be used to distinguish between AGN and starburst-driven nuclei - and is a potentially useful tool to help track starburst evolution. This is of particular importance to deeply enshrouded ultraluminous galaxies, where heavy extinction makes optical age-dating methods difficult to apply.

LYMAN ALPHA GALAXIES AT HIGH- AND LOW-REDSHIFT

Matthew Hayes[1], Göran Östlin[1], J. Miguel Mas-Hesse[2], Daniel Kunth[3], Claus Leitherer[4], Artashes Petrosian[5]

1 Stockholm Observatory, Sweden
2 CISC-INTA, Spain
3 IAP, France
4 STScI, USA
5 BOA & INIC, Armenia

E2 I will outline some techniques for surveying the high-redshift universe, paying particular attention to determination of cosmic star-formation rates and probing structure. I will discuss the cosmological significance of the Lymanα emission line from starburst galaxies and present some of the results of our HST/ACS imaging program to observe a sample of local starburst galaxies in the Lyα line. I will focus on the modeling work done by our group on the starburst BCG laboratory ESO338-IG04 and explain the complexities involved with the analysis of these images. The Lyα morphology is complex, and photon-escape is regulated by several different mechanisms which can be disentangled from within our processed images. Correlations with Hα surface photometry reveal that the Lyα escape fraction is just 5%, and each Lyα photon must have undergone on average $\sim$ 2 resonant scatterings to account for this attenuation beyond the level of internal dust extinction. I will then introduce some of the simulations carried out by our group that aim to examine how observational biases or astrophysical phenomena may impact upon the interpretation of data from high-z Lyα surveys. I will close by talking about the future of our programs: HST Cycle 14 observations and possible future Lyα survey projects.

THE DYNAMICS OF BLUE COMPACT GALAXIES: GAS AND STARS

T. Marquart[1] G. Östlin[2], N. Bergvall[1], P. Amram[3], J. Masegosa[4]

1 Uppsala Astronomical Observatory
2 Stockholms Observatory
3 Marseille Observatory, France
4 Astrophyical Institute Granada, Spain

E3

Blue Compact Galaxies (BCGs) undergo an intense phase of star formation and their spectra are dominated by light from young stars and prominent emission lines from the ionized interstellar medium. Investigating the dynamics of BCGs and less intense star-forming galaxies helps to understand the triggering mechanism for star formation. We have used Fabry-Perot spectroscopy the H_α line to measure spatially resolved Doppler-shifts of the H_α line (velocity fields) and thereby get a handle on the dynamics of the ionized gas in a large sample of BCGs. We find many non-relaxed systems with disturbed kinematics. It is however unclear if gas-kinematics always traces the potential well of the galaxy and can hence be used to measure the mass of the object, or if strong feedback from supernovae invalidates this assumption. We have therefore used integral field spectroscopy to tackle the near-IR $[CaII]_{\lambda\lambda 8498,8542,8662}$ triplet to investigate the stars' motions and compare to the gas. Latest results will be presented.

PROGRESS IN SEARCHES FOR PRIMORDIAL RESONANT LINES USING THE ODIN SATELLITE

Carina Persson[1], Pierre Encrenaz[2], Åke Hjalmarsson[1]

1 Onsala Space Observatory
2 LERMA, Observatoire de Paris

E4

The presence of a primordial molecular (e.g. *HD*, H_2^+, *LiH*, HeH^+) or atomic medium allows us to investigate the first phases of structure formation in the expanding universe. The lines produced by resonant scattering of the CMB photons are the most important signals coming from the *dark ages* of the post-recombination universe. Using the Odin satellite we have performed a spectral line survey from 547 to 578 GHz, with a resolution of 1 MHz, towards two of WMAP:s hot spots (Bennett et al. 2003) to search for the primordial resonant lines. The observations were made during the summer 2004 and are planned to continue during the winter 2005. The major improvements by these observations are the absence of spectral line poisoning by the terresterial atmosphere and the use of a much increased bandwidth. This allows a wide range of redshifts to be explored and also has the advantage of a possible detection of several lines produced by the same species and primordial cloud at the previously unknown redshift. This is the best way to check the origin of the line.
The first search for primordial resonant lines was made with the IRAM telescope 1992 and was characterized by a small bandwidth of 1 GHz (de Bernardis et al. 1993). In the future the Herschel satellite will allow us to search across an even larger bandwidth than Odin and at a much higher sensitivity.

REMOVING NOISE FROM ASTRONOMICAL DATA: A WAVELET CODE FOR THE SWEDISH COMMUNITY

Alessandro Romeo[1,2]

1 Onsala Space Observatory
2 Chalmers University of Technology

E5

Astronomical data are polluted by noise, which strongly reduces the effective resolution and makes it difficult to interpret the data appropriately. Wavelets are the state-of-the-art method for removing noise from scientific data. They outperform standard techniques of noise reduction and their use is growing exponentially.
In this talk, I present a wavelet code designed for such an application, which I make it available for the Swedish community through collaborations: JOFILUREN (for information and references see `http://www.oso.chalmers.se/~romeo/JOFILUREN/`). I also preview work in preparation.

POPULÄRASTRONOMISKA STILIDEAL UNDER TIDIGT SVENSKT 1900-TAL

Johan Kärnfelt

För dagens forskare börjar det så kallade tredje uppdraget - att samverka med det omgivande samhället – att bli allt mer av en självklarhet. Denna samverkan kan ta sig många former, men en traditionstyngd sådan är genom det populärvetenskapliga tilltalet. När man som forskare sätter sig ned för att skriva sin artikel eller sitt anförande ställs man inför en rad val: Hur ska man bäst lägga tankegodset till rätta för att passa den tänkta publiken? Vad kan uteslutas och vad måste vara med? Vilket språk kan användas? Frågor som dessa är emellertid långt ifrån nya. De har följt populärvetenskapen sedan genrens uppkomst i folkbildningsrörelsernas Sverige decennierna runt sekelskiftet 1900. Med denna föreläsning vill jag varken ge pekpinnar eller rekommendationer, utan snarare försöka **F1**
göra ett nedslag i diskussionen kring hur man bäst skriver populärt, vid den tid då genren fortfarande var ung. När svenska astronomer på allvar började engagera sig i det populärvetenskapliga arbetet efter sekelskiftet, hade de ingen tradition att falla tillbaka på. Alla frågorna var nya; ingen hade några givna svar. Det populärastronomiska stilideal som vid denna tid tog form, kan i huvudsak ledas tillbaka till en man – uppsalaastronomen Östen Bergstrand. Bergstrand var inte bara en mycket inflytelserik forskare, utan han skulle också bli en framträdande popularisator. Ett led i detta senare arbete var att han, vid sidan av sina populärastronomiska böcker och artiklar, programmatisk formulerade sina tankar om hur man bäst bör tilltala en allmänhet. Genom en skarp kritik av den prosa som den franske astronomen och popularisatorn Camille Flammarion skrev under senare delen av 1800-talet, skapade han det ideal som för lång tid framöver kom att dominera genren.

CURRENT AND FUTURE RESOURCES FOR SWEDISH ASTRONOMY

Discussion around five topics to be introduced by short talks as follows:

- Claes Fransson (ESO + VR/KFI)
- Lennart Nordh (ESA, Odin, etc.)
- Johannes Andersen (NOT)

  The Nordic Optical Telescope was inaugurated as a general-purpose facility for Nordic astronomy in 1989. It operates today in a totally different scientific, technical, and political environment. Our strategy to meet this challenge is increased specialization on high-profile science in the near term, integration in a scientifically more powerful as well as more cost-effective facility in the longer term. The content and status of these plans will be described and reactions and advice from the audience are invited. **F2**
- Lars-Åke Nyman (APEX)

  APEX is a recently commisioned 12 m diameter sub-mm telescope, located on the ALMA site in the Chilean Andes at an altitude of 5000m. It is operated in collaboration between the MPIfR, ESO and Onsala Space Observatory. I will describe the the telescope, instrumentation, operations and future plans.
- Hans Olofsson (Onsala)

Posters

ACCURATE LABORATORY UV WAVELENGTHS FROM SEVEN SPECIES OF INTEREST TO THE INVESTIGATION OF A POSSIBLE SPACE-TIME VARIATION OF THE FINE STRUCTURE CONSTANT

M. Aldenius[1], S. Johansson[1], M. Murphy[2]

1 Atomic Astrophysics, Lund Observatory
2 Institute of Astronomy, University of Cambridge

P1

The quality of astronomical spectra is now so high that the accuracy of the laboratory data is getting more important for the analysis and interpretation. One of the methods of investigating possible space-time variations of the fine structure constant, $\alpha = (1/\hbar c)(e^2/4\pi\epsilon_0)$, is the many multiplet method. The use of this method requires very accurate laboratory wavelengths of several spectral lines visible in highly redshifted QSO absorption spectra. A change in α could be detected as a shift in wavelengths of atomic transitions in the QSO systems. For this purpose laboratory wavelengths and wavenumbers of 23 UV lines from Mg I, Mg II, Ti II, Cr II, Mn II, Fe II and Zn II have been measured using high-resolution Fourier transform spectrometry. The spectra of the different ions (except for one Fe II line, one Mg I line and the Ti II lines) are all measured simultaneously in the same FTS recording by using a composite hollow cathode as a light source. This increases the relative accuracies of all the wavenumbers.
The calibration accuracy is limited by the standard of the Ar II calibration lines, by possible pressure shifts and by effects of illumination. To ensure a minimization of pressure shifts of the calibration lines, only 4s-4p transitions of Ar II are used. The absolute wavenumber uncertainties are $\pm$0.001 and $\pm$0.002 cm^{-1} for the symmetric lines with good signal to noise ratios, $\pm$0.003 to $\pm$0.006 cm^{-1} for the weaker lines and $\pm$0.003 cm^{-1} for the asymmetric, hyperfine affected Mn II lines. The relative wavenumbers are for the strong lines determined with an uncertainty of $\pm$0.0005 cm^{-1} or better, depending mostly on the uncertainty of the line fitting.

BALMER LINE FORMATION IN LATE-TYPE SPECTRA: EFFECTS OF NON-LTE

P.S. Barklem[1]

1 Uppsala Astronomical Observatory

P2

The effects of departures from local thermodynamic equilibrium (LTE) on the Balmer line spectra of late-type stars is investigated. A model hydrogen atom for non-LTE calculations has been constructed accounting for a range of collision processes using the best available data from the literature. Using the semi-empirical 1D solar model of Maltby et al., a systematic investigation of the relative importance of these collision processes in the solar atmosphere has been carried out. LTE conditions are found in the photosphere below log $\tau_{500\mathrm{nm}} \sim -2.5$, and the most important collisional mechanisms in establishing LTE in the present model are identified to be inelastic collisions due to electrons and hydrogen, and the resonant excitation transfer process with ground state hydrogen. Thus, as has long been assumed, the wings of Balmer lines formed in the solar photosphere do indeed form in LTE, and the LTE approximation is safe for the calculation of Balmer line wings in solar-type stars. This result is shown to hold even for metal-poor and giant stars. In the solar chromosphere it is found that charge exchange collisions with protons have a substantial effect on the statistical equilibrium of hydrogen. While populations in the chromosphere are significantly affected, the effect on the predicted Balmer line cores is small.

SPACE SCIENCE IN NORRBOTTEN

Martin Bohm[1]

1 Department of Space Science, Kiruna

Kiruna is the center of the space activities in Norrbotten. The city is favourably placed in the auroral zone and has a well developed infrastructure. Here the Royal Swedish Academy of Science 1957 founded the research institute, the Swedish Institute of Space Physics, IRF. The European Space Research Organisation built the launch site Esrange 1966. EISCAT (European Incoherent Scatter Scientific Association) has its headquarters in Kiruna together with one of its receivers. Outside of Kiruna, the Lycksele Ionospheric Observatory and the infra-sound station in Jämtön both belong to IRF.

P3

Space education in Kiruna has grown as a result of the resident competence in engineering and science linked to the space activities in the city. In 1987 Umeå University started a 2-year Space Engineering Programme. The education has since grown at a steady rate. In the beginning of 2000 Luleå University of Technology located the last year of its engineering programme in Space Technology in Kiruna and the two universities have now in Kiruna, the common department, the Department of Space Science, IRV. The two programmes can each be followed by an optional Masters programme.

There exists a close cooperation between the research centers and the department. IRV and Esrange have an agreement where students actively contribute with experiments on balloons and rockets. The space-oriented upper secondary school in Kiruna, Rymdgymnasiet, and IRV have together an astronomical observatory, Bengt Hultqvist-observatory and Umeå University will have an observatory in Umeå from the autumn of 2005.

DRAG AT THE UPPER ATMOSPHERE BY PLASMA UPFLOW

S. Buchert[1]

1 Swedish Institute of Space Physics, Uppsala

Satellites with very accurate accelerometers like CHAMP have measured surprisingly strong density enhancements in the upper thermosphere near the so-called cusp where solar wind plasma can move along the geomagnetic field lines and come directly into contact with the Earth's ionosphere (Lühr et al., GRL, 31, doi: 10.1029/2003GL019314, 2004). Observations with the European Incoherent Scatter Radars indicate that such neutral density enhancements occur when the ionosphere is heated and ionized by precipitation of solar wind plasma. Another effect of this precipitation, according to the radar data, is the upflow of ionospheric plasma which causes also a collisional drag on the neutral gas. We have modelled this drag and find that it can cause intense buoyancy waves propagating similarly as it is seen in the satellite acceleration data. Our model predicts that at altitudes above the satellite orbit in the so-called exosphere the waves have even higher amplitudes, and this might contribute to direct loss of neutral atmosphere. A similar mechanism could be effective at other planets, particularly those without a strong internal field like Mars.

P4

COMET TAILS AND PLANET FLYBYS – ROSETTA ACTIVITIES DURING ITS TEN YEAR CRUISE

Anders Eriksson[1]

1 Swedish Institute of Space Physics, Uppsala

P5

The Rosetta spacecraft was launched in 2004, with the principal aim of investigating a comet in detail, including putting a lander on its surface and following the development of cometary activity from at least 3.5 AU to perihelion. Rosetta does not arrive at comet 67 P/Churyomov-Gerasimenko until 2014, but the long cruise phase, involving flybys of Mars, two asteroids and the Earth (thrice), provides opportunities not least for the two Swedish instruments onboard. In this poster, we summarize what lies ahead and what has already been done.

THE POLAR WIND – CLUSTER RESULTS ON ATMOSPHERIC LOSS

Anders Eriksson[1]

1 Swedish Institute of Space Physics, Uppsala

P6

The polar wind is a continuous outflow from the Earth, in some respects similar to the solar wind outflow from the Sun. Previously, the polar wind have been observed at low altitudes (below a few Earth radii) by ion detectors on spacecraft, but observations further out has been a challenge because of the low energy and density of the polar wind combined with the high electrostatic potential attained by a sunlit (and thus photoelectron emitting) spacecraft in a low-density medium. By turning what was initially seen as a measurement problem into a useful signal using an analytical model and numerical simulations, we are able to present polar wind observations from the Cluster spacecraft all the way to their apogee around 20 Earth radii. We can thus show that the polar wind continues essentially unchanged to this distance, indicating that the bulk of the polar wind ions never returns to Earth but are lost to interplanetary space.

FUNDAMENTAL LIMITS OF ULTRA-HIGH-PRECISION OPTICAL ASTROMETRY: THE ASTROMETRIC EFFECTS OF ASTROMACULAE

Urban Eriksson[1], Lennart Lindegren[1]

1 Lund Observatory

P7

The accuracy of astrometric measurements has improved tremendously in the past decades as a result of new techniques being introduced, both on the ground and in space. This development will continue in the next decade; for example, Gaia will improve parallax accuracy by an other two orders of magnitude compared with Hipparcos. As a result, trigonometric distances will be obtained for the Magellanic Clouds, and thousands of Jupiter-size exoplanets will be found from the astrometric wobbles of their parent stars. How far can we expect this trend to continue? Will nanoarcsec astrometry soon be a reality, with parallaxes measured to cosmological distances and Earth-size planets found wherever we look? Or will the accuracy ultimately be limited by other factors such as variable optical structure in the targets and weak microlensing in the Galactic halo? The purpose of this research project is to assess the importance of such limitations for future ultra-high-precision astrometry.

In this first part of the project we consider the astrometric effects of surface structure on ordinary stars. These are currently of great interest as a possible limitation when using the astrometric method to search for Earth-like exoplanets (e.g., NASA's SIM PlanetQuest mission).

Since there is limited information about surface structures on other stars than the Sun, an interesting question is whether we can use more readily accessible photometric and spectroscopic data to infer something about possible astrometric effects. For example, a dark spot on a rotating star will in general cause periodic variations both in the integrated intensity and radial velocity of the star, as well as periodic shifts of the astrometric photocentre. It may therefore be possible to estimate the size of the astrometric effect from the light curve or radial-velocity curve.

Using a simple starspot model we find a general statistical relation between the astrometric, photometric and radial-velocity effects, which to some extent can be generalised to arbitrary surface structures (e.g., stellar granulation). Likely effects in different regions of the HR-diagram are estimated. It is concluded that surface structure could be a serious problem for the astrometric detection of exoplanets around many types of stars, but that it is generally unimportant for parallax determinations.

STELLAR POPULATIONS IN DWARF SPHEROIDAL GALAXIES EXAMINED USING STRÖMGREN PHOTOMETRY

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P8

Dwarf galaxies are by far the most frequent type of galaxies in the Universe and are characterized by their small masses and low luminosities. Of particular interest is the sub category Dwarf Spheroidal galaxies (dSph) which are predominantly found in close proximity to massive hosts, such as our own Milky Way. DSph can therefore be expected to play a key role in the many merger and accretion events observed in the outer regions of large galaxies. In order to fully understand the importance of such events in the context of galactic evolution, a detailed knowledge of the stellar populations in dSphs is desirable. However, because dSph are the faintest and least massive galactic type known observational efforts are made difficult. Obtaining spectral observations of even the brightest dSph stars is very time consuming.
The Strömgren uvby photometric system provides an attractive alternative to spectroscopy. It allows the possibility to classify stars according to luminosity class and stellar evolutionary phase. In addition, it also allows accurate age-independent metallicities to be derived for individual stars!
We present the first results from a large programme at Lund Observatory to study the stellar populations in several Galactic dSph galaxies. In particular we will show:

- How Strömgren photometry is efficiently used to distinguish members in the Draco dSph from a foreground of galactic dwarf stars and hence obtain a clean Draco member list.
- How Strömgren photometry can be used to derive accurate metallicities. We present the metallicity distribution function based on age-independent metallicities for individual stars in a central field in the Draco dSph.

ATOMIC DATA FOR INFRARED LINES IN COOL STARS

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For present and upcoming studies using near infrared (NIR) high-resolution spectrometers, there is a need for experimental wavelengths and gf-values. In detailed abundance analyses using high-resolution instruments the accuracy of the atomic data is also important. The present status of atomic data in the NIR is scarce, but by using the new Fourier Transform Spectrometer (FTS), presently being installed at Lund Observatory, we will be able to improve the situation. Depending on the atomic structure of specific elements, resonance lines and high excitation lines can occur as NIR transitions. Various lines are expected to be observed in stellar spectra, and we discuss in general terms how gf-values for these can be measured. We present theoretical stellar spectra with atomic lines expected to be observed in spectra of cool stars, along with laboratory recordings.

GEOMETRY OF GIANT STAR MODEL ATMOSPHERES: A CONSISTENCY TEST

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We investigate the effect of an inconsistency in geometry on synthetic spectra of giant stars. Spectra computed with model atmospheres calculated in spherical geometry while using the plane-parallel approximation for line formation calculations (*s_p*), as well as the fully plane-parallel case (*p_p*), are compared to the consistently spherical case (*s_s*). We present abundance differences for solar metallicity models with $T_{\rm eff}$ ranging from 5000 to 6500 K and $\log g$ from 0.5 to 3.0 (log cm s^{-2}). The effects are smaller for *s_p* calculations (up to -0.09 and -0.07 dex for majority and minority species, respectively, with equivalent widths $\leq$ 150 mÅ) than for the *p_p* case (up to $+0.30$ and -0.04 dex, respectively), both with respect to the *s_s* case. In the *s_p* case the differences increase slightly with temperature, while they decrease in the *p_p* case. Thus, within the parameter range of F and G giants, consistency seems to be less important than using a spherical model atmosphere.

P10

HANDS-ON UNIVERSE, EUROPE: BRINGING FRONT-LINE INTERACTIVE ASTRONOMY TO THE CLASSROOM

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1 Onsala Space Observatory, Chalmers University of Technology,

Hands-On Universe, Europe (EUHOU, see www.euhou.net) is a project supported in part by the European Commission to use modern astronomy to increase the interest of the young generation for science and technologies. Pedagogical resources are developed in a close collaborative work between teachers and professional astronomers. Eight countries are involved: France, Greece, Italy, Poland, Portugal, Spain, Sweden, and the United Kingdom. The idea is to use real astronomical data, possibly acquired by the pupils themselves in the classroom thanks to automated telescopes operated via Internet, and didactical tools developed within the EUHOU collaboration. For example, the Polish collaborators have developed low-cost webcam systems for astronomical observations. A small radio telescope built at Onsala Space Observatory can be used to map the distribution of the hydrogen gas in the Milky Way. The data can be analyzed in the classroom using a specific, pupils-friendly software.
The initial duration of the project is two years (Oct. 2004– Sept. 2006). Training sessions for teachers will be organized twice a year. The first one will be held in Torun, Poland, in October 2005 and the second one in France in early 2006. Interested teachers are invited to register via the web site.

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MAXIMAL DISKS IN LOW SURFACE BRIGHTNESS GALAXIES

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P12

It is generally believed that dwarf and low surface brightness (LSB) galaxies are dominated by their dark matter halos - not only at large radii, but also in their centres. We challenge this view with support from maximal disk (no halo) fits to rotation curves of 6 bulgeless, very blue LSB galaxies. The rotation curves are derived from Hα long slit spectroscopy and the baryonic disk contribution is estimated from BVI photometry. We conclude that, while two of the galaxies in the sample are clearly not suitable for mass modelling due to significant irregularities and non-circular motions, the remaining 4 are in agreement with maximal disks.

HIDDEN EXTRA DIMENSIONS IN DUSTY STELLAR WINDS

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P13

Pulsation, dust formation and mass loss through massive stellar winds are characteristic phenomena associated with Asymptotic Giant Branch (AGB) stars. These processes influence both the observable properties and the further evolution of these objects. During the past decade, major progress has been made regarding modelling of dynamical atmospheres and winds of cool giants, and the models are reaching a stage where they can be used for quantitative interpretation of spectra and prediction of mass loss rates. Such models, however, rely on stellar pulsation properties as external input, typically in the form of variable inner boundary conditions ("piston models"), while realistic modelling of pulsations of AGB stars is a notorious problem. In this contribution, we report ongoing work combining spherically symmetric dynamical models for atmospheres and winds (including detailed microphysics) with 3D "star-in-a-box" radiation hydrodynamical models for interiors of AGB stars (based on simpler input physics). In particular, we focus on how variable boundary conditions for the spherical models can be extracted from the 3D models, and we show first results obtained by applying these more complex boundary conditions to our atmosphere and wind models.

THE TRIPPEL SPECTROGRAPH OF THE SST

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P14

We present the new Tri-Port Polarimetric Echelle-Littrow (TRIPPEL) Spectrograph of the Swedish 1-m Solar Telescope (SST) on La Palma.

DARK-CORED FILAMENTS - THE BUILDING BLOCKS OF SUNSPOT PENUMBRAE?

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P15

Full Stokes spectro-polarimetry, together with refined techniques to interpret the measurements and continual modelling efforts, have improved our understanding of sunspot penumbrae in the last years. In spite of this progress, an improvement in the spatial resolution of the observations is clearly needed to establish in a more direct way the fine structure of the penumbra. The discovery of dark penumbral cores by Scharmer et al. (2002) suggests that we are starting to resolve the fundamental scales of the penumbra. Spectro-polarimetric measurements that are sensitive to the magnetic field in both the photosphere and higher layers, and obtained at a spatial resolution approaching 0.1", may therefore allow us to draw firm conclusions about the fine scale organization of penumbral magnetic fields. We will present recent polarization measurements at very high spatial resolution obtained with the Swedish 1-m Solar Telescope on La Palma, trying to reconcile the different scenarios put forward to explain the structure of the penumbra.

OSCILLATOR STRENGTHS IN ZR II

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1 Lund Observatory

P16

Using the Fourier Transform Spectrometer at Lund Observatory, spectra from zirconium have been recorded and analyzed. From these spectra measured relative intensities have been used to derive branching fractions for singly ionized zirconium, Zr II. Oscillator strengths for 263 spectral lines in Zr II have been derived by combining the branching fractions with previously measured radiative lifetimes.

ISOTOPE COMPOSITION OF SAMARIUM AS R- VS. S- PROCESS INDICATOR

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P17

Line profiles of Sm II in stellar spectra are explored as a means of determining the relative proportion of material created via the *r*- and *s*- processes of nucleosynthesis. The seven stable isotopes of samarium are produced to varying degrees by the *r*- and *s* processes, with the heavier isotopes having a larger contribution from the *r*-process. Relative to the solar system isotope mixture, the dominance of either of these two processes will result in a small wavenumber shift of the line profile in opposite directions. It can also introduce a change to the width and the shape of a line, making it narrower and more asymmetric when changing the isotope composition from that of the solar system to a composition dominated by the *r* process. Isotopic shifts in 11 lines of Sm II, many among the largest shifts, have been measured in a laboratory spectrum obtained with the Lund UV Fourier transform spectrometer. The hyperfine structure for the two odd isotopes is calculated for the lines where hyperfine constants (A and B values) were found in the literature. The isotope shifts are compared with previous laboratory work, where the isotope shift is measured by laser techniques. The results are introduced into a synthetic spectrum analysis of the metal-poor halo star CS31082-001 and confirm previous indications that its stellar photosphere shows the signature of only *r*-processed material.

3D CALCULATIONS ON GAS ACCRETING PLANETARY EMBRYOS

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1 Uppsala Astronomical Observatory
2 Nordita

P18

The core accretion scenario is used here as the starting point of a 3-D model for the runaway gas accretion that completes the event of gas giant planet formation. Calculations start with a planetary embryo accreting gas from its neighborhood. The shearing box approximation is used, simulating the disk hydrodynamical environment as viewed from the immediate vicinity of the forming planet. The code involves solving the Navier-Stokes equations considering thermo-hydrodynamics and gravity. Further on, radiative transfer, magnetic fields and second-order dynamical interactions (e.g., resonances) with the disk will be added, aiming toward a more realistic 3D model of the process.

HYDRODYNAMIC MODELLING OF DETACHED SHELLS AROUND AGB STARS

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We present a self consistent model of the formation of detached shells around asymptotic giant branch (AGB) stars. Using stellar parameters sampled from an evolutionary track for a 2 $M_{\odot}$ star, we have computed the time evolution of the atmospheric layers and wind acceleration region during a He-shell flash event with detailed radiation hydrodynamical models including dust formation. Based on these results, we simulate the long term hydrodynamical evolution of the subsequent wind interaction. The goal is to reproduce the observed wind properties and the structures of detached shells around AGB stars.

CORE-COLLAPSE SUPERNOVA RATES AT HIGH REDSHIFTS

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1 Stockholm Observatory

P20

We report initial results from the VIMOS high-z supernova search. This is a large programme on VLT and we have over 100 hours of exposure time divided in five filters (UBVRI) and two fields (total size of $\sim$ 0.1 square degrees). The main aim of the project is to determine the rates of core collapse and thermonuclear SNe at redshifts $0 < z < 1$. We will also be able to study how the star formation rates in galaxies at high redshifts determined by other methods correlate with the supernova rates. The SN detection is done by image subtraction in our deepest band (I), simulations show that we will reach an I (Vega) band SN detection limit (3 σ) of $\sim$ 26. Detected variable sources have also been classified into different types (SN types, AGN and variable stars) using colour and light curve information.
Currently 1/8 of the total search area has been searched for supernovae and a number of possible candidates have been detected. The search method, as well as the classification method have to be further fine tuned by running simulations. Host galaxy redshifts have been determined using photometric redshifts and the detected SN candidates have been found in the range $0 < z < 1$.

SIMULATED SOLAR WIND PLASMA INTERACTION WITH NEUTRALS EXOSPHERES: MARS AND TITAN COMPARISON

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P21

Venus, Mars and Titan do not possess a strong magnetic field and the incident plasma interacts directly with the ionosphere and the upper atmosphere of the body. The "upper atmosphere" is ionized by solar photons, solar wind electrons and charge exchange between incident plasma ions and neutral constituents of the exosphere. This interaction is strong enough to modify the atmospheric escape and resulting atmospheric erosion of the body. Titan spends most of its time in the magnetosphere of Saturn, but at times it can be in the magnetosheath or in the solar wind. When Titan is in the magnetosheath of Saturn, the interaction of the incident plasma, principally the solar wind plasma, is very similar to the interaction of the solar wind plasma with the Martian exosphere. The solar wind plasma interaction with the neutral atmosphere is investigated for Mars and Titan with a three-dimensional multi-species hybrid model. The assumed neutral coronae of the two bodies have spherical symmetry and their radial density profiles are provided by Chamberlain's model. The Martian exosphere is made of atomic hydrogen and oxygen; the main constituents of the Titan exosphere are molecular hydrogen, nitrogen and methane. Ionization processes are included self consistently through the specification of the ionization frequencies and cross sections. Although the two bodies have similarities, the different chemical composition of the coronae, which have different ionization frequencies, induces a different planetary ion production and dynamics. Pickup ions densities and energies are presented and compared for Mars and Titan. The ion production is more efficient on Titan and lead to a strong interaction between the accelerated pick-up ions and the magnetic environment around the body.

LABORATORY EXPERIMENTS AND TECHNIQUES FOR MEASUREMENTS OF ASTROPHYSICAL ATOMIC DATA

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1 Lund Observatory

P22

We can now record high resolution laboratory spectra in a broad wavelength interval (1000 to 50000 Å) with three modern instruments in our laboratory: an echelle spectrograph (1000-2000 Å), a UV-FTS (2000-7000 Å) and a recently acquired IR-FTS (2000-50000 Å). With these instruments we measure line wavelengths and intensities, from which we can derive energy levels, oscillator strengths, hyperfine constants and isotopic shifts. A tight collaboration within the Lund Laser Centre (LLC) gives us access to equipment with which we can measure radiative lifetimes. The focus is to describe our laboratory equipment, the technique used to measure the atomic parameters and the advantages and limitations in our experiments.

ASTRONOMICAL QUANTUM OPTICS - EXPLORING EXTREMELY SHORT TIMESCALES IN THE OPTICAL

Ricky Nilsson[1], Helena Uthas[1]

Lund Observatory

P23

Electromagnetic radiation, being the main source of information about our Universe, is studied in astrophysics in various spectral and temporal regions. When probing this parameter space and reaching time scales of nanoseconds one enters the realms of quantum optics, where the information content of light goes beyond classical properties like intensity, polarization and wavelength (which measure only first-order spatial or temporal coherence) and instead allows us to determine higher-order coherence and study quantum statistical variations in photon streams. By measuring second-order temporal coherence using temporal correlation of intensity (as opposed to the first-order correlation of the electromagnetic field like in a Michelson interferometer) one can discover non-classical phenomena, e.g. bunching of photons in time. A digital miniature version of Hanbury Brown's and Twiss' intensity interferometer has been set up in the optics laboratory at Lund Observatory as a part of the design and testing of possible components in a quantum optical instrument for astronomy applications. Such an instrument will, with the advent of extremely large telescopes, enable us to explore the field of astronomical quantum optics.

RUM OCH RYMD

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P24

Projektet Rum och Rymd är ett samarbetsprojekt mellan konstnärer och uppsalaastronomer. Vi har under flera år arbetat med tankar och bilder om rymden. Projektet har inkludrerat en doktorandkurs. Syfte, metod och resultat inklusive konstnärliga verk presenteras.

DARWIN SPACE SWEDEN - FINNS DET LIV UTANFÖR KLASSRUMMET?

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P25

DSS är ett långsiktigt projekt, i samarbete med bl a forskare vid ESA, som har två huvudsyften:
1. Att följa ESAs Darwin-projekt fram till, och förbi, uppskjutningen 2015. Under tiden fram till uppskjutningen uppmärksammas även projekt som Corot och Gaia.
2. Att införa astronomi i den ordinarie skolundervisningen, i enlighet med Skolastros visioner, dels i fysiken men även i kemi, biologi, naturkunskap och matematik.
I DSS ingår lärarfortbildning, laborationer och observationer, presentations-material för lärare mm. En kärngrupp av lärare har bildats, i vilken projektets implementerande i skolan diskuteras.

X-RAY EMISSION FROM RADIATIVE SHOCKS IN TYPE II SUPERNOVAE.

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1 Stockholms Observatorium

A numerical model will be presented which calculates the X-ray emission from radiative shocks in supernovae. Type IIL and Type IIn supernovae generally have a sufficiently dense circumstellar medium for the interaction between the supernova ejecta and circumstellar medium to be strong, leading to substantial X-ray emission already a few days after the explosion. Assuming the flow is stationary, our model combines hydrodynamic calculations with time dependent ionization balance and multi-level calculations. The dependence of the resulting spectrum on shock velocity and chemical composition will be discussed, as well as the difference between spectra produced by this model and single-temperature spectra. The great difference between the two means that the emission from a cooling region cannot be adequately represented by a single-temperature model, and that it is necessary to have a model which takes into account the emission from a number of cooling cells, as our model does.
The applicability of our model for various types of supernovae is discussed, and examples of applications to observations will be given, e.g. the ring collision in SN 1987A.

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A SPECTRAL SURVEY OF ORION KL FROM 487–492 AND 542–577 GHZ WITH THE ODIN SATELLITE

Carina Persson[1], A.O. Henrik Olofsson, Åke Hjalmarson, P. Bergman, P. Bernath, U. Frisk, T. Hasegawa, N. Koning, S. Kwok, M. Olberg, Aa. Sandqvist, K. Volk and E.S. Wirström

1 Onsala Space Observatory

Orion KL is an ideal target for spectral line surveys at millimeter and submillimeter wavelengths due to the chemical richness and close proximity of this region. Several ground-based spectral line surveys have been made of this source, but due to the absorption by H_2O and O_2, the terrestrial atmosphere is completely opaque in the spectral regions around 487 and 557 GHz. The Odin satellite (A&A Odin Letters, 2003, Hjalmarson et al., 2005) is the first telescope capable of observing this frequency range, using its four sub-mm receivers.
During spring 2004 to spring 2005 we have performed a spectral scan of the Orion KL region in the frequency ranges 487–492 and 542–577 GHz. The data reduction and spectral line identification work is being performed in parallel in Onsala and in Calgary. This work complements the earlier ground-based spectral line surveys of this source in nearby frequency bands 455–468 and 492–507 GHz at JCMT and 607–725 GHz at CSO.
The spectral line density observed by Odin (on average about 10 lines per GHz) is similar to that obtained by the much larger ground-based telescopes – reflecting their suffering from atmospheric attenuation as well as the long Odin integrations and good data quality. The rms noise in our averaged spectra is typically < 0.03 K. This noise level is somewhat higher than expected from the receiver noise, which may indicate that we are approaching a low-level line forest.
The Odin spectral scan can also be considered as an important pilot study for the much more sensitive spectral surveys to be performed by the Herschel Space Observatory.

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IS CO RADIO LINE EMISSION A RELIABLE MASS-LOSS-RATE ESTIMATOR FOR AGB STARS?

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1 Stockholm Observatory

P28

The final evolutionary stage of low- to intermediate-mass stars, as they evolve along the asymptotic giant branch (AGB), is characterized by mass loss so intense ($10^{-8} - 10^{-4}$ $M_{\odot}$ yr^{-1}) that eventually the AGB life time is determined by it. The material lost by the star is enriched in nucleo-synthesized material and thus AGB stars play an important role in the chemical evolution of galaxies. A reliable mass-loss-rate estimator is of utmost importance in order to increase our understanding of late stellar evolution and to reach conclusions about the amount of enriched material recycled by AGB stars. For low-mass-loss-rate AGB stars, modelling of observed rotational CO radio line emission has proven to be a good tool for estimating mass-loss rates [Olofsson et al. (2002)] for M-type stars and [Schöier & Olofsson (2001)] for carbon stars, but several lines are needed to get good constraints. For high-mass-loss-rate objects the situation is more complicated, the main reason being saturation of the optically thick CO lines. Moreover, Kemper et al. (2003) introduced temporal changes in the mass-loss rate, or alternatively, spatially varying turbulent motions, in order to explain observed line-intensity ratios. This puts into question whether it is possible to model the circumstellar envelope using a constant mass-loss rate, or whether the physical structure of the outflow is more complex than normally assumed.

We present observations of CO radio line emission for a sample of intermediate- to high-mass-loss-rate AGB stars. The lowest rotational transition line ($J = 1-0$) was observed at OSO and the higher-frequency lines ($J = 2-1$, $3-2$, $4-3$ and in some cases $6-5$) were observed at the JCMT. Using a detailed, non-LTE, radiative transfer model we are able to reproduce observed line ratios and constrain the mass-loss rates for the whole sample, using a constant mass-loss rate and a "standard" circumstellar envelope model. However, for some objects only a lower limit to the mass-loss rate could be obtained. An independent measure of the mass-loss rate can be obtained from dust radiative transfer modelling, in turn coupled to a dynamical wind model. We have modelled the observed SEDs for our sample sources and find that the mass-loss rates obtained in this way agree, within the mutual uncertainties, with those estimated from the CO line modelling. The main advantage of this procedure is that there is no saturation problem in the high-mass-loss-rate regime.

PLANETARY CRADLES

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This work aims towards modelling protostellar gas disks to see if the existence of planets (or planetary embryos) embedded in the disk can produce observable features at the disk surface. The modelling is done using a one-dimensional code that includes a treatment of both hydrodynamics and radiative transfer. Realisitic physics such as the effect of stellar irradiation on a flared disk and detailed microphysics of the radiative transfer process will be included in the model. The work is currently in its early stages.

ALGORITHMS FOR STELLAR PERTURBATION COMPUTATIONS ON OORT CLOUD COMETS

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1 Uppsala Astronomical Observatory

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TBD

THE LONGEST OBJECTS IN THE SOLAR SYSTEM? SPACECRAFT ENCOUNTERS WITH COMET ION TAILS

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In 1996, the Ulysses spacecraft crossed the ion tail of comet Hyakutake, at a distance of more than 3 AU from the comet. Despite this huge distance, a clear signature of the comet ion tail was seen in magnetometer and ion data. We have constructed a model for prediction of comet ion tail crossings using spacecraft and comet orbital elements and a simple model for the solar wind and ion tail expansion. We use this to obtain predictions for the Rosetta spacecraft, cruising for almost ten years in interplanetary space before reaching its target comet in 2014. One result of this work was that Rosetta tried to catch one possible tail crossing in June 2005, apparently without success. Possibilities for other interplanetary and Earth orbiting spacecraft have also been considered.

ORBITAL LINKAGES OF COMET 6P/D'ARREST BASED ON ITS ASYMMETRIC LIGHTCURVE

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TBD

HIGH-SPEED ASTROPHYSICS - EXPLORING VERY SHORT TIMESCALES IN THE OPTICAL

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1 Lund Observatory

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With the temporal resolution that can be achieved today, it is possible to detect phenomena on timescales of seconds, milliseconds and even microseconds. Quasi-periodic oscillations originating from instabilities in accretion discs around compact objects or non-radial oscillations in neutron stars are examples of high speed optical phenomena on short timescales. A high-speed detector system could include some sort of photon-counting detectors such as avalanche photo-diodes, which have a high time resolution, and real-time signal processors which reduce the amount of data and display the variability on short timescales. If we are to draw firm conclusions on the astrophysical origin of any observed signature in a statistical function it is also important to investigate all sources of error that might interfere with measurements of high-speed events.
In the ongoing concept study for ESO's proposed 100-m OverWhelmingly Large telescope (OWL), a design study of an instrument for the exploration of quantum optical phenomena in astronomical sources, but also for high speed observations in general, is made. This is a project in collaboration between ESO, Lund Observatory and the University of Padua in Italy.

MAGNETIC RECONNECTION IN SPACE PHYSICS AND ASTRONOMY: SPACECRAFT AND REMOTE SENSING OF A UNIVERSAL ENERGY CONVERSION MECHANISM

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Magnetic reconnection is a universal process allowing fast energy conversion in astrophysical plasmas. It is of importance for transport of energy, momentum and mass in planetary magnetospheres, and is believed to be of importance in the solar corona and in the surroundings of stars and galaxies. Reconnection involves large-scale energy transport and conversion but is initiated in very small regions on an ion-inertial length scale, so-called diffusion regions. We present detailed observations of magnetic reconnection obtained by the four Cluster spacecraft in the terrestrial magnetosphere, and speculate how in situ spacecraft observations can be used to understand astrophysical plasmas.

NEW OBSERVATIONS OF SYMBIOTIC STARS

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Symbiotic stars are binary star systems typically comprised of a cool giant star and a hot source, usually a white dwarf. The two stars are sufficiently close to each other that mass transfer and wind interactions can account for a variety of physical phenomena, including accretion disks and jets. We have initiated an observing program that utilizes ground and space observations to learn more about the circumstellar environment of symbiotic stars. Imaging and low resolution spectroscopy are currently being taken for a small group of symbiotics using the Spitzer IR space telescope. The imaging may reveal the extent of mass (warm and cool dust) and its geometry. The spectroscopic data already collected reveals emission lines not observed earlier for symbiotics, based on ISO satellite spectra. Ground based spectra have been obtained from several observatories and are being analysed for higher excitation emission lines.

CARBON STARS TOWARDS THE BULGE AND THE SAGITTARIUS DWARF GALAXY.

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We will present preliminary abundances of carbon and oxygen for a sample of carbon stars in the Sagittarius dwarf galaxy including its stream and towards the galactic bulge.
The carbon stars in the bulge were recently proposed to belong to the Sagittarius system which with its lower metallicity more easily would produce carbon stars (Ng 1997-1999). It is not obvious that this is the case, but the overall metallicities in the dwarf and bulge systems are expected to be different and the abundances might be used to distinguish between true members of the bulge and members of the Sagittarius stream seen through the bulge.
The abundances are determined from infrared spectra obtained with the ISAAC spectrometer on VLT (R=1500). The synthetic spectra used in the analysis are computed with the MARCS model atmosphere code, originally presented in Gustafsson et al. (1975).

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