NEDERLANDSE ASTRONOMENCLUB

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NAC 2009

64e Nederlandse Astronomen Conferentie

13 –15 mei 2009, Conferentieoord Rolduc, Kerkrade

The 64^{th} Nederlandse Astronomen Conferentie (NAC) is organized by
the Anton Pannekoek Sterrenkundig Instituut,
University of Amsterdam.

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Introduction

Dear participants,

We are very pleased to welcome you at Kerkrade for this year's 'Nederlandse AstronomenConferentie', which is already the 64^{th} in a long tradition. It is the second time the NAC meets at Rolduc and we hope you will all enjoy your stay. The programme includes oral and poster presentations from the various astronomical fields to which the Dutch and Flemish astronomers are actively contributing.

We look forward to a stimulating scientific environment, but also hope you will enjoy the surroundings of the Rolduc abbey during the conference's traditional socializing Thursday afternoon.

Enjoy!
Godelieve Hensberge and Lex Kaper,
on behalf of the organizing committee.

This conference was made possible with financial aid from:

Anton Pannekoek Sterrenkundig Instituut, University of Amsterdam
ASTRON - Netherlands Institute for Radio Astronomy
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NAC 2009

64th Dutch Astronomers Conference

13 –15 mei 2009, Conference Center Rolduc, Kerkrade

PROGRAMME

Wednesday 13th of May

11:15 – 12.00	Registration NAC 2009 (continues in the afternoon)	
12:00 – 13:30	Lunch	
13:50 – 14:00	Opening NAC 2009	
Session I		
14:00 – 14:30	C. Aerts *Probing Stellar Physics and Testing Stellar Evolution through Asteroseismology*	13
14:30 – 14:45	P. Degroote *The Beta Cephei star HD 180642: analysis and interpretation of the CoRoT light curve*	26
14:45 – 15:00	R. Rutten *The solar chromosphere*	69
15:00 – 15:15	I. Brott *Rotational mixing in Magellanic Cloud O and B stars*	18
15:15 – 15:30	R. Navarro *NOVA-ASTRON optical - infrared instrumentation*	56
15:30 – 16:00	**Coffee, tea / registration / check-in hotel / posters**	

16:00 – 16:15	F. Helmich *Herschel-HIFI: mission, technology and science*	37
16:15 – 16:30	I. Kamp *Protoplanetary Disks with Herschell: line diagnostics*	45
16:30 – 16:45	R. Visser *A new CO photodissociation model applied to circumstellar disks*	88
16:45 – 17:00	M. Hogerheijde *Resolved molecular hydrogen emission near the young star DoAr21*	40
17:00 – 17:15	M. Rodenhuis *First-Light Observations of Protoplanetary Disks with the ExPo*	67
17:15 – 17:30	P. Groot *Results from the European Galactic Plane Surveys*	32
17:30 – 18:00	**Registration / check-in hotel**	
18:00 – 19:30	**Dinner**	
20:00	**Historic Tour Abbey (4 $\times$ 25p)**	
20:00 – 02:00	**Cellar Bars**	
21:30 – 22:15	**Movie: Spiral Galaxy, de melkweg ontrafeld**	

Thursday 14th of May

07:30 – 9:00	Breakfast	
Session II		
09:00 – 9:30	E.P.J. van den Heuvel *Ten years of NOVA as Top Research School and its importance for Dutch Astronomy*	81
09:30 – 9:45	K. Öberg *The formation of complex molecules in circumstellar ices*	58
09:45 – 10:00	J. Bouwman *VUV induced chemistry in PAH containing interstellar ice analogues*	15
10:00 – 10:30	**Coffee, tea / posters**	
10:30 – 11:15	J. McEnery *A new view of the high energy gamma-ray sky with the Fermi Gamma-ray Space Telescope*	54
11:15 – 11:30	P. Soleri *X-ray jets from the X-ray binary Cir X-1*	74
11:30 – 11:45	A. Patruno *Probing standard accretion theory with accreting pulsars*	61
11:45 – 12:00	A. Watts *Firestorms and starquakes: the dangerous life of a neutron star*	90
12:00 – 13:30	**Lunch**	
13:30 – 15:30	**Outdoor activities**	
15:30 – 16:00	**Coffee, tea with Limburgse vlaai / posters**	

Session III

16:00 – 16:15	H. Hoekstra *A look at the dark side: weak lensing by large scale structure*	39
16:15 – 16:30	M. Haas *Physical properties of simulated galaxies from varying input physics*	33
16:30 – 16:45	F. Maschietto *Tracing Protoclusters at High Redshift*	53
16:45 – 17:00	V. Jelic *CMB-EoR cross-correlation study*	43
17:00 – 17:15	D. Groen *Simulating the universe on an intercontinental grid of supercomputers*	31
17:15 – 17:30	S. Portegies Zwart *The lost siblings of the Sun*	64
18:00 – 19:30	**Dinner**	
19:45	**Poster prizes**	
20:00 – 21:00	**Evening lecture: prof. dr Frits Rosendaal (Leiden University Medical Centre)** *Air travel and thrombosis: experiments at 10,000 meter altitude and on the South pole*	68
21:00 – 02:00	**Afterglow in cellar bars**	

Friday 15th of May

07:30 – 9:00	Breakfast	
Session IV		
09:00 – 9:30	H. Falcke *From black holes to ultra-high energy cosmic rays*	28
09:30 – 9:45	E. Helder *Measuring the cosmic ray acceleration efficiency of a supernova remnant*	36
09:45 – 10:00	D. Kosenko *X-ray spectroscopy of LMC supernova remnants*	47
10:00 – 10:30	Coffee, tea	
10:30 – 10:45	V. Tudose *Aql X-1 and its identity problems*	79
10:45 – 11:00	R. Overzier *The co-evolution of black holes and starbursts at low and high redshift*	60
11:00 – 11:15	R. Scheepmaker *The resolved cluster formation efficiency in M51*	71
11:15 – 11:30	M. Brentjens *Preparing (for) LOFAR*	17
11:30 – 11:45	W. Frieswijk *Allegro: the ALMA Local Expertise Group*	30
11:45 – 12:00	G. Nelemans *Gravitational wave astrophysics*	57
12:00	**Closing remarks**	
12:00 – 13:30	**Lunch**	
13:30 & 14:15	**Bus departure**	

POSTERS

Probing Stellar Physics and Testing Stellar Evolution through Asteroseismology

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We begin with a general introduction into the research field of asteroseismology and show how it can improve stellar evolution models to a level that cannot be achieved by any other method so far. Subsequently, we discuss several results from ground-based campaigns and from the operational French-led European space mission CoRoT (Convection, Rotation, planetary Transits) for various types of stars. We illustrate the immense advantage of having long-term uninterrupted data from space with a factor 100 better precision compared to data from the ground. Finally, we will highlight the next step in this research, to be expected from the space missions Kepler (NASA) and PLATO (ESA), which have been designed for exoplanet hunting. PLATO will allow us to do asteroseismology of thousands of bright exoplanet host stars.

Publication status: Approved ERC Advanced Investigator Grant

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Do different softwares and hardwares give comparable N-body simulation results?

P. Anders[1]

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Publication status:

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VUV induced chemistry in PAH containing interstellar ice analogues

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Polycyclic aromatic hydrocarbons (PAHs) are believed to be present in space and to play a key role in inter- and circumstellar reaction schemes. Their presence is evidenced by characteristic infrared emission features following UV excitation, but unambiguous identifications have not been possible, mainly because of spectral congestion and overlap. Here we present a new laboratory experiment that provides optical fingerprint spectra of PAHs in water ice. As the technique is fast - with a subsecond time resolution - also reactions in the ice following energetic processing can be monitored at astrophysically relevant temperatures. For this, the ice is irradiated with a special VUV source that simulates the interstellar radiation field. Spectral changes show that PAH-ions and reaction products involving dissociation products from the water matrix (PAH-OH and its ions) are readily formed. The technique is demonstrated on the example of pyrene in water ice.

Publication status: Astrophysical Journal, submitted

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Distance determination for RAVE stars using stellar models

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We developed a method to derive distances from spectroscopic data and to obtain full 6D phase-space coordinates for the RAVE second data release. We use stellar models combined with atmospheric properties from RAVE (effective temperature, surface gravity and metallicity) and $(J-K)$ photometry from archival sources to derive absolute magnitudes. In combination with apparent magnitudes, sky coordinates, proper motions from a variety of sources and radial velocities from RAVE, we are able to derive the full 6D phase-space for a large sample of RAVE stars. This method is tested with artificial data, Hipparcos trigonometric parallaxes and observations of the open cluster M67. When we apply our method to a set of $16\,663$ stars we find $2\,067$ stars with relative distance errors $< 25\%$, while $5\,295$ and $12\,701$ have relative errors smaller than 37.5% and 50% respectively. The known kinematic substructures in the U and V velocity components of stars in the Solar neighbourhood are clearly apparent in our dataset confirming the accuracy of our data and the reliability of our technique. We provide independent measurements of the orientation of the UV velocity ellipsoid and of the Solar motion which are in very good agreement with previous work. The distance catalogue for the RAVE second data release is available at http://www.astro.rug.nl/∼rave.

Publication status: A&A, in preparation

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Preparing (for) LOFAR

M.A. Brentjens[1] on behalf of the LOFAR collaboration

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The LOFAR radio telescope is currently making the transition from prototype to full scale astronomical observatory. Stations are being constructed at this very moment, and before the end of the year we will have an array surpassing any previous instrument in the frequency range from 10 to 100 MHz in both resolution and sensitivity. It will be comparable to the GMRT at frequencies between 110 and 240 MHz. Although there are few new observational results from the past year, there were massive changes under the hood that greatly enhanced the power of LOFAR. I will discuss some of these changes, as well as LOFAR construction work, the capabilities of the instrument now and in the near future, and the first large calibration survey, to be observed the coming autumn/winter.

Publication status: NAC specific talk.

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Rotational mixing in Magellanic Cloud O and B stars

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[4]Space Telescope Science Institute, Baltimore, USA
[5]Astronomical Institute Anton Pannekoek, University of Amsterdam
[6] UK Astronomy Technology Centre, Royal Observatory, Edinburgh, UK

Rotational mixing is potentially one of the most important processes in massive stars; its effectiveness still remains to be proven. While the VLT FLAMES Survey of O and B Stars undertook a major step in this direction, its results are ambiguous and raise important new questions. Nitrogen is an easily observed tracer element for rotational mixing. It is produced in the stellar center and can be mixed gradually to the surface over the main sequence lifetime. So, in fast rotating stars one expects N enhancement towards the end of the main sequence, while slow rotators should not show any N enhancement.
We used the VLT FLAMES data to constrain the uncertain physics of rotational mixing in our stellar evolution code. When we simulate a population of single stars we find that there are two groups of stars that cannot be explained: (1) a group of fast rotating stars which do not show any evidence for rotational mixing and (2) a group of slow rotators with strong N enrichment. Clearly binary effects and strong magnetic fields have to be considered to explain those two groups.
The element boron can be used to distinguish between the rotational mixing or binary scenarios. Since boron can only exist in the coolest outer layers, the element will be gradually destroyed by rotational mixing, while in a mass transfer scenario practically Boron free material is dumped on the mass gainer. Our single star population simulations quantify the expected amount of boron in fast and slow rotators and allow a comparison with measured boron abundances in galactic B-Stars.

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Dutch Astronomy Olympiad 2009

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We report about the preliminary round of the thirth Dutch Astronomy Olympiad. Result and participation statistics are given and compared to the two previous years. Plans about the final round, the accompanying masterclass and future editions are presented.

More information: http://www.sterrenkundeolympiade.nl

Testing the next generation of stellar population models

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We present a new model for computing the spectral evolution of stellar populations at different ages at a resolution of 2.3 Å for a wide range of metallicities ($0.0001 \leq Z \leq 0.05$). These models are based on the recent MILES stellar spectral library of observed stellar spectra in the optical. We compute the spectral evolution from 3500–7500 Å at constant resolution. By comparing index-index grids from our SSP-integrated spectra with different stellar evolution prescriptions we find that the resulting predictions agree well. To assess our model, we compare it with Bruzual & Charlot (2003). We find it is basically in accordance with their work, especially around solar metallicity. The predictions for the strengths of spectral features are reliable, given the good agreement with the work from Yamada et al. (2006). We are now building an α-enhanced spectral library based on the MILES library and the theoretical spectral library of Coelho et al.(2005,2007) to make predictions for the spectra of stellar populations with [α/Fe]$\neq$0. These models are expected to analyze existing and new spectra of early-type galaxies and get more reliable information from the galaxy evolution.

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Binary progenitor model for SNIIb

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Type IIb supernovae start as type II SNe and evolve into a type Ib, because of the low hydrogen abundance in the envelope of the progenitor before the supernova. Binary stellar evolutionary calculations, performed with Eggleton's stellar evolution code, are presented. In these calculations the parameter space is explored for different initial periods and intial mass ratios, with an initial primary mass of 15 $M_{\odot}$. We selected the binaries which go through a late case B mass transfer and result in a Type IIb SNe for the primary. We also looked at the differences in the secondary due to non-conservative or conservative mass transfer. Our results are compared with the observations of type IIb SNe 1993J and 2001ig and their observed remaining companions.

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A systematic spectroscopic study of polluted interstellar water ice analogues

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The results of a laboratory infrared study of various x:H_2O containing interstellar ice analogues are presented, with x = CO, CO_2, N_2 and O_2. The ices are grown under high vacuum conditions at low temperature and a Fourier Transform Infrared setup is used to cover the spectral range of 500 to 4000 cm^{-1}. A systematic comparison of the mixing and temperature behaviour for the different constituents provides structural information. The spectroscopic H_2O absorption features (peak position, band width and intensity ratios) change significantly when impurities are present in the ice matrix, presumably because the pollutants disturb the hydrogen bond network in the solid state. For example, the free OH stretching mode of water gains intensity with an increasing impurity dose while for the other fundamental modes (bulk stretching, bending and libration) a reduction in intensity is found. The strength of these trends is different for the four pollutants. This reflects the different nature of these species in the ice and the different spectral behaviour that is observed in the end is a consequence of differences in molecular size, proton affinity and polarity of the pollutant.

Publication status: In preparation

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Tracing the Mass Loss of Asymptotic Giant Branch Stars

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Asymptotic Giant Branch (AGB) stars have mass outflows that are driven by a combination of stellar pulsations and radiation pressure on dust forming close to the star. This mass loss dominates the late evolutionary stages of low and intermediate-mass stars. The state-of-the-art radiative transfer code GASTRONOOM, developed by Decin et al. (2006), allows to model these outflows in detail, and to reproduce the molecular data with which they are probed. Since we want to estimate the mass-loss rate for a statistically relevant sample of 40 evolved targets and since individual target modelling is very time-consuming, a formalism is needed to achieve this based on a limited number of parameters. We set up a grid of more than 15 000 GASTRONOOM-models covering the relevant parameter space for AGB stars and derived a general analytical expression to estimate mass-loss rates based on some stellar parameters and CO emission-line parameters.

Publication status: Paper in preparation.

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The UKIDSS-2MASS proper motion survey - I. Ultracool dwarfs from UKIDSS DR4

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The UK Infrared Telescope Infrared Deep Sky Survey (UKIDSS) is the first of a new generation of infrared surveys. Here, we combine the data from two UKIDSS components, the Large Area Survey (LAS) and the Galactic Cluster Survey (GCS), with Two-Micron All-Sky Survey (2MASS) data to produce an infrared proper motion survey for low-mass stars and brown dwarfs. In total, we detect 267 low-mass stars and brown dwarfs with significant proper motions. We recover all 10 known single L dwarfs and the one known T dwarf above the 2MASS detection limit in our LAS survey area and identify eight additional new candidate L dwarfs. We also find one new candidate L dwarf in our GCS sample. Our sample also contains objects from 11 potential common proper motion binaries.

Publication status: Published in MNRAS 2009, vol394, p857

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ASSIST : The test set-up for VLT Adaptive Optics Facility

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ESO is currently implementing an Adaptive Optics Facility (AOF) at one of the VLT Unit Telescopes. AOF includes an Adaptive Secondary mirror and the two AO systems GALACSI and GRAAL for instruments MUSE and HAWK-I respectively. ASSIST (The Adaptive Secondary Set-up and Instrument STimulator) is the test set-up for the verification and calibration of three elements of the VLT Adaptive Optics (AO) Facility. ASSIST features two modes : the DSM testing mode that will allow for direct on-axis testing of the DSM using both interferometry and fast wave front sensing. In full AO mode, ASSIST will allow full testing of the two AO system under conditions which simulate realistic atmospheric conditions and optically equivalent to the conditions on the telescope. The final opto-mechanical design of ASSIST will be presented together with the projected performance of the test bench for both the testing and calibration of the DSM as well as for the two AO systems under test.

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The Beta Cephei star HD 180642: analysis and interpretation of the CoRoT light curve

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The CoRoT space mission has obtained μmag-precision photometry for the known pulsating Beta Cephei star HD180642, as part of the asteroseismology program. The unprecedented quality of the CoRoT data is the start of a new era of observational constraints on stellar evolution models. The dominant mode has a high amplitude and is highly nonlinear, which was already discovered from ground based data. For the first time, nonlinear phenomena such as resonant mode coupling and variability of amplitudes and phases of many newly discovered modes are determined in such great detail. Despite the large amplitude of the dominant mode, many other features are visible which have not been so clearly detected before: these include long term variability and broad band power excess. Combining this information into one stellar model proves to be an interesting challenge.

Publication status: Astronomy & Astrophysics, submitted

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The Effects of CCD radiation damage on the Euclid Weak-Lensing survey

C.H.M. de Valk

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The Euclid mission is a part of the Cosmic Vision 2015-2025 program by ESA and its aim is to map the dark universe by measuring baryonic acoustic oscillations and weak gravitational lensing (WGL). For the measuring of WGL the optical imaging channel of Euclid will be used and control over the quality and systematics of the Point Spread Function (PSF) of the obtained images is necessary.
Euclid will orbit between Earth and Sun at L2 and will be damaged by irradiation-particles of the Solar Winds. These particles create traps in the pixels of the CCD. The traps can hold electrons on one position for an amount of time (Charge Transfer Inefficiency (CTI)), but will release them again. This results in signal loss and a systematic change in the PSF. The goal of this research is to find out what the effects of the CTI are on the weak lensing signal and how this effects the measuring of cosmological parameters.

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From black holes to ultra-high energy cosmic rays

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Publication status:

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Segregation dynamics of astrophysically relevant ices

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[1]Leiden Observatory

In cold dense clouds, molecules accrete on dust grains forming an icy mantle. The main components of these interstellar ices are known to be CO, H_2O and CO_2. H_2O and CO_2 ices form simultaneously and are observed to be mixed. Recent infrared observations suggest that pure CO_2 ice may form through thermal segregation of H_2O:CO_2 mixtures around a protostar where the ice has been heated.

Here we present the first quantitative laboratory study on the segregation of a H_2O:CO_2 ice analog. Kinetic modeling of the experimental results provids a segregation energy barrier for thin H_2O:CO_2 ices. The segregation mechanism is investigated with Monte-Carlo simulations. Extrapolating the segregation rate to astrophysical time-scales results in a new characteristic temperature for the H_2O:CO_2 segregation which can be used as a tracer of protostellar ice heating.

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Allegro: the ALMA Local Expertise Group

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Allegro is an acronym for the ALMA Local Expertise Group, which is the Dutch node of the European ALMA Regional Center. The aim of Allegro is to integrate the expertise relevant for ALMA within the astronomical institutions and universities within the Netherlands. Allegro provides general face-to-face user support and expert help for ALMA users in three areas:

- High-frequency ALMA observations, in particular Band 9 (602-720 GHz), including support for observation preparation, data calibration, reduction and interpretation.
- Wide-field imaging and high dynamic range imaging.
- Advanced science tools including the Leiden Atomic and Molecular Database (LAMDA) and radiative transfer codes such as RADEX and RATRAN.

In this talk I will give an update on the current status and activities of Allegro. I will also touch upon some ongoing synergetic activities such as the high-frequency heterodyne array receiver CHAMP+ on APEX and the extended Submillimeter Array (interferometry with the SMA, JCMT and CSO).

Publication status: N/A

More information: frieswyk@astro.rug.nl, http://www.strw.leidenuniv.nl/allegro

Simulating the universe on an intercontinental grid of supercomputers

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[1]Institute Anton Pannekoek, University of Amsterdam

Understanding the universe is hampered by the elusiveness of its most common constituent, cold dark matter. Almost impossible to observe, dark matter can be studied effectively by means of simulation and there is probably no other research field where simulation has led to so much progress in the last decade. Cosmological N-body simulations are an essential tool for evolving density perturbations in the nonlinear regime. Simulating the formation of large-scale structures in the universe, however, is still a challenge due to the enormous dynamic range in spatial and temporal coordinates, and due to the enormous computer resources required. The dynamic range is generally dealt with by the hybridization of numerical techniques, leaving the computational requirements as the final challenge. We deal with the latter by connecting two supercomputers via an optical network and make them operate as a single machine which is a challenge, if only for the fact that both the supercomputers of our choice are separated by half the planet, as one is located in Amsterdam and the other is in Tokyo. The co-scheduling of the two computers and the gridification of the code enables us to achieve a 90% efficiency for this distributed intercontinental supercomputer.

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Results from the European Galactic Plane Surveys

P. Groot[1], K. Verbeek[1], E. de Groot[1], N Deacon[1] and the EGAPS Collaboration

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The European Galactic Plane Surveys are currently mapping the Plane of our Milky Way (10×360 deg) using the Isaac Newton Telescope on La Palma and, from 2010 on, the VST on Paranal. I will review the exciting new results coming from the Northern part of the Survey, and in particular the large population of new, UV-excess source we are finding in the blue part of the survey. This blue part, called UVEX, is led from the Netherlands and has the express aim to uncover the population of blue, intrinsically low-luminosity, objects in the Galactic plane: white dwarfs, white dwarf binaries, sdB stars, planetary nebulae and we are also picking up distant Wolf-Rayet stars. An unexpected result is the sensitivity the survey has for Mira-type of giant + main sequence/white dwarf binaries.

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Physical properties of simulated galaxies from varying input physics

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The OverWhelmingly Large Simulation (OWLS) set of cosmological N-body/SPH runs follow the formation of galaxies in a representative volume of the universe for a large range of physical and numerical parameters. Input physics, such as the prescriptions for star formation, supernova feedback, AGN feedback, chemical enrichment, cooling and cosmology, as well as numerical parameters such as box size and particle number are varied one by one, in order to investigate their influence on the resulting synthetic universe and its constituents.
We will show correlations between the stellar masses, star formation rates and related properties of galaxies. For a range of input parameters, we relate the differences in the relations between these physical properties to the differences in the input physics. We find that the implementation of supernova feedback and the inclusion of AGN feedback are crucial for the star formation rates of galaxies. The details of the treatment of high density gas and the parameters of the star formation law are largely unimportant for these quantities, but do result in strongly different morphological appearances.

Publication status: MNRAS, to be submitted

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The European Solar Telescope (EST): Goals and Instrumental Concepts

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The EST is a 4-m class telescope planned to be placed on the Canary Islands. The Swedish Solar Telescope (SST) with a 1-m diameter lens, at the same time vacuum window, produces nowadays the highest-resolution images of the solar surface ever obtained, even surpassing the quality of recently launched space observatories. A 4-m class telescope cannot follow anymore the principle of a lens telescope. The primary optical element will be a mirror and in addition evacuation of the primary beam is no longer possible because of problems with such a large vacuum window.

Also the 45-cm Dutch Open Telescope (DOT) is capable to obtain very sharp images. It is the pioneering demonstrator of the open-telescope technology proving a previous misconception to be wrong that solar telescopes necessarily should be evacuated. The 4-m mirror diameter of the EST will tremendously increase the resolution on the solar surface. Magnetic fields are of eminent importance to understand the solar processes and become visible in high resolution. Consequently, high resolution and polarimetric observations will be the primary goals of the EST. The conceptual design study started in 2008 and will continue till 2011 with important funds from the EU-FP7. We will discuss the instrumental concepts necessary to reach the mentioned goals. Important issues are obtaining an extremely homogeneous temperature of the air in the entrance beam, telescope stability and low polarization.

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Constructing Arches

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We have performed a large number of N-body simulations to model the Arches cluster, a young, compact star cluster near the Galactic center. The clusters age and location make it an ideal laboratory for studying star formation. The cluster has formed under extreme conditions and it has been suggested that the initial mass function (IMF) of the cluster differs from the standard due to this. In the simulations, the cluster is evolved in the Galactic potential and stellar evolution and mass loss are included. The cluster orbit and the initial conditions are based on recent observational data. Our aim is to find the best fitting model for the Arches cluster by varying parameters such as the IMF and total mass of the cluster and comparing our simulations with the observed mass profile and the present day mass function. We show that the cluster can be well explained with a Salpeter IMF and appears to be more massive than previously thought.

Publication status: MNRAS, in preparation

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Measuring the cosmic ray acceleration efficiency of a supernova remnant

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Although cosmic rays are the most energetic particles observed, the location of their acceleration still is, for a large part, a mystery. Cosmic rays up to $\sim 10^{15}$ eV are thought to be accelerated in the shocks of supernova remnants. If these shocks have truly accelerated all the cosmic rays in the Galaxy up to $\sim 10^{15}$ eV, this requires that $\sim 10\%$ of the total kinetic energy of the supernova is used to accelerate cosmic rays. The highest energy cosmic rays may escape the remnant when it is still young, so we can no longer treat the thermodynamics of the shocks in the remnant under the assumption of energy conservation. In particular, the standard relation between shock velocity and post-shock temperature is no longer valid. Surprisingly, until recently, this effect was not observed, since it requires accurate measurements of temperatures and shock velocities.

Recently, we measured this effect in the supernova remnant RCW 86. This allowed us to quantitatively determine the amount of energy escaping the shock and the fraction of the post-shock pressure contributed by cosmic rays.

Publication status: submitted

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Herschel-HIFI: mission, technology and science

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Phenomena connected with star-formation and the evolution of galaxies are often obscured by large quantities of dust and therefore not easily studied With the launch of Herschel in mid-April, the most complex space instrument ever developed in the Netherlands, HIFI, will give us a completely new look at the cool and obscured Universe. HIFI, the Heterodyne Instrument for the Far-Infrared is a spectrograph with ultra-high spectral resolution, capable of measuring and resolving an unprecedented number of molecular, atomic and ionic lines. Careful study and modelling of these lines will put current models to stringent tests.

In this presentation I will give an overview of the Herschel mission, the key technology developed for HIFI and the HIFI science as organized in Key Programmes.

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Cosmic Magnification of Lyman-break Galaxies

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Weak gravitational lensing (WL) is a unique tool to study the large-scale mass distribution of the universe since it is sensitive to both, visible and dark matter. So far, the large-scale structure has been mainly studied through WL by employing its shear effect. Here we present a measurement of the magnification effect introduced by WL of foreground masses on 80,000 background Lyman-break galaxies (LBGs), which are selected from the Deep part of the Canada-France-Hawaii-Legacy-Survey (CFHTLS) to be at z = 3 - 5. This cosmic magnification effect leads to characteristic angular cross-correlations of galaxies that are physically far apart. The amplitude of the signal depends on the slope of the luminosity function (LF) of the background sample. Taking literature estimates of the LFs of LBGs, we show that the signal of this cross-correlation function agrees very well with theoretical predictions. This technique will be used extensively in upcoming imaging surveys like KIDS-VIKING complementing other cosmological probes. Cosmological parameters as well as the dark matter and dust environments of galaxies can be studied in this way.

Publication status: paper in preparation

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A look at the dark side: weak lensing by large scale structure

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Intervening structures in the universe give rise to small distortions in the shapes of distant galaxies. By measuring this tiny coherent signal, we can study the mass distribution in the universe directly, without relying on baryonic tracers. This makes weak lensing by large-scale structures a powerful probe of cosmology. I will review the topic of "cosmic shear" and discuss how the signal is extracted from the data. I will present results from recent surveys, most notably the CFHT Legacy Survey. Finally I will discuss what will be required to significantly improve constraints on the properties of dark energy.

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Resolved molecular hydrogen emission near the young star DoAr 21

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Most young stars form surrounded by a circumstellar accretion disk. Over the course of 2–3 Myr, these disks disappear either because the stellar radiation disperses the gas or because the dust forms into planets. A recently identified class of disks with cleared-out inner regions represents this stage. Traditionally, the molecular hydrogen content of disks (99% by mass) is difficult to observe. We present observations of fluorescent line emission from H_2 at 2.12 μm from the young star DoAr 21, which traces the X-ray irradiated disk surface. Using the AO-assisted Integral Field Unit SINFONI on VLT, we resolve the emission as an $\sim 180^\circ$ arc circling the star at ~ 150 AU distance. VISIR imaging at 18 μm reveals the presence of warm (160 K) dust at the same location. We hypothesize that we are either observing DoAr 21 in the last stages of disk clearing *or* that we are witnessing a chance encounter of the star with an unrelated condensation in its parental molecular cloud.

Publication status: A&A, in preparation

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The black-hole X-ray binary LMC X-1

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Investigation of the intriguing binary LMC X-1 shows a potential bow shock structure around the system. This structure is in the fairly dense region of the LMC known as N159. Using UVES spectra of the O star companion as well as previous investigations of the nebular region this bow shock can be reasonably explained by the wind of the O star. The dynamics of this system are analyzed and a potential origin in the one of the nearby O star clusters is discussed.

Publication status: NAC 2009: 64th Dutch Astronomy Conference

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The hydrodynamics of very eccentric mass-losing binary stars

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In preparation for a large-scale 3D radiation hydrodynamics simulation of Eta Carinae, I have conducted a systematic 2D study of the flow patterns in very eccentric mass-losing binaries. The series of simulations was targeted at the parameter space around the properties of Eta: mass ratio about 0.25, eccentricity 0.9, mass loss rates about equal for both stars. It appears that the recurrent shock wave pattern shows a well-defined generic behaviour, and the free-free radiation due to the shocks closely resembles the X-ray light curve of Eta. The overall pattern is extremely sensitive to the wind launching velocity on the surface of the stars, suggesting a possible mechanism for the formation of the 'skirt' disk surrounding the binary.

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CMB-EoR cross-correlation study

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In addition to the direct measurement of the cosmological 21-cm signal from the Epoch of Reionization (EoR), there is a big prosperity for the complementary probes of the EoR. One of them is imprint of the EoR in secondary CMB anisotropies generated via scattering off the free electrons produced during the reionization - kinetic Sunyaev-Zel'dovich effect (kSZ).
In the recent work we calculate the kSZ anisotropies from the homogeneous and patchy reionization based on large-scale radiative transfer numerical simulations. Further, we cross-correlate them with the simulated cosmological 21-cm maps. As expected, the kSZ and the EoR maps are correlated in the case of the homogeneous reionization model and anti-correlated in the case of the patchy model. However, once when the primordial CMB fluctuations are included, there is no significant (anti-)correlation between the kSZ and EoR maps any more.

Publication status: MNRAS, to be submitted

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Radio observations of IC 2497 and Hanny's Voorwerp

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Dutch school teacher, Hanny van Arkel, discovered what is surely one of the most bizarre objects discovered via the GalaxyZoo.org morphological census, SDSS J094103.80+344334.2. This object, now known as "Hanny's Voorwerp" appears as an irregular cloud located $15 - 25\,\mathrm{kpc}$ from the massive disk galaxy IC 2497. Optical observations show that the nebulosity, while being highly ionised, lacks any significant stellar counterpart. The leading hypothis to explain the appearance of Hanny's Voorwerp is that it is photo-ionised by an Active Galactic Nucleus (AGN) hosted by IC 2497. In the optical wavelength regime that AGN has not been detected.
I will present recent radio observations of IC 2497 and Hanny's Voorwerp with the WSRT, EVN, and MERLIN that show the presence of an AGN at the centre of IC 2497 and strongly support the hypothesis that Hanny's Voorwerp is being ionised by the AGN.

Publication status: A&A, in prep.

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Protoplanetary disks with Herschel: line diagnostics

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Gas emission lines from protoplanetary disks originate mainly from the irradiated surface layers, where the gas is generally warmer than the dust. Therefore, the interpretation of emission lines requires detailed thermo-chemical models, which are essential to convert line observations into understanding disk physics. We use new hydrostatic disk models (PRODIMO, Woitke, Kamp & Thi 2009) to study the origin and diagnostic power of atomic and molecular lines observed by Herschel within the GASPS open time key program. The main focus are the fine structure lines of C^+ and neutral oxygen as well as a couple of water lines. I will discuss the information that we expect to deduce from these tracers based on our disk models and a detailed radiative transfer analysis.
The GASPS program contains over 250 protoplanetary disk systems with ages in the critical 1 to 30 million year age range over which the gas appears to dissipate. The systems also span a wide range of star and disk properties, since many factors may affect disk evolution. Our survey aims at characterizing both the gas and dust content in a large representative sample of disks thus constituting a legacy dataset for the star and planet formation community.

Publication status: A&A submitted and in preparation

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From a million to a couple thousand – the co-added SDSS and its applications to medium band surveys

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We create empirical spectral libraries from the Sloan Digital Sky Survey (SDSS) by co-adding spectra from galaxies close to eachother in different parameter spaces including mass, mass density and metallicity. We pay particular emphasis on retaining the physical properties related to each spectrum, making it possible to assign physical properties to each empirical spectrum. We use these spectral libraries to create tools to make predictions for medium band surveys either in the optical (for low-redshift studies) or near-IR (for high-redshift studies) by convolving the emperical models with appropriate throughput functions for medium band surveys, with particular emphasis on the effect of emission lines on the photometry. We are currently in the process of establishing probabilities to ascertain how well each physical property can be estimated.

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X-ray spectroscopy of LMC supernova remnants

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We report on X-ray observations of supernova remnants 0509-67.5 and 0519-69.0 in the Large Magellanic Clouds with XMM-Newton X-ray observatory. Both objects are young (400 and 600 years) remnants of thermonuclear supernova explosions. We performed a detailed analysis of the X-ray spectra produced by the hot shocked material of the shells. Spectral fitting and numerical simulations allowed us to evaluate physical conditions in the plasma, ejecta chemical abundances, and dynamical properties of these objects.

Publication status: Astronomy and Astrophysics, Volume 490, 2008, pp.223-230

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On the interpretation of the globular cluster luminosity function

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The conversion of the globular cluster luminosity function (GCLF) to the globular cluster mass function (GMCF) is addressed. Dissolving globular clusters (GCs) become preferentially depleted in low-mass stars, which have a high mass-to-light ratio. This has been shown to result in a mass-to-light ratio (M/L) that increases with GC luminosity or mass, because more massive GCs have lost a smaller fraction of their stars than low-mass GCs. Using GC models, we study the influence of the luminosity dependency of M/L on the inferred GCMF. Contrary to what is noted in earlier studies, the observed GCLF is consistent with a powerlaw or Schechter type GC initial mass function and a cluster mass-dependent mass loss rate. The interpretation of the GCLF as a direct representation of the GCMF is found to be incorrect. Below the peak, the logarithmic slope of the GCMF is shallower than that of the GCLF (0.7 versus 1.0), whereas the peak mass is 0.1—0.3 dex lower when accounting for the variability of M/L than in the case where a constant M/L is adopted.

Publication status: ApJ Letters, submitted

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On the mass-to-light ratios of Galactic globular clusters

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The observed mass-to-light ratios of Galactic globular clusters (GCs) are about 25% lower than expected from their respective metallicities. Recent studies have indicated that the mass-to-light ratios could be decreased by cluster dissolution. This would occur due to the preferential loss of low-mass stars ensuing from two-body relaxation. Using analytical cluster models in which this effect is accounted for, we model the mass-to-light ratios of 24 GCs and compare these to the observed values. We obtain an average mass-to-light ratio drop of 20% and show that within the statistical uncertainty the mass-to-light ratios of GCs can indeed be explained by low-mass star depletion.

Publication status: A&A, accepted `(ArXiV:0903.4683)`

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A New Instability in Eccentric Stellar Disks around Supermassive Black Holes

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I will discuss a secular instability in eccentric stellar disks around supermassive black holes. Coherent torques amplify deviations of individual orbital eccentricities from the average, and thus drive all eccentricities away from their initial value.
I will consider applications to the Galactic center, where massive stars are likely to form in eccentric disks around the SgrA* black hole. I will show that the dynamical evolution of such a disk results in several of its stars acquiring high ($1 - e \ll 0.1$) orbital eccentricity. Binary stars on such highly eccentric orbits would get tidally disrupted by the SgrA* black hole, possibly producing both S-stars, a cluster of young stars on random orbits near the black hole, and high-velocity stars in the Galactic halo.

Publication status: Submitted to ApJL

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Wavelength Characterization of the Mid-InfraRed Instrument (MIRI) for James Webb Space Telescope (JWST)

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The Mid-InfraRed Instrument (MIRI) is one of 4 instruments for the *James Webb Space Telescope* (JWST), which will be launched into space in 2013. It will provide JWST with imaging, coronagraphy, polarimetry and medium and low resolutions spectroscopic capabilities in the wavelength range $5 - 29\,\mu\mathrm{m}$. The instrument's flight hardware will be assembled and tested in 2009-2010 at the Rutherford Appleton Laboratory (RAL), in the UK. A flight-like verification model of MIRI was extensively tested at RAL in 2008. We present first results on the performance of the MIRI medium resolution IFU spectrometer, based on test data obtained with the verification module. We have performed a preliminary wavelength characterization, and measured its spectral properties at short wavelengths, which are compared with predictions from optical models. Artifacts due to fringing and spectrum extraction widths have been quantified. We also show the first spectral data cubes recover! ed from the IFU spectra, using an image reconstruction algorithm.

Publication status: In preparation

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The Disk Mass Survey: Breaking the disk-halo degeneracy

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Little is known about the content and distribution of dark matter in spiral galaxies. There is a degeneracy in the galaxy rotation curve decompositions, which allows a wide range of dark matter halo density profiles. To break this disk-halo degeneracy an independent measure of the mass surface density is needed. Here, the current status of the *Disk Mass Survey* is presented. We have used two custom-built Integral Field Units to measure the vertical velocity dispersion of the stars in $\sim$40 nearly face-on spiral galaxies. These stellar velocity dispersions provide a kinematic measurement of the disk mass. For these galaxies we have also obtained optical and near-infrared photometry, Hα velocity fields, HI imaging and Spitzer imaging, which will provide us with rotation curves out to large radii and the contributions from the cold gas and the dust to the total mass surface density. With these data we will be able to break the disk-halo degeneracy, calibrate the mass scale of stellar population models and determine the dark matter properties in spiral galaxies with unprecedented accuracy.

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Tracing Protocluster at High Redshift

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Venemans et al. (2005) found evidence for an overdensity of Lyα emission line galaxies associated with the radio galaxy MRC 0316–257 at $z = 3.13$ indicating the presence of a massive protocluster. Here, we present the results of a search for additional star-forming galaxies and AGN within the protocluster. Narrow-band infrared imaging was used to select candidate [OIII] emitters in a 1.1×1.1 Mpc^2 region around the radio galaxy. Thirteen candidates have been detected. Four of these are among the previously confirmed sample of Lyα galaxies, and an additional three have been confirmed through follow-up infrared spectroscopy. The three newly confirmed objects lie within a few hundred km s^{-1} of each other, but are blueshifted with respect to the radio galaxy and Lyα emitters by ~ 2100 km s^{-1}. Although the sample is currently small, our results indicate that the radio–selected protocluster is forming at the centre of a larger, ~ 60 co-moving Mpc super-structure. On the basis of an HST/ACS imaging study we calculate dust-corrected star-formation rates and investigate morphologies and sizes of the [OIII] candidate emitters. From a comparison of the star formation rate derived from UV-continuum and [OIII] emission, we conclude that at least two of the [OIII] galaxies harbour an AGN which ionized the O^+ gas.

Publication status: 2008MNRAS.389.1223M, in press

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A new view of the high energy gamma-ray sky with the Fermi Gamma-ray Space Telescope

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Following its launch in June 2008, high energy gamma-ray observations by the Fermi Gamma-ray Space Telescope have opened a new and important window on a wide variety of phenomena, including pulsars, black holes and active galactic nuclei, gamma-ray bursts, supernova remnants and the origin of cosmic rays, and searches for hypothetical new phenomena such as supersymmetric dark matter annihilations. In this talk I will describe the current status of the Fermi observatory and review the science highlights from the first year of observations.

Publication status: NOVA invited talk

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Effect of the radial (stellar) migration on the Galactic Habitable Zone

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Considering the context that the Galactic Habitable Zone (GHZ) is the region of a galaxy where planetary systems may be created with enough amounts of chemical elements for the formation of a planet with Earth-like characteristics. Such zone may be predicted by the knowledge of a Chemical Evolution (CE) model. Three GHZs of M31 were predicted, one based only in conditions of formation and survival of an Earth-like planet. However, there is a phenomenon that has not been previously considered, gaseous and stellar migration. Since it is very important to emulate the real behavior of the galaxy in order to produce accurate models, migration has been applied to the CE model. The latter has as consequence a profound modification to the GHZs allowing to deduce a new scene for planetary systems to surge and survive.

Publication status: Astrobiology, in press

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NOVA-ASTRON optical - infrared instrumentation

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Astronomers need equipment to observe the heavens. The Dutch astronomical community has an optical - infrared instrumentation group that provides astronomers the opportunity to observe with the best telescopes and instrumentation imaginable.
This NOVA-ASTRON optical - infrared instrumentation group has successfully commissioned numerous instruments for the ESO VLT, such as VISIR, MIDI, SPIFFI and very recently X-shooter. With even more VLT instruments under development, such as Sphere-Zimpol and Matisse, it is one of the most active groups in Europe, demonstrating the success of the NOVA-ASTRON collaboration.
Recently MIRI for the JWST has been completed and at this moment 4 instruments for the E-ELT are being studied: METIS, EPICS, MICADO and OPTIMOS-EVE.
This presentation will give an overview of the activities of the group, the way it operates and the involvement in current instrumentation projects.

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Gravitational wave astrophysics

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Ground based gravitational wave detectors have reached design sensitivity and will soon be upgraded to sensitivities where (regular) detections of neutron stars and black hole mergers are anticipated. The space borne detector LISA is currently reviewed on both sides of the Atlantic and will detect thousands of Galactic binaries, compact objects spiralling into massive black holes and mergers of super-massive black holes. New results on the complementarity of electro-magnetic and gravitational wave detections of Galactic binaries will be presented in the general context of gravitational wave astrophysics.

Publication status: review

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The formation of complex molecules in circumstellar ices

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In star-forming regions, up to 90% of all molecules (except for H_2) are frozen out on dust grains. These ices are the formation site of simple species like water and methanol, and probably also of more complex, prebiotic molecules. Inspired by a recent model on the origin of complex molecules around protostars, (Garrod et al. 2008), we have experimentally investigated the photochemistry of methanol-dominated ices under astrophysically relevant conditions. The final complex ice abundances depend on the initial ice composition, the ice temperature during irradiation and the UV fluence. The results suggest that ice chemistry is efficient enough to explain observed complex molecular abundances around protostars. The experiment provides predictions on abundance ratios, which can be used both to test the formation mechanism and the formation conditions of complex molecules in space. This has been done qualitatively and quantitatively by comparing the experimental outcomes with observations of complex molecules around protostars.

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Protoplanetary Disk Evolution in Serpens

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Based on the 'Cores to Disk' (c2d) Spitzer Legacy Program, a new population of young stellar objects (YSO) was uncovered in a region of 0.5 deg^2 in the Serpens Molecular Cloud. This sample contains 150 bright YSOs with infrared excess, having a broad range of temperatures and luminosities, making Serpens a unique target region for obtaining a complete, well-defined sample of multi-wavelength observations of young stars in a possible evolutionary sequence. Follow-up complimentary observations in the optical, near- and mid-infrared (Spitzer IRS GO3) have allowed us to characterize the central stars, as well as the surrounding disks. The shape and slope of the midinfrared excess provide information on the flaring geometry of the disks. The spectral features give constraints on grain growth and mineralogy, which in turn probes heating and radial mixing. The presence of PAH features traces UV radiation, whereas Hα and Brγ are used as diagnostics of accretion. Assuming that the stars within a small region are nearly coeval, this provides direct constraints on the importance of environment and initial conditions on disk evolution. We are studying this rich population in order to connect the evolution of the disks with the evolution of their harboring stars, attempting to establish the mechanisms that determine the evolutionary sequence of protoplanetary disks.

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The co-evolution of black holes and starbursts at low and high redshift

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Using a large UV-optical survey, we have constructed a sample of relatively nearby galaxies that is remarkably similar to the high redshift population of “Lyman-break galaxies” in most physical properties. The nearby sample may offer a unique view on the process of formation of galaxies in the early Universe, as it is much less limited by the effects of physical resolution and sensitivity compared to similar studies at high redshift. We find evidence for the presence of (weak) AGN buried deep inside massive starburst regions. Our findings establish a link between collisions of gas-rich galaxies, UV-bright starbursts, star clusters and the formation of intermediate mass black holes. I will discuss the possible implications for galaxy formation in the high redshift universe.

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Probing standard accretion theory with accreting pulsars

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Publication status:

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Extra-Planar HI in the Inner Milky Way: New High-Resolution Data

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A number of Galactic HI halo clouds were studied in high resolution using the Very Large Array (VLA), with the Green Bank Telescope (GBT) providing the short-spacing flux. Two of them which seem to belong to the Ophiuchus superbubble were observed in both C and D configurations yielding ≈ 30 arcsec resolution. Analysis of their structure and physical parameters provides useful information about the disk-halo transition region as well as possibly reveals the origins of the lower Galactic halo HI cloud population.

Publication status: in preparation

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Mathematical modelling of jets with a view to physically fitting observed black hole systems

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Stellar mass black hole systems share many characteristics with supermassive black holes in the centre of galaxies, however the time scales are much shorter. Therefore stellar mass black holes might hold the key to understanding their effectively frozen supermassive counterparts.
Aspects that are currently poorly understood are the production mechanisms and energy contents of the jet. Using a semi-analytic code based on the full magnetohydrodynamic equations, we hope to link the conditions around the black hole, like the geometry and temperature of the accretion disc and corona, to the characteristics of the jet, like the density and velocity of the matter and strength and geometry of the magnetic field. Eventually by fitting the model to observational data, we hope to be able to provide these physical parameters for the observed systems.
I’ll present an introduction to the problem, the model used and the results so far.

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The Lost Siblings of the Sun

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The anomalous chemical abundances and the structure of the Edgewood-Kuiper belt observed in the solar system constrain the initial mass and radius of the star cluster in which the sun was born to $M \simeq 500$ to $3000\,M_\odot$ and $R \simeq 1$ to $3\,$pc. When the cluster dissolved the siblings of the sun dispersed through the galaxy, but they remained on a similar orbit around the Galactic center. Today these stars hide among the field stars, but 10 to 60 of them are still present within a distance of $\sim 100\,$pc. These siblings of the sun can be identified by accurate measurements of their chemical abundances, positions and their velocities. Finding even a few will strongly constrain the parameters of the parental star cluster and the location in the Galaxy where we were born.

Publication status: Submitted to ApJ Letters

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Decoupling in line driven stellar winds of hot massive stars

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Metal rich massive stars launch powerful hypersonic outflows during most of their evolution, emit vast quantities of hard, ionizing radiation, and enrich the space around them with heavy nuclei.

The first stars that ever formed are predicted to be very massive but practically metal-free. Due to a lack of metals to drive the outflow, their stellar winds are expected to be very weak.

In very weak (low density) winds a decoupling may occur of ions that actively participate in the wind driving (typically metals) from ions that are passive, but that represent the bulk of the plasma (i.e. hydrogen and helium). Depending on the location in the wind where the decoupling occurs, this may affect the mass loss rate or the terminal velocity of the decoupled ions.

In this poster we explore the parameter space in which decoupling may occur in terms of the stars position in the Hertzsprung-Russell diagram and metal content.

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Simulating the universe on an intercontinental grid of supercomputers

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Understanding the universe is hampered by the elusiveness of its most common constituent, cold dark matter. Almost impossible to observe, dark matter can be studied effectively by means of simulation and there is probably no other research field where simulation has led to so much progress in the last decade. Simulating the formation of large-scale structures in the universe, however, is still a challenge due to the enormous dynamic range in spatial and temporal coordinates, and due to the enormous computer resources required.
We deal with these requirements by connecting two supercomputers via an optical network and make them operate as a single machine which is a challenge, if only for the fact that both the supercomputers of our choice are separated by half the planet, as one is located in Amsterdam and the other is in Tokyo.

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First-Light Observations of Protoplanetary Disks with the Extreme Polarimeter

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The Extreme Polarimeter (ExPo) is an imaging polarimeter for the study of circumstellar disks and possibly exoplanet detection currently under development at the University of Utrecht. The aim of the instrument is to achieve a contrast ration of 10^{-5} between the unpolarized starlight and the polarized source. The instrument works at visible wavelengths and provides a field of view of 20×20 arcsec. After a short overview of the instrument design, we will present the results obtained during the first light observations at the William Herschel Telescope in La Palma. These include observations of protoplanetary disks around the young stars AB Auriga, V1685 Cygni and SU Auriga.

Publication status: In preparation

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Air travel and thrombosis: experiments at 10000 meter altitude and on the South pole

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Immobilisation is a well established cause of venous thrombosis, which is obstructive clot formation in the legs, often embolising to the lungs. Interest in air travel as a potential cause of thrombosis only arose recently, when a young woman died of pulmonary embolism shortly after arrival at Heathrow Airport, following a 20-hr flight from Australia. A recommendation in the House of Lords led to the WRIGHT (WHO Research Into Global Hazards of Travel) project, conducted by researchers from Leiden and Amsterdam. The main goals were to establish whether the risk was indeed elevated, whether risk groups could be identified by constitutional and behavioural factors, such as body height, weight, age, sex, genetic coagulation variants, exercise, alcohol intake, sleep medication. Part of the project focussed on alternative mechanisms besides immobilisation: there were indications from previous studies that hypobaric hypoxia, as exists in an airplane at high altitude, activates blood clotting. Therefore, a lab was built in a Boeing 757 and blood tests were done during a flight, and blood was examined in participants of the Concordia project of the European Space Agency on Antarctica, to study prolonged exposure to mild hypoxia.

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The solar chromosphere

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The solar chromosphere is widely seen as the most complex regime in the atmosphere of our star, being the one where magnetism takes over from radiation hydrodynamics as major structure and dynamics agent. I will review recent developments based on movies from the Dutch Open Telescope and imaging spectrometry at other telescopes and on numerical MHD simulations performed at Oslo. Together, these provide exciting progress and excellent prospects after decades of bewilderment.

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Captured at millimeter wavelengths: a flare from the Classical T Tauri star DQ Tau

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For several hours on 2008 April 19, the T Tauri spectroscopic binary DQ Tau was observed to brighten, reaching a maximum detected flux of 468 mJy and likely making it (briefly) the brightest object at 3 mm in the Taurus star-forming region. We present the light curve of a rarely before observed millimeter flare originating in the region around a pre-main-sequence star, and the first from a classical T Tauri star. We discuss the properties and nature of the flaring behavior in the context of pulsed accretion flows (the current picture based largely on studies of this object's optically variable spectrum), as well as magnetospheric re-connection models (a separate theory that predicts millimeter flares for close binaries of high orbital eccentricity). We believe that the flare mechanism is linked to the binary orbit, and therefore periodic. DQ Tau makes a strong case for multi-wavelength follow-up studies, performed in parallel, of future flares to help determine whether magnetospheric and dynamical interactions in a proto-binary system are independent.

Publication status: Salter et al. 2008, A&A, 492, L21-24

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The resolved cluster formation efficiency in M51

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Publication status:

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Constraint on the Value of Fine-Structure Constant

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We present a study of fine structure constant evolution using a large sample of Sloan Digital Sky Survey spectra. This work is an extension of Bahcall et al (2004) where we include star-forming galaxies, and quasars in order to provide a robust low-redshift constraint on the value of the fine structure constant. Two independent analyses have been developed to check for systematic uncertainties using a pair of forbidden [OIII] emission lines. One of the objectives is to provide a stronger constraint on the variation of the fine structure constant with redshift using high redshift spectra.

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Detection of PAH emission in S-type AGB stars

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Polycyclic aromatic hydrocarbon molecules (PAH) have been observed in many astrophysical environments where carbon rich material is exposed to UV photons. Our recent detection of PAH emission in our Spitzer spectra of the circumstellar shells around 5 cool S-type AGB stars came therefore as a surprise: the UV radiation fields of these cool objects is negligible, much too dim to excite the PAH molecules. This PAH emission therefore poses some very fundamental questions: how are these PAH's formed, what is their link to PAHs in the interstellar medium, how are they excited and why do we see them around these special AGB stars only, and not around carbon-rich AGB stars nor around the bulk of our S-star sample (all with C/O ratio's very close to 1).

Publication status: in preperation

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X-ray jets from the X-ray binary Cir X-1

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Cir X-1 is an accreting neutron-star binary system that exhibits ultra-relativistic arcsec-scale radio jets and an extended arcmin-scale radio nebula. Heinz et al. (2007) have shown an X-ray excess on armin-scale prominent on the side of the receding radio jet. We present the results of the analysis of two Chandra observations of Cir X-1 performed in 2007, where we clearly detect X-ray structures both on the side of the approaching and the receding radio jet. Our detection clearly confirms that neutron-star binaries can be as efficient as black-hole binaries in producing X-ray outflows, despite their shallower potential.

Publication status: Soleri et al. (2009), MNRAS in press

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Spitzer IRS constraints on Lambda Bootis stars: debris disks or diffuse interstellar clouds

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The abundance pattern of λ Bootis stars may be physically connected to their infrared excess. We investigate the circumstellar environment of a sample of λ Bootis stars in an effort to distinguish between different scenarios. If a debris disk gives rise to the infrared excess, the λ Bootis phenomenon may be related to the properties and evolution of the disk and be circumstellar in origin. On the other hand, if the anomalous abundance pattern is a result of selective accretion of interstellar gas, the infrared excess may be caused by an interstellar reflection nebula. SED modeling alone is not sufficient to constrain the properties of the stellar environment. Therefore we have performed a spectroscopic study with Spitzer IRS data to analyze the composition of the surrounding material of λ Bootis stars. This analysis also included a search for PAH features, since they would be a clear indication of the presence of interstellar matter.

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Adaptive Optics in Antarctica

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Astronomical observations from the earth can be severely hindered by turbulence in the atmosphere, limiting the median resolution, even on excellent sites and using the largest telescopes, to 0.5-0.7Ť. Measurement campaigns on several locations on Antarctica have shown that excellent seeing conditions exist, providing resolutions of 0.2Ť, if measured above a thin, turbulent boundary layer. Furthermore, these conditions are provided over a large field. Using either an Adaptive Optics (AO) system, by putting the telescope on an open tower–similar to the DOT–, or a combination of both, a telescope can be constructed that provides an excellent resolution over extremely large fields, making an Antarctic telescope the ultimate survey machine. These conditions, combined with the low sky background in the infrared and the long Antarctic winter make an Antarctic Adaptive Telescope an excellent choice for many deep surveys and high-resolution follow-ups. In this paper I provide the results of simulations performed to investigate the optimal configuration for an Antarctic Adaptive Telescope for Infrared surveys

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Systematic errors in the astrometric measurements on damaged Gaia CCDs

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When Gaia is in orbit it is exposed to solar wind protons, which damage its CCDs. The radiation damage creates so called traps in the pixels of the CCDs. These traps capture electrons, and releases them at a later time. The release time ranges from milliseconds to hundreds of seconds, decreasing the charge transfer efficiency and introducing systematic errors in the astrometric measurements.
The positions of stars are shifted (centroid bias) and some of the charge on the CCD is lost (charge loss). This can add up to a centroid bias of 10 mas and a charge loss of 20% for a magnitude 14 star, while the objective of Gaia is a an astrometric precision of 20-25μas for this magnitude.
We describe an investigation into the behaviour of the systematic errors using the computer model CEMGA, developed by Th. Prod'homme in Leiden.

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Void Merging Tree

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Voids are a major component of the large scale Universe. They evolve out of the underdensities in the primordial Universe. In the standard hierarchical structure formation scenarios, their evolution is highly dependent on their internal substructure. Voids emerge through the gradual merging with neighbouring voids, while small voids in overdense regions disappear as a result of collapse which was shown by Sheth and van de Weygaert (2004). The complex hierarchical evolution of the void population can be modelled by the extended Press Schechter formalism (Press and Schechter, 1974; Bond et al., 1991). Following the Lacey and Cole description of the merging history of dark halos (Lacey and Cole, 1993), we have extended their formalism in to an analytical framework to describe the more complex void merging history.
In this poster we will present our results and illustrates their significance. This results will be used for the interpretation and analysis of large N-body simulations and shed light on the hierarchical development of the morphological constituents of Cosmic.

Publication status: in preparation

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Aql X-1 and its identity problems

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We study the accretion/ejection processes (i.e. disc/jet coupling) in the neutron star X-ray binary (NSXRB) Aql X-1 via a multi-wavelength approach. We use in the radio band the publicly available Very Large Array (VLA) archive containing observations of the object between 1986–2005, in the X-ray band the archival Rossi X-ray Timing Explorer (RXTE) data between 1997–2008, and in optical (R band) observations with the Small and Moderate Aperture Research Telescope System (SMARTS) recorded between 1998–2007. In the combined data set we find three outbursts for which quasi-simultaneous radio, optical (R band) and X-ray data exist and focus on them to some extent. We provide evidence that the disc/jet coupling in Aql X-1 is similar to what has been observed in black hole X-ray binaries (BHXRBs), at least from the point of view of the behaviour in the hardness-intensity diagrams (the hysteresis effect included), when the phenomenology of the jet is taken into account. Although based on a very small number of observations, a radio/X-ray correlation seems to exist for this system, and it is different than the one found for another atoll source, 4U 1728-34, but interestingly enough is close to the correlation obtained for several BHXRBs. No significant correlation is found between the radio and optical (R band) emissions. We also reveal evidence that Aql X-1 shows signs of severe drop in radio flux above some X-ray luminosity. This has been noted only once before in a NSXRB, in 4U 1728-34, but it is commonly observed in BHXRBs, and suggests that from this point of view NSXRBs can mimic the behaviour of BHXRBs in suppressing the jet in soft/disc-dominated X-ray states.

Publication status: submitted to MNRAS

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Post-AGB stars in the LMC: preliminary results of our extensive sample study

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Post-AGB stars are key objects in the study of the dramatic chemical and morphological changes of stars on their ascent on the Asymptotic Giant Branch (AGB) and subsequent evolution towards the Planetary Nebulae stage. The detected variety of the Galactic sample of post-AGB stars is so large that there is no consensus on how the detailed studies of individual objects are linked by evolutionary channels. The evaluation is complicated by the fact that the distances and hence luminosities of the Galactic objects are poorly known. To overcome this problem we focus on post-AGB stars of the LMC. Via cross-correlation of the SAGE-SPITZER catalog with optical catalogs we selected a sample of 327 post-AGB candidates based on their colours and we determined the fundamental properties of the central stars using low-resolution optical spectra. Now, we are studying a subsample at high spectral resolution to connect the accurate positions in the HR diagram with the detailed chemical composition at the stellar surface, the intrinsic metallicity and the chemical signature of the circumstellar gas and dust. Preliminary results of this survey will be presented.

Publication status: in preparation

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Ten years of NOVA as Top Research School and its importance for Dutch Astronomy

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In 1998 the Netherlands Research School for Astronomy NOVA and five other research schools in the Netherlands were selected by an interdisciplinary international jury for special funding by the Dutch Government as "Top Research Schools", starting in 1999. This special funding has been vital for the research of the astronomy groups in Dutch Universities and has enabled them to participate in important national and international instrumentation programs such as ESO-VLT, ALMA, James Webb Space Telescope and LOFAR.
This presentation reviews the role of NOVA and its place in the tradition of Dutch astronomy.

The UV Luminosity Function at z=3-5

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We use very deep multicolour imaging to identify u', g' and r' dropouts in the CFHT Legacy Survey Deep fields, after which we determine how the ultraviolet galaxy luminosity function varies over cosmic time. Because of its close relationship to the star formation rate, such a study can bring more understanding about the physical processes that govern star formation.
The survey covers 4 square degrees in 4 independent patches on the sky, to such a depth that galaxies with luminosities both below and above the characteristic luminosity L* can be studied.
The sample completeness function is determined for each field, for several amounts of dust attenuation and for several model ages, where we make use of the Bruzual & Charlot spectral synthesis library.
The number counts are corrected for incompleteness, after which the ultraviolet galaxy luminosity function can be determined as a function of cosmic time. We find a significant increase in the characteristic luminosity from $z\sim5$ to $z\sim3$, indicative of a hierarchical build-up of galaxies.

Publication status: in preparation

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Multiplicity of Herbig Ae/Be stars - a survey

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One of the most interesting constraints on star formation models comes from the study of multiplicity of young stars as a function of mass. While multiplicity studies of low-mass T Tauri stars have been quite exhaustive, an unbiased and systematic investigation of multiplicity among intermediate-mass Herbig Ae/Be (HAEBE) stars is still lacking. We are therefore conducting a photometric and spectroscopic survey of HAEBE stars to detect companions, establish their physical association with the primary and investigate their properties. The frequency and degree of multiplicity of HAEBE systems will provide new constraints on their formation mechanisms. In this paper we present the survey and some of the first results, based on high resolution NIRI/Altair imaging data and GNIRS spectroscopic data.

Publication status: in preparation

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How global hot and cold accretion rates affect the cosmic star formation rate

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The global star formation rate (SFR) in the universe is known to drop sharply after $z = 2$. We present evidence from a smoothed particles hydrodynamics simulation that this decline is driven by a decline in the accretion of cold gas onto haloes. Cold (hot) accretion is accretion of gas with maximum temperature below (above) $10^{5.5}$ K. The amount of gas accreting onto a *halo* in the cold mode peaks at $z \approx 3$ and dominates the growth of haloes at high redshift. It is overtaken by the global hot accretion rate at $z \approx 2$, which peaks at $z \approx 1$. Both the total global accretion rate and global hot accretion rate stay roughly constant down to $z = 0$, whereas the global cold accretion rate declines. The drop in the global SFR must be the direct result of the decrease in the global cold accretion rate. Cold accretion dominates the growth of *galaxies*.

Publication status: in preparation

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High resolution numerical hydrodynamics and the circumstellar medium

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Using modern numerical techniques we can run numerical simulations of hydrodynamical interactions in the circumstellar medium at a higher resolution than was previously possible. This allows us to fully resolve instabilities in such interactions, which can help us to produce accurate and detailed results that can be compared with observations. Our results show that even in 1D the small scale of some features necessitate a high local resolution. The need to maintain the high resolution while moving on to 2D and 3D simulations makes it imperative to use and adaptive mesh grid (AMR) as well as extensive parallelization in order to reduce computation times.
Eventually, we intend to combine these results with similar simulations of such events as supernovae and gamma-ray bursts. The results can then be used to determine if and how the circumstellar medium influences the observations of these events.

Publication status: NAC 2009

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S-process branching in AGB stars

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The $slow$ neutron capture process (*s* process) is a nucleosynthesis process that occurs at relatively low neutron density such that once an unstable isotope is created it decays before it captures another neutron. This way stable isotopes heavier than Fe are produced by moving along the valley of beta stability in the chart of the isotopes. However, some isotopes have decay times that are so long that, depending on the neutron density, they can capture another neutron before they would have decayed. These isotopes are known as branching points. Two such isotopes are: ^{86}Rb and ^{85}Kr, their capturing a neutron before decaying results in a higher overall Rb abundance than if they would have decayed first. Massive asymptotic giant branch (AGB) stars (mass higher than $\approx 5\ M_{\odot}$) have higher neutron densities in the relevant area than less massive AGB stars and should therefore exhibit higher relative rubidium abundances. A recent survey of a large sample of massive Galactic AGB stars indeed shows that significant overabundances of rubidium (up to 100 times solar), but merely solar zirconium, are present in these stars. We try to match these observations using our theoretical model.

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2D MHD model of solar atmosphere

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The Sun's magnetic field is the source of most of the solar activity. The interaction of magnetic fields with convective flows leads to a spatial organization of the magnetic flux. Most of this flux outside sunspots is concentrated in small-scale structures of large fields strength, magnetic elements. To study the properties of magnetic elements and their effects on the solar atmosphere, we employ a 2D Magnetohydrodynamics(MHD) model including the solar atmosphere all the way from the upper chromosphere to the solar corona. The plasma in the model is treated in the single-fluid MHD approximation. The state of the plasma is predicted using the Versatile Advection Code (VAC). Spatial and temporal discretizations are all being second order accurate. This model aims to relate the thermodynamic and spectral properties of magnetic elements to current observations, thus improving their interpretation.

Publication status: in preparation

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A new CO photodissociation model applied to circumstellar disks

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Carbon monoxide is efficiently destroyed by ultraviolet radiation. Because this process is dominated by absorption in discrete lines, it is subject to self-shielding: at a given column depth, the lines become optically thick and CO can no longer be dissociated. CO naturally occurs in six isotopic variants. The more abundant a variant, the sooner it becomes self-shielding. This leads to a zone in many astronomical objects where atomic ^{12}C and ^{16}O are less abundant than the rarer isotopes ^{13}C, ^{17}O and C^{18}O. When these atoms are incorporated into other molecules, the products can obtain carbon and oxygen isotope ratios vastly different from the interstellar medium. We present here a fully revised CO photodissociation model. We couple it to a chemical network to analyse the isotopic behaviour in a circumstellar disk and to explain the anomalous oxygen isotope ratios found in some meteorites.

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Internal and external shocks of the ultra-relativistic shells in the afterglow phase

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Firestorms and starquakes: the dangerous life of a neutron star

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On December 26 2004, an earthquake off the western coast of Sumatra triggered a deadly tsunami. The tremor was so violent that it left the Earth ringing for days afterwards, enabling seismologists to study the interior of our planet. Less than 48 hours later, the Earth was hit by the brightest burst of gamma-rays even recorded. The cause? A starquake on a neutron star with an ultra-intense magnetic field, 50,000 light-years from our solar system. And just as on Earth, the quake left the star ringing with seismic vibrations - the first time this had ever been observed. This has opened up a new way of studying these fascinating stars, with their crushing gravity, exotic nuclear physics and enormous magnetic fields. I will discuss what we are learning from neutron starquakes, triggered by everything from magnetic flares to thermonuclear explosions, and outline what we hope to discover with future observations using both electromagnetic and gravitational wave astronomy.

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Optical Spectroscopy of the Red Rectangle nebula compared to LIF spectroscopy in the laboratory

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We obtained optical spectra of the Red Rectangle proto-planetary nebula at 3, 7, 16 and 20 arcsec distance to the central star using the EMMI spectrograph on the NTT in La Silla, Chile. The observations cover the range between 550 and 700 nm and thus show the ERE (extended red emission) of the source. Superimposed on the ERE we find narrow emission features. Up to now an identification is lacking. A correlation between these features and the diffuse interstellar bands has been suggested by Scarrott et al. (Mon. Not. R. astr. Soc., 255, 1992) and Sarre et al (Science, 269, 1995). Our approach is to compare the optical emission spectra of the Red Rectangle to Laser Induced Fluorescence (LIF) spectra of carbon chain molecules obtained in the laboratory, using time gated fluorescence spectroscopy of a supersonically expanding plasma. The first results are presented.

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Observational Disk Dynamics of Late-Type Galaxies

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We measure 2D plasma and stellar kinematics for a set of seven nearly face-on, late-type galaxies obtained via WIYN SparsePak spectroscopy. The primary objective in the analyses of these data — taken as part of the larger Disk-Mass Survey (M. Bershady and M. Verheijen, Co-PIs) — is to establish the radially dependent stellar velocity ellipsoid (SVE) in each galaxy disk. Such analyses are crucial to the overall goal of the Disk-Mass Survey — a breaking of the disk-halo degeneracy using dynamical disk-mass surface densities measured via vertical velocity dispersions — and provide a wealth of insights into the dynamical state of each galaxy disk. Herein, we comment on (1) our analysis techniques and results for the SVE of each disk and (2) departures of the observed line-of-sight (LOS) stellar kinematics from our idealized determinations of the SVE. For the latter, we often find a break in the LOS stellar velocity dispersion that imply dynamically distinct characteristics in the outer disks of late-type galaxies.

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The shocking truth about star formation as revealed by warm CO CHAMP$^+$ Mapping

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Stars form by gravitational collapse of dense gas in molecular clouds. In the early stages, the protostar is surrounded by a collapsing envelope and a disk through which material is accreted onto the growing star. In subsequent stages, this envelope is dispersed by outflows, the disk grows and the young stellar object brightens. Characterizing these different components (envelope, disk, outflow) of low-mass YSOs is therefore important for understanding the early stages of star formation. Here we present observations of highly excited CO emission done with the CHAMP$^+$ 650/850 GHz array receiver at APEX in Chile of two low-mass protostars NGC1333 IRAS 4A/4B which are located in Perseus (D=250 pc). The large-scale maps clearly reveal the powerful CO outflows through the red and blue line wings. However, on the source positions and around the outflows we find narrow quiescent CO emission implying that UV photons heat the gas of the outflow cavity walls to higher temperatures, but are unable to dissociate the CO molecules. These CO maps generate new insights for understanding the interactions between outflows and envelopes, which also affect the chemistry.

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