# The Variable Sky:

# from Tiny Variations to Big Explosions

Fall Meeting of the Astronomische Gesellschaft 2014

September 22 - 26, 2014

Bamberg, Germany

## Scientific Program and Abstracts

**Edited by:**

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# Welcome Address

## from the President of the Astronomische Gesellschaft

Dear honorary guests, dear conference participants, dear members of our society,

it is a great pleasure to welcome you in Bamberg on the occasion of the 87th annual scientific Fall meeting of the Astronomische Gesellschaft. This is a special occasion as we celebrate the the 125th anniversary of the inauguration of the Dr. Remeis-Observatory, which today is the astronomical institute of the Friedrich-Alexander-University, Erlangen-Nürnberg. Founded as a private institution from the donation of the rich Bamberg lawyer and amateur astronomer Dr. Karl Remeis in 1886, the observatory was inaugurated on October 24, 1889. Its first director, Ernst Hartwig, focussed on variable stars. His successor, Ernst Zinner, started the photographic Sky patrol ("Felderplan") together with Berlin-Babelsberg and Sonneberg observatories. Variable objects remained as the main field of research for decades and the observatory became internationally renowned for its "Bamberger Veränderliche".

In 1962 the Dr. Remeis-Sternwarte became a member of the University of Erlangen-Nürnberg. Its third director, Wolfgang Strohmeier, then moved the Bamberg sky patrol to the southern hemisphere by operating an observing station at Boyden (South Africa) until 1974. The sky patrols resulted in an archive of 40 000 plates, covering the time span from 1926 to 1974, that remained at the Dr. Remeis-Sternwarte. Its scientific content is now harvested by a digitization project in collaboration with Hamburg observatory and the Leibniz Institut für Astrophysik in Potsdam.

When the Dr. Remeis-Sternwarte became a University institute, research interests moved to astrophysics but variable objects remained at the heart of research until today. Two research groups are presently active at the institute. The stellar astrophysics group is studying hot stars in various phases of their evolution from young massive main sequence stars to the white dwarf graveyard from quantitative spectral analysis of optical and ultraviolet spectra, using sophisticated model atmospheres. Many open questions in today's understanding of stellar evolution are related to the evolution of close binaries and the notoriously complicated common envelope phases. This includes the various paths that may lead to type Ia supernovae. The team has undertaken major observational efforts such as the ESO SPY and the MUCHFUSS surveys to pin down the SN Ia progenitor populations. Stellar kinematics of halo stars is another research topic which started with the discovery of two hyper-velocity stars by the team in 2005.

The second team specialises in X-ray astronomy and high energy astrophysics. A currently very hot topic in astrophysics and a research focus of this group is the emission processes from black holes in Galactic X-ray Binaries and from supermassive black holes, detected in the centres of galaxies, the physics of

Active Galactic Nuclei, and the physics of neutron stars. Both teams make heavily use of large international facilities, both on ground, such as ESO, Calar Alto and La Palma observatories, and in space, in particular using all X-ray satellites available.

Close ties have been established over the last years to the astroparticle physics teams in Erlangen. When the Erlangen Centre for Astroparticle Physics (ECAP) was founded in 2008, the Dr. Remeis-Sternwarte, became part of this largest research institute in astroparticle physics at a German University. Collaborations with the University of Würzburg have also been intensified with the aim to form a northern Bavarian center of multi-messenger Astrophysics.

This is the 3rd time that we hold our annual meeting in Bamberg. The first meeting took place in 1896, the second in 1957. The topic of our meeting, "The Variable Sky: from Tiny Variations to Big Explosions" follows the long tradition of Bamberg astronomy but it is also perfectly suited to describe modern research in astrophysics that deals with dynamical processes in the Universe and the formation and evolution of its components. Our panel sessions will discuss new insights into stellar structure and evolution, with astro- and helioseismology now revolutionising the field. We will hear reviews on exosolar planets and white dwarfs, optical transients, the status of X-ray and radio astronomy, the GAIA mission, space telescopes and the Cherenkov Telescope Array. As usual we also include highlight talks on current hot research topics. Splinter meetings will cover various field of astrophysics, allowing the experts and especially also your young researchers to present and discuss their results.

During the Tuesday morning session we will honour outstanding persons in Astronomy. And on Wednesday we will have our Mitgliederversammlung with new elections of board members.

The program promises an exciting week of astronomy in Bamberg. Special thanks go to Prof. Ulrich Heber und Prof. Horst Drechsel who devoted a lot of time and effort to make this a successful meeting.

I now wish all of you a great time in Bamberg and a successful meeting with exciting and fruitful discussions.

München/Bamberg, September 2014

Yours
Andreas Burkert

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# General Information

The Annual Meeting of the Astronomische Gesellschaft will be held from Sep. 22 through 26, 2014 at premises of the University of Bamberg.
The meeting is organized by the Dr. Remeis Observatory Bamberg, Astronomical Institute & Erlangen Centre for Astroparticle Physics (ECAP) of the University Erlangen-Nürnberg on behalf of the German Astronomical Society.
The plenary sessions (and public talk) take place in the Hörsaalgebäude MG1 on the Bamberg University campus Markusgelände, Markusstraße 8a, 96047 Bamberg.
Splinter meetings and other special meetings will be scheduled in other lecture halls and seminar rooms on the campus in the immediate vicinity of MG1.
The opening welcome and registration on Monday, 22 Sep. 2014 as well as the coffee breaks during the meeting are held in the cafeteria next to the Hörsaalgebäude MG1.
The conference dinner will be hosted by the Welcome Hotel Residenzschloss, Untere Sandstr. 32, 96049 Bamberg.
WLAN is available. Information and the login data will be provided during the first day of the conference.

## Maps

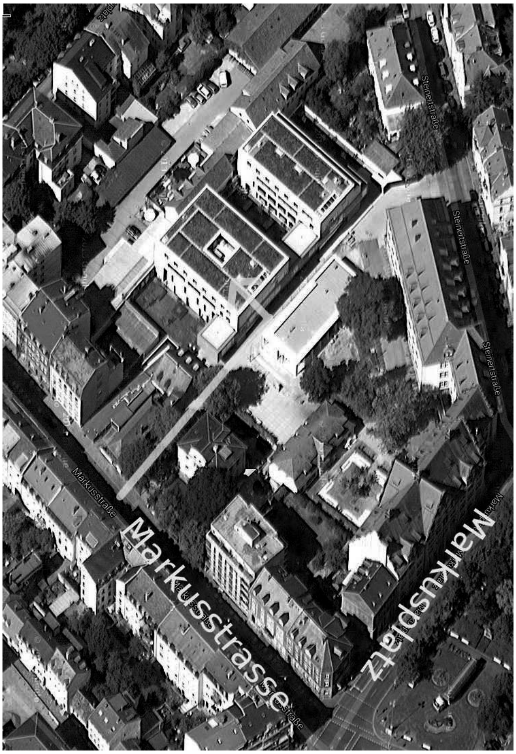


Figure 0.1: Markusstraße and Markusplatz

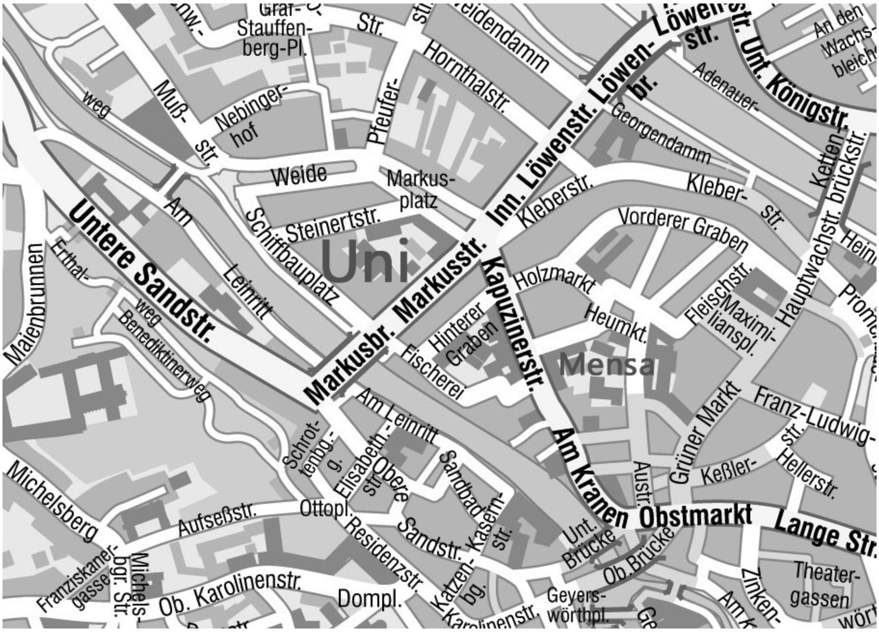


Figure 0.2: Town Center of Bamberg © Special Moments Verlag. The conference venue is marked by “Uni”. The location of the Mensa is labeled as well.

# 125 years Remeis Observatory Bamberg


Bamberg was chosen to host the 87th annual meeting of the Astronomische Gesellschaft to commemorate the 125th anniversary of the inauguration of the Dr. Remeis-Observatory, which today is the Astronomical Institute of the Friedrich-Alexander-University, Erlangen-Nürnberg. Founded as a private institution from the donation of the rich Bamberg lawyer and amateur astronomer Dr. Karl Remeis (1837 – 1882) in 1886, it was inaugurated on October 24, 1889. The observatory was designed according to the model of the Straßburg observatory by the architects Hermann Eggert and Max Ißleber. The separation of the observing (Meridian) building from the main building hosting the offices, library and residential properties, was a novelty first realised in Straßburg. The two domes of the observatory were equipped with a heliometer and a refractor, respectively. The Meridian hall hosted a passage instrument and a precision pendulum clock as well as smaller instruments. Ernst Hartwig was appointed as the first director in 1986. He established research into variable stars as the main topic of the Dr. Remeis-Sternwarte, which was pursued by the researchers in Bamberg for decades and the astrophysics of variable objects remains at the focus of today's research activities in the institute. Therefore it was obvious to focus the 87th annual meeting of the Astronomische Gesellschaft on *The Variable Sky: from Tiny Variations to Big Explosions.*

# Schedule

**PROGRAM**

**Annual Meeting of the Astronomische Gesellschaft**

**Bamberg, 21 - 26-September 2014**

| **Sunday, 21-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| Various events | Gudrun Wolfschmidt | Working Group History of Astronomy | |

| **Monday, 22-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| 8:30 - 17:00 | Gudrun Wolfschmidt | Working Group History of Astronomy | Remeis Observatory |
| 9:00 - 12:00 | Andreas Burkert | Meeting of AG Executive Committee (closed session) | MG2 / 00.10 |
| 12:00 - 16:00 | Felicia Krauß<br>Annika Kreikenbohm<br>Tobias Beuchert | PhD Students Meeting | MG1 / 02.06 |
| 13:00 - 18:00 | Andreas Burkert | Meeting of RDS (closed session) | MG2 / 00.10 |
| 16:00 - 18:00 | Sonja Schuh,<br>Maria Hirsch | Astro-Frauen-Netzwerk Get-together | MG1 / 02.09 |
| 17:00 - 18:00 | Gudrun Wolfschmidt | Meeting of Members of Working Group History of Astronomy | Remeis Observatory |
| 18:00 - 22:00 | | Registration & Welcome | Cafeteria |

| **Tuesday, 23-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| 9:00 - 9:30 | Andreas Burkert | Opening Ceremony | MG1 / 00.04 |
| 9:30 - 10:15 | Andreas Burkert | Karl Schwarzschild Medal:<br>Margaret J. Geller | MG1 / 00.04 |
| 10:15 - 10:45 | | Coffee & Posters | Cafeteria & M3N/02.27 |

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|---|---|---|---|
| 10:45 - 11:15 | Andreas Burkert | Ludwig Biermann Prize:<br>Stephan Geier | MG1 / 00.04 |
| 11:15 - 11:40 | Andreas Burkert | PhD Prize:<br>Christian Fromm | MG1 / 00.04 |
| 11:40 - 11:50 | Andreas Burkert | Bruno H. Bürgel Prize:<br>Ulrich Bastian | MG1 / 00.04 |
| 11:50 - 12:00 | Andreas Burkert | “Jugend forscht” Special Prize:<br>Jan Fotakis, Fabian Tripkewitz, Jonas Faber | MG1 / 00.04 |
| 12:00 - 13:30 | | Lunch | |
| 12:15 - 13:15 | Stefanie Mühle | ALMA Users Meeting | MG1 / 02.09 |
| 13:30 - 14:00 | Stefan Krückeberg | DFG Research Funding for Early<br>Career Researchers | M3N / 02.32 |
| 14:00 - 18:00 | Various Convenors | Splinter Meetings C, G, H, I | |
| 15:30 - 16:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 18:30 - 21:00 | Andreas Burkert | General Meeting of AG Members | M3N / 02.32 |

| **Wednesday, 24-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| 9:00 - 9:40 | Heike Rauer | Exoplanets – Status and Future of their<br>Detection and Characterization (*Review*) | MG1 / 00.04 |
| 9:40 - 10:05 | Laurent Gizon | Helioseismology with SDO (*Highlight*) | MG1 / 00.04 |
| 10:05 - 10:45 | Conny Aerts | Asteroseismology: the Revolution<br>in Stellar Physics (*Review*) | MG1 / 00.04 |
| 10:45 - 11:15 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 11:15 - 11:40 | Beate Stelzer | Variability of Young Stars:<br>Magnetic Activity and Accretion<br>(*Highlight*) | MG1 / 00.04 |

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|---|---|---|---|
| 11:40 - 12:05 | Dominik Schleicher | Planet Formation in Post Common Envelope Binaries (*Highlight*) | MG1 / 00.04 |
| 12:05 - 12:45 | Ulrich Bastian | GAIA: ESA's High-precision Astrometry Mission – Status and Prospects Nine Months after Launch (*Review*) | MG1 / 00.04 |
| 12:45 - 14:00 | Heiko Wilkens | Public Telescope - Space Telescope: Scientific Usage (UV and visual) | MG1 / 02.09 |
| 12:45 - 14:00 | | Lunch | |
| 14:00 - 18:00 | Various Convenors | Splinter Meetings B, I, K, L | |
| 14:00 - 18:00 | Klaus Jäger, Markus Pössel | Public Outreach in der Astronomie | MG1 / 02.06 |
| 15:30 - 16:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 18:45 - 19:20 | | Scenic Boat Trip on Regnitz River | Pier: Am Kranen |
| 19:30 - | | Conference Dinner | Hotel Residenzschloss |

| **Thursday, 25-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| 9:00 - 9:40 | Thomas Marsh | White Dwarfs in Detached and Interacting Binay Stars (*Review*) | MG1 / 00.04 |
| 9:40 - 10:05 | Friedrich Röpke | Modeling Type Ia Supernova Explosions (*Highlight*) | MG1 / 00.04 |
| 10:05 - 10:30 | Roland Diehl | Supernova SN 2014 J (*Highlight*) | MG1 / 00.04 |
| 10:30 - 11:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 11:00 - 11:40 | Paul Nandra | X-ray Astronomy: Present and Future (*Review*) | MG1 / 00.04 |
| 11:40 - 12:20 | Anna Watts | X-ray Binaries (*Review*) | MG1 / 00.04 |

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|---|---|---|---|
| 12:20 - 12:45 | Anna Pasquali | How Environment Drives Galaxy Evolution: Lessons Learnt from Satellite Galaxies (*Highlight*) | MG1 / 00.04 |
| 12:45 - 14:00 | | Lunch | |
| 13:00 - 14:00 | Oliver Schwarz | Treffen des Bildungsausschusses (closed session) | MG1 / 02.09 |
| 14:00 - 18:00 | Oliver Schwarz | Astronomy & Education Meeting | MG1 / 02.09 |
| 14:00 - 18:00 | Various Convenors | Splinter Meetings A, D, F, J | |
| 15:30 - 16:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 20:00 - 22:00 | Joachim Wambsganß | *Öffentlicher Abendvortrag:* Auf der Suche nach der zweiten Erde | MG1 / 00.04 |

| **Friday, 26-Sep** | **Name** | **Title / Session** | **Room** |
|---|---|---|---|
| 9:00 - 9:40 | Shri Kulkarni | The Dynamic Universe: Palomar Transient Factory (*Review*) | MG1 / 00.04 |
| 9:40 - 10:05 | Thomas Krühler | Gamma-ray Bursts and their Host Galaxies (*Highlight*) | MG1 / 00.04 |
| 10:05 - 10:30 | Silke Britzen | Supermassive Black Holes – Jet Signatures (*Highlight*) | MG1 / 00.04 |
| 10:30 - 11:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |
| 11:00 - 11:25 | Matthias Kadler | TANAMI: Multiwavelength and Multimessenger Observations of Active Galaxies (*Highlight*) | MG1 / 00.04 |
| 11:25 - 12:05 | Michael Kramer | Probing Fundamental Physics in the Dynamic Radio Sky (*Review*) | MG1 / 00.04 |
| 12:05 - 12:30 | Stefan Funk | The Cherenkov Telescope Array (CTA) (*Highlight*) | |
| 12:30 - 12:40 | Andreas Burkert | Concluding Remarks | MG1 / 00.04 |

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|---|---|---|---|
| 12:40 - 14:00 | | Lunch | |
| 13:30 - 18:00 | Andreas Irrgang | AG Institutes Soccer Cup | |
| 14:00 - 18:00 | Various Convenors | Splinter Meetings A, D, E | |
| 14:00 - 18:15 | Cecilia Scorza | Training of Teachers (Lehrerfortbildung) | MG1 / 02.06 |
| 15:30 - 16:00 | | Coffee & Posters | Cafeteria & M3N/02.27 |

*Coffee breaks:* The Cafeteria on the campus Markusgelände (in front of the lecture halls MG1/2) will host the coffee breaks; complimentary coffee is included in the conference fee. Light lunches (not included) will also be offered by the Cafeteria. We also recommend the nearby Mensa at Austraße for lunch. In addition there are many restaurants along Austraße and Sandstraße.

# Events

## Splinter A High Resolution Solar Physics

**Convenors** R. Schlichenmaier, A. Lagg, H. Balthasar
**Time [Location]** Thursday, Sept. 25, 14:00 - 18:00
Friday, Sept. 26, 14:00 - 18:00
[MG2/01.10]

In this SPLINTER, we focus on radiation-magnetoconvective phenomena of the Solar photosphere and chromosphere. We intend to present and discuss new high resolution observations and their theoretical implications, as well as theoretical models of such features. We invite for contributions in the field of high resolution solar physics. Special focus will be given to first results from GREGOR (the largest European Solar telescope) and the two flights of SUNRISE (a 1m balloon borne telescope) in 2009 and 2013

In the last decade, we have seen numerical simulations to advance to a state that made it difficult to be tested by observational means. This could change now, as we expect GREGOR to produce excellent spectro-polarimetric and imaging data, which will allow to characterise small-scale magneto-convective processes with a 'not-reached-before' precision. The same applies for data from the two SUNRISE flights in 2009 and 2013, and, e.g., SP/Hinode and HMI/SDO, CRISP@SST, and IBIS@DST. These measurements may challenge or confirm existing theoretical models. At this meeting we invite for contributions on magneto-convective phenomena in the solar photosphere and chromosphere. We look forward to see observational as well as theoretical and numerical contributions. At the same time, as data calibration and analysis are becoming increasingly complex, we dedicate a session to pipelines and analyses of spectro-polarimetric data

Sessions:

- Theoretical modelling of small-scale magneto-convective processes.
- Analysis of spectro-polarimetric data
- Observations of small-scale magneto-convective processes.

## Splinter B — Asteroseismology along the Main Sequence and beyond

**Convenors** S. Randall, M. Roth, V. Antoci, S. Schuh
**Time [Location]** Wednesday, Sept. 24, 14:00 - 17:30 [MG2/01.10]

Asteroseismology lets us look inside stars and determine their fundamental parameters on the basis of observed pulsation spectra. Interest in this area of research has recently soared with the availability of high precision time-series photometry from dedicated space telescopes. Thanks largely to missions such as Kepler, Corot and MOST the number of known oscillation frequencies particularly of faint stars has increased by an order of magnitude, and new classes of pulsators have been discovered across the H-R diagram. In fact, there appear to be few stars that do not exhibit variability at some level.

Of course, our own Sun also oscillates. For Helioseismology the availability of spatially resolved data means that the analysis of local phenomena such as sunspots has become possible, while for asteroseismology the current focus lies on global stellar properties. By comparing the observed pulsation spectra with those predicted from models we can constrain the input physics, such as the opacity data used, the efficiency of convection, and its interaction with pulsation. Moreover, pulsations can be used to trace internal stellar rotation, element mixing and magnetic fields. For planet-hosting stars, asteroseismically derived quantities such as the stellar mass, radius and age are particularly useful as they can be exploited to characterise the orbiting planets. Asteroseismology may ultimately provide the key to solving long-standing problems regarding stellar structure physics, stellar evolution theory, and exo-planet science.

This splinter meeting will bring together helio- and asteroseismologists working on very different types of stars, from the Sun and other main sequence stars to red giants and more evolved objects such as hot subdwarfs and white dwarfs. While the specific challenges faced in the seismic analyses of the different classes of pulsator vary wildly, the ideas and advances pioneered for one type of star have in the past often lead to a breakthrough in our understanding of another. This meeting will provide the necessary forum for such a scientific exchange, particularly timely in light of the planned extension of Kepler in K2 mode.

## Splinter C — Unified Particle Transport Models in Multi-Scale Astrophysical Environments

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| **Convenors** | R.C. Tautz, H. Fichtner, A. Kopp |
| **Time [Location]** | Tuesday, Sept. 23, 14:00 - 18:00 [MG2/01.10] |

Supernova remnants (SNRs) are remains of stellar explosions, which release a large amount of energy and matter into the interstellar space. Stellar matter is thrown out with an initial velocity of 10000 km/s, and the spherically expanding blast-wave shock produces a cavity with a very low density, high-temperature interior. Particles are accelerated in the shock fronts of SNRs and can gain energy up to 1015 eV or higher. Therefore, SNRs are engines for the matter cycle in a galaxy and sources of cosmic rays.

The Solar system provides a unique laboratory as it allows for detailed in-situ measurements that have helped our understanding of both the generation and the properties of electromagnetic turbulence as well as transport processes of, for example, Solar energetic particles.

Starting from simple Bohm diffusion, the understanding of such random scattering processes has made tremendous progress, with increasingly specialized theories for various astrophysical scenarios, even though often simple heuristic approaches remain in use. However, phenomena such as anomalous and anisotropic transport, shock waves, and magnetic reconnection can be found on various spatial scales, which should allow for a unified description of particle transport.

## Splinter D The Life and Death of Hot Stars

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| **Convenors** | S. Geier, M. Miller-Bertolami, H. Todt |
| **Time [Location]** | Thursday, Sept. 25, 14:00 - 18:00<br>Friday, Sept. 26, 14:00 - 18:00<br>[M3N/02.32.] |

The population of hot stars is very diverse, ranging from young massive main sequence stars, giants and supergiants to old and evolved objects like white dwarfs and their immediate progenitors. Studying those stars helps us to understand key problems of stellar astrophysics like the formation of massive stars, close binary interactions, radiation-driven winds, and the final stages of stellar evolution. Solving these problems is central to our understanding of related issues like supernovae, with important implications for cosmology, and the history of chemical enrichment in galaxies. Although considerable progress has been made in the last decade, analysing hot stars remains challenging, because peculiar chemical compositions, NLTE effects, mass-loss, rotation, variability, and binarity have to be taken into account. Trying to make sense out of the observational evidence makes us aware of the shortcomings in stellar evolution models.

This splinter meeting aims at bringing together the hot star community, both observers and theorists, for giving the opportunity to present recent contributions to the field and to discuss the open issues. We would like to invite you to contribute both oral and poster presentations.

## Splinter E — Gamma-Ray Bursts: Theory, Observation, Application (from stellar evolution to cosmology)

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| **Convenors** | S. Klose |
| **Time [Location]** | Friday, Sept. 26, 14:00 - 18:00 [MG2/00.10] |

More than 15 years after GRB 970228, GRB research is still a rapidly growing and spreading field. This splinter meeting shall bring together observers and theorists covering all potential research topics that touch GRBs, including the use of GRBs as a new observational tool.

## Splinter F Dark Matter

**Convenors** G. Anton, D. Elsässer, C. van Eldik

**Time [Location]** Thursday, Sept. 25, 14:00 - 18:00 [MG1/02.06]

Unveiling the nature of Dark Matter is one of the most important challenges of the physical sciences today. While the concept of Dark Matter is based on astronomical observations, the search for the fundamental Dark Matter particles is a main subject of astroparticle physics. To constrain the parameter space of Dark Matter particle physics models, these searches rely on accurate predictions of the density distribution of Dark Matter in the Galaxy, which in turn get tested by more and more precise astronomical observations.

The splinter meeting aims at bringing Dark Matter experts of both the astronomy and astroparticle physics communities in close discussion.

## Splinter G E-Science & Virtual Observatory

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| **Convenors** | H. Enke, K. Polsterer, J.K. Wambsganss |
| **Time [Location]** | Tuesday, Sept. 23, 14:00 - 18:00 [MG1/02.06] |

Research in Astronomy and Astrophysics is increasingly dependent on the public availability and accessibility of astronomical data sets. The huge and growing amounts of data produced by large area photometric and spectroscopic surveys, data intensive instruments like LOFAR, high resolution simulations, and many other facilities pose new challenges to both information technology and data processing algorithms. The new generation of dedicated survey telescopes like LSST aim for unveiling the variable sky. Astronomers will need new methods and techniques to make use of these data-intense projects. Further, the distribution of these data sets among collaborations or the whole community requires new approaches.

The questions of data infrastructure in astronomy and standardised access are addressed by the Virtual Observatory (VO) and several Grid and Cloud Computing projects. Together these approaches aim at providing suitable tools and research environments aiding scientists in essentially all fields of astronomy. Data management, data access, and data publication are considered key aspects. Also, the analysis of huge data sets requires new approaches in data mining.

## Splinter H — The formation and evolution of extrasolar planets

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| **Convenors** | E.W. Guenther |
| **Time [Location]** | Tuesday, Sept. 23, 14:00 - 18:00 [MG2/00.10] |

Since the discovery of the first extrasolar planets there has been a tremendous increase in both observational discoveries and theoretical work in this field of research. It is now possible to study the planet population from several Jupiter-masses down to only a few Earth-masses. These studies have unveiled that extrasolar planets are more diverse than previously thought. For example, planets of the same mass can have very different densities. Studies of proto-planetary disks have also made a great leap forward. It is now possible to study the sites of planet formation in detail by resolving the proto-planetary disks. These new observational capabilities have triggered the development of new theories for planet formation. The aim of this splinter session is to bring together observers and theorists that study the various aspects of planet formation for a fruitful exchange of ideas. A special emphasis will also be given on future instrumentation like the E-ELT, CHEOPS and PLATO. Another focus of this splinter meeting will also be planets and their building blocks in our solar-system, since these give us detailed information about their formation and evolution.

## **Splinter I** Exploiding stellar transients

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| **Convenors** | W. Hillebrandt, H.T. Janka, M. Kromer, F. Röpke |
| **Time [Location]** | Tuesday, Sept. 23, 14:00 - 18:00<br>Wednesday, Sept. 24, 14:00 - 18:00<br>[M3N/02.32] |

The observation and modeling of explosive stellar transients is a thriving field in astrophysics. Apart from supernovae, new classes of transients have been discovered and are currently studied in great detail. Explosive stellar transients are observed with extensive campaigns in optical astronomy, but some classes of objects are also expected to be sources of gravitational waves and prime targets of the emerging field of neutrino astronomy. With their nucleosynthetic processing and dynamical ejection of material, explosive stellar transients give rise to chemical enrichment of galaxies. Moreover, the class of Type Ia supernovae is an important tool in observational cosmology. Recent, nearby events like SN2011fe and SN2014J allow to study the important, still unsolved problem of their progenitors. We therefore propose a splinter session covering the latest results from observational as well as modeling efforts that give new insights into the physics of these objects.

## Splinter J The Interstellar Medium

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| **Convenors** | A. Burkert, R. Diehl, M. Gritschneder, M. Krause, M. Schartmann |
| **Time [Location]** | Thursday, Sept. 25, 14:00 - 18:00 [MG2/00.10] |

A characteristic property of the interstellar medium is its astonishing dynamics: turbulent high average density regions ('clouds') form, for example by converging flows, and disperse again due to energy release from stars. Even on the largest scales, significant inflows and outflows of often multi-phase gas is observed, and essential to explain the amount of gas in galaxies, or enriched gas outside galaxies. Since it is partly ionised, magnetic fields are amplified by the dynamics. The dynamics is also vital for the mixing of freshly ejected metals into all the phases of the interstellar medium. The entire electromagnetic spectrum contributes and time-dependent simulations are required to interpret the data. This splinter meeting will focus on recent developments in the area of interstellar medium research.

## Splinter K Variability of Quasars

**Convenors** m. Haas, M. Ramolla, R. Chini, . Kollatschny, H. Meusinger

**Time [Location]** Wednesday, Sept. 24, 14:00 - 18:00 [MG2/00.10]

Accreting black holes in the centres of massive host galaxies may show strong irregular brightness variations. While the origin of the variations is still debated, the echo techniques offer the prospects to study the central regions with exceptional spatial resolution exceeding that of the best imaging capabilities by factors of several thousand. The splinter meeting shall bring together the experts and newcomers on this field, to stimulate further research activity.

## Splinter L The impact of LOFAR and SKA in astronomy and fundamental physics

**Convenors** M. Kadler, R.J. Dettmar, M. Brüggen, D. Schwarz, M. Kramer, H.R. Klöckner

**Time [Location]** Wednesday, Sept. 24, 14:00 - 18:00 [MG1/00.04]

The new generation of radio telescopes like LOFAR and ultimately the SKA addresses fundamental questions in physics and gradually transform the way how astronomy is done today. LOFAR leads the way to the next-generation multi-tasking radio interferometer the SKA, which will be the world's premier imaging and surveying telescope, with a combination of unprecedented versatility and sensitivity. Furthermore, the data products provided by these infrastructures challenge the way of data transport and analysis and will not only open up new windows of discovery space in radio astronomy, it will also revolutionise cosmology and gravitational physics.

We invite everybody of the scientific community to present their science and their visions with LOFAR and the SKA.

The envisaged science areas that will be discussed are: Cosmology, galaxy evolution, AGN and compact objects, star formation, interstellar medium, The Milky Way and Galactic science, radio transients, fundamental and astroparticle physics, extreme physics and associated theory, and Big Data.

# Workshops and Colloquia

## PhD-Student Meeting

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|---|---|---|
| **Convenors** | T. Beuchert, F. Krauss, A. Kreikenbohm | |
| **Time** | Monday, Sept. 22 | 12:00 - 16:00 |
| **Location** | Lecture room: MG1/02.06 | |

The PhD meeting will take place in the framework of the AG Tagung 2014. The topic of the meeting is to inform PhD students of Astronomy and Astrophysics about post-graduate career opportunities in science and industry. Therefore we offer invited talks by experts on the various fields. There will be room for discussions after each talk and during coffee breaks in between.

http://www.black-hole.eu/index.php/ag2014/special-meetings/270-phd-students-meeting

## Working Group History of Astronomy

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|---|---|---|
| **Convenors** | G. Wolfschmidt | |
| **Time** | Sunday, Sept. 21 & Monday, Sept. 22 | 8:30 - 17:00 |
| **Location** | Remeis Observatory | |

Die Tagung des Arbeitskreises Astronomiegeschichte in Bamberg steht unter dem Thema "Astronomie in Franken - Von den Anfängen bis zur modernen Astrophysik". Die Dr. Remeis-Sternwarte wurde 1889 auf einem der sieben Hügel Bambergs, dem Stephansberg, in 288m Höhe am Rand der Stadt im Nordosten errichtet. Die instrumentelle Ausstattung zeigt den Übergang von der klassische Astronomie, u.a. mit Meridiankreisbeobachtungen, (Passageinstrument, Refraktor und Heliometer) zur modernen Astrophysik (Heliograph, Astrograph, Kometensucher, astrophysikalische Instrumente, besonders Photometer, und nach dem Zweiten Weltkrieg ein Spiegelteleskop und ein Schmidtspiegel). Ernst Hartwig (1851-1923) legte die Grundlagen für die Astrophysik mit der Himmelsphotographie und seinen Forschungen zu Veränderlichen Sternen - 80 Jahre lang das Hauptarbeitsgebiet der Bamberger Sternwarte, auch in der Ära von Ernst Zinner (1886-1970) und Wolfgang Strohmeier (1913-2005). Aufgrund eines Sky Survey-Programms unter Einbeziehung des Südhimmels (Boyden Observatory, Bloemfontein, Südafrika, Mount John University Observatory, Lake Tekapo, Neuseeland und La Plata, Argentinien, 1963 bis 1974) entstand eine eindrucksvolle Photoplattensammlung, die bald vollständig digitalisiert vorliegt.

Ernst Zinner führte ein weiteres Interessensgebiet in der Remeis-Sternwarte ein, die astronomiehistorische Forschung. Deshalb wurde als Tagungsthema "Astronomie in Franken" gewählt, um diese Pionierarbeit auf diesem Gebiet mit einzubeziehen, also zum Beispiel das Wirken von Johannes Schöner, Christopher Clavius und von vielen weiteren fränkischen Astronomen vom Mittelalter bis heute. Man denke auch an die wertvollen Sammlungen astronomischer Handschriften, Inkunabeln, Bücher und Globen in der Staatsbibliothek Bamberg und der Schloßbibliothek Pommersfelden.

Bei der Tagung sind auch freie Vorträge möglich; es wäre natürlich gut, wenn viele sich mit Themen der Astronomie in Franken oder der Astrophysik in der Sternwarte beschäftigen würden. Von der Tagung soll ein Proceedings-Band erscheinen, vgl. hier: Nuncius Hamburgensis; Band 31 (2015); hier sollen alle Vorträge aufgenommen werden, die im weitesten Sinne zum Thema passen.

`http://www.hs.uni-hamburg.de/DE/GNT/events/akag-bamberg-2014.php`

## Public Outreach Meeting

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|---|---|---|
| **Convenors** | K. Jäger, M. Pössel | |
| **Time** | Wednesday, Sept. 24 | 14:00 - 18:00 |
| **Location** | MG1/02.09 | |

Unsere Grundmotivation seit dem ersten Treffen in Bonn ist nach wie vor aktuell:

Die Situation bzgl. des "Public Outreach in der Astronomie" hat sich in Deutschland in den letzten 10 Jahren zwar deutlich verbessert, doch es gibt noch "Luft nach oben". Zwar gibt es mittlerweile über die Republik verteilt einige Aktivposten (Personen, Institute, Institutionen), aber die Kommunikation und Vernetzung untereinander ist noch nicht optimal - trotz des "Jahr der Astronomie 2009". Diese Vernetzung ist jedoch enorm wichtig, z.B.

- für den Austausch von guten Ideen,
- um eigene Projekte besser bekannt zu machen,
- um Partner und Unterstützung für eigene Aktionen zu gewinnen,
- um neue gemeinsame Projekte und Konzepte zu entwickeln, und
- um astronomische Themen, die uns alle betreffen, gemeinsam öffentlich zu machen.

Um hier nach und nach eine Verbesserung zu erreichen und den Dialog zu fördern, haben wir ab der Herbsttagung der AG in Bonn 2010 eine Veranstaltung bei AG-Tagungen eingeführt, die sich speziell mit dem Public Outreach in der Astronomie befasst und neben Beiträgen der Teilnehmer vor allem Freiraum zur Diskussion bieten soll.

`http://www.mpia.de/homes/jaeger/index.htm`

## ALMA Users Meeting

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|---|---|---|
| **Convenors** | S. Mühle | |
| **Time** | Monday, Sept. 23 | 12:15 - 13:15 |
| **Location** | MG1/02.09 | |

## Public Telescope (Space telescope)

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|---|---|---|
| **Convenors** | H. Wilkens (astrofactum GmbH) | |
| **Time** | Wednesday, Sept. 24 | 12:45 - 14:00 |
| **Location** | MG1/02.09 | |

`www.publictelescope.org`

## Treffen des Bildungsausschusses

| | | |
|---|---|---|
| **Convenors** | O. Schwarz | |
| **Time** | Thursday, Sept. 25 | 13:00 - 14:00 |
| **Location** | MG1/02.09 | |

Am 25.9.2013 traf sich der Bildungsausschuss der Astronomische Gesellschaft in Tübingen zu seiner ersten konstituierenden Sitzung. Dieser neue Bildungsausschuss geht auf Grund eines Mitgliederbeschlusses aus der bisherigen Bildungskommission hervor. Dieser Schritt war notwendig geworden, weil die Heterogenität der astronomisch-schulischen Bildungslandschaft in den letzten Jahren deutlich zugenommen hat. Neben dem klassischen Schulfach Astronomie und den Angeboten zur Astrophysik in den Physikkursen der gymnasialen Oberstufe vieler Bundesländer werden himmelskundliche Bildungsinhalte zunehmend auch im sogenannten NAWI-Unterricht gelehrt. Darüber hinaus gibt es astronomisch motivierte Lehrplaninhalte im Sachunterricht - in einigen Bundesländern sind sogar vorschulische Lernangebote in die Bildungspläne aufgenommen worden. Hinzu kommt die Tatsache, dass einige Universitäten inzwischen die Gelegenheit nutzen, die Umstellung der Lehrerausbildung auf Bachelor und Master so zu interpretieren, dass sie Astronomie und Astrophysik als verpflichtende oder fakultative Angebote in die Studiengänge der Physiklehrerausbildung integrieren, woraus sogar eine klar erkennbare Tendenz resultiert, auch verstärkt fachdidaktische Promotionen zur Astronomie und Astrophysik zu vergeben. Diese Vielfalt konnte ein kleines Gremium wie die Bildungskommission nicht abdecken. Der neue Bildungsausschuss der AG ist deshalb so strukturiert, dass er sich nicht ausschließlich auf die klassisch-schulischen Lehrangebote zur Himmelskunde beschränken muss, sondern auch die oben skizzierten neuen Arbeitsfelder umfassen kann.

`http://www.ag-bildungsausschuss.de/`

## Astronomy and Education Meeting

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|---|---|---|
| **Convenors** | O. Schwarz | |
| **Time** | Thursday, Sept. 25 | 14:00 - 18:00 |
| **Location** | MG1/02.09 | |

"Sharing what we learn about the universe is an investment in our fellow citizens, our institutions, and our future." This citation of the Washington Charter published by the CAP working group of the IAU describes the necessity of communicating astronomy. Although this statement is very true, we should be aware of the right moment to start the investment in astronomy education – in the childhood or the adolescence at the latest. Especially young people need a sound knowledge of natural sciences in order to realize the saturation limits they have to face now and in the future and to counteract the exploitation of the natural resources of the Earth. This knowledge is very incomplete without astronomical education that clarifies the true proportions in the universe and the connections behind the universal cycles of matter and energy. Besides helping pupils to evolve into a self-determined person, astronomy education wakens interests in natural sciences especially astronomy and engages them to become a professional astronomer.

The Bildungsausschuss of the Astronomische Gesellschaft has embarked on this splinter meeting to bring together young scientists working on the broad field of astronomy education. The aim of this splinter session is to exchange knowledge, experiences and ideas of how to bring fundamental issues and latest research into the classroom. In addition students working on their Exams or PhDs get the possibility to present and discuss their thesis and to get into contact with each other.

`http://www.ag-bildungsausschuss.de/AE.html`

## AstroFrauenNetzwerk Get-together

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|---|---|---|
| **Convenors** | S. Schuh, M. Hirsch | |
| **Time** | Monday, Sept. 22 | 16:00 - 18:00 |
| **Location** | MG1/02.09 | |

`http://www.astro.rug.nl/~kamp/Frauen_Netzwerk.html#Treffen`

## Training of Teachers

| | | |
|---|---|---|
| **Convenors** | C. Scorza | |
| **Time** | Friday, Sept. 26 | 14:00 - 18:14 |
| **Location** | MG1/02.06 | |

## Exhibitions

All exhibitions are found in the ground floor foyers
of the lecture hall buildings MG1 and MG2

- German Astrophysical Virtual Observatory GAVO
- Square Kilometre Array SKA
- Public Telescope (Space Telescope)
- Baader Planetarium
- Springer Verlag
- EDP Sciences Publishing Company
- Oculum-Verlag

# Abstracts

# Abstracts of Price Winners

Ludwig Biermann Prize Lecture

## Hot subdwarfs - Small stars indicating major events in stellar evolution

S. Geier

*European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany*

Hot subdwarf stars are regarded as the bare helium cores of red giants that lost almost their entire hydrogen envelope. The formation of these objects is still unclear since it requires an episodes of extreme mass loss, which is likely triggered by interactions with other objects. The formation of hot subdwarfs turned out to be connected to phenoma as diverse as the interactions of stars and planets, stellar mergers or even the origin of type Ia supernovae. I will review the state-of-the-art in hot subdwarf research and highlight the relevance of those small stars for the late phase of stellar evolution.

PhD Prize Lecture

# Shock-Shock Interaction in the relativistic outflows of active galactic nuclei

C. M. Fromm[1,2]

[1] *Max Planck Institute for Radio Astronomy, Auf dem Hügel 69, 53121 Bonn, Germany*
[2] *Institute for Space Propulsion, German Aerospace Center, Langer Grund, 74239 Hardthausen, Germany*

The analysis of the single-dish light curve of 2006 radio flare in the blazar CTA102 (z=1.04) revealed a peculiar spectral evolution. The observed spectral evolution could be explained and modeled by a recollimation shock- travelling shock interaction.
Further evidence for the existence of these features were found from the analysis of several multi-frequency Very Long Baseline Interferometry observation of the source during the flare. In order to bridge the observational time gaps and to test in detail your hypothesis we performed relativistic hydro-dynamic simulations and computed the non-thermal emission.
The results of these simulations confirmed our initial assumption of shock-shock interaction as explanation for the 2006 radio flare in CTA102.

# Abstracts of Review Talks

Review

# Exoplanets: Status and future of their detection and characterization

H. Rauer[1,2]

[1] *Institut für Planetenforschung, DLR, Rutherfordstr. 2, 12489 Berlin*
[2] *Zentrum für Astronomie und Astrophysik, TU Berlin, Hardenbergstr. 36, 10623 Berlin*

In this decade our knowledge of the nature of extra-solar planets has increased significantly. Missions such as Corot and Kepler have confirmed that small extrasolar planets are common and multiple planetary systems are frequent. New classes of planets, such as “super-Earths” and “mini-Neptunes” have been detected, which are not found in our Solar System. As a result, with increasing detection numbers also new questions arose, such as: What is the composition and internal structure of these planets? What are their atmospheres made of? And for the smallest planets, their potential for habitable surface conditions is of strong interest. In future, the Kepler mission will continue as K2-Mission with shorter time-baseline per target field, but still able to detect small exoplanets. The ESA Small Mission CHEOPS (launch 2017) will extend the sample of planets with known radii by following-up planets previously detected from ground, e.g. by the radial-velocity method. NASA has selected the TESS mission (launch 2017), which will perform an all-sky survey for short-period planets around bright stars. Following these missions, the European PLATO mission, selected as ESA M3 mission (launch 2024), which will revolutionize our understanding of extrasolar planets by discovering and characterizing planets for their radius, mass and age, including planets in the habitable zone of solar-like stars. This talk will provide an overview of the status and future of extrasolar planet detections, with emphasize on past and future transit missions.

Review

# Asteroseismology: the Revolution in Stellar Physics

C. Aerts[1,2] and the CoRoT and *Kepler* teams

[1] *Institute of Astronomy, KU Leuven, Celestijnenlaan 200D, 3001 Leuven, Belgium*
*Conny.Aerts@ster.kuleuven.be*
[2] *Department of Astrophysics/IMAPP, Radboud University Nijmegen,*
*6500 GL Nijmegen, The Netherlands*

After a basic introduction, we illustrate how asteroseismology works in practice by visiting several kinds of stars in various evolutionary stages. We show how their oscillation properties allow us to understand details of their interior structure that are impossible to unravel without time-resolved uninterrupted high-precision data. In particular, the talk will be built around the major question of how stars rotate internally by showing how the recent seismic data can answer it, and, by implication, help to improve stellar evolution theory. We end by summarizing ongoing observational projects and present future prospects, also highlighting the potential of asteroseismology as a tool to study galactic structure and exoplanetary systems.

Review

# Gaia: ESA's high-precision astrometry mission — status and prospects nine months after launch

U. Bastian

*Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg*

I will briefly review the Gaia mission and its technical and scientific goals. Gaia was launched on Dec 19, 2013 and is expected to enter scientific operations by early July 2014. All systems on board are working fine; astrometric data of unprecedented quality and quantity are already being collected in the ongoing phase of commissioning and fine-tuning. Nevertheless there are also some problems: unexpected straylight, water ice contamination and a possibly reduced geometric stability of the telescopes. I will give an up-to-date description of our knowledge on Gaia as of September 2014, of the data quality and of the plans for early releases of scientific results (i.e. of preliminary Gaia Catalogues).
While there will likely be some loss relative to Gaia's pre-launch performance predictions, we already know that the scientific return from the mission will still be immense and unique, revolutionising our understanding of the formation and evolution of the Milky Way galaxy, and strongly influencing many other central scientific topics in present-day astronomy.

Review

# White Dwarfs in Detached and Interacting Binary Stars

T.R. Marsh

*Department of Physics, University of Warwick*

Large surveys over the past 15 years have led to a dramatic rise in the number of known white dwarfs, in particular the number of white dwarfs in binaries. For instance, whereas 10 years ago we knew of just 5 white dwarf / main-sequence detached binary stars, today we know close to 100, and within the past 5 years have even found examples of eclipsing double white dwarfs. Observations of white dwarf binaries allow us to test structure models of white dwarfs and their companions, to test theories of binary star evolution that underpin almost all populations of close binary stars, and even to detect the presence of circumbinary planets. In this review I will focus upon what these systems tell about (a) the common envelope phase of binary star evolution, (b) precision fundamental stellar parameters of white dwarfs and their companions, (c) the build up of mass in accreting white dwarfs, and (d) evidence for planets around white dwarf binaries.

Review

# Probing Fundamental Physics in the Dynamic Radio Sky

M. Kramer[1,2]

[1] *Max-Planck-Institut für Radioastronomie, Bonn, Germany*
[2] *JBCA, University of Manchester, Manchester, UK*

Radio photons are often the result of very energetic processes. They may be emitted by compact objects, telling us about these objects, their formation and properties. The photons may also interact with an intervening medium, magnetic fields or other entities. Overall, they reveal a huge amount physics and astrophyics. This talk will mostly concentrate on radio pulsars, and how we can use them as unique probes for fundamental physics, from studying theories of gravity to properties of super-dense matter. Other recent results of the studies of fundamental physics using time domain phenomena are also being presented.

Review

# X-ray binaries

Anna L. Watts

*University of Amsterdam*

X-ray binaries, harbouring neutron stars or black holes, exhibit variability on timescales from years to milliseconds. From gentle fluctuations in accretion flow to violent thermonuclear explosions, transient and dynamical phenomena are ubiquitous. Intrinsically interesting as showcases for the endpoints of stellar evolution, X-ray binaries also allow us to explore strong gravity and the coldest, densest matter in the Universe. In this talk I will review both the astrophysics - and the physics - of these fascinating systems.

Review

## The Dynamic Universe: Palomar Transient Factory

S. R. Kulkarni
Principal Investigator, Palomar Transient Factory

*Caltech Optical Observatories*
*California Institute of Technology, Pasadena, USA*

That occasionally new sources ("Stella Nova") would pop up in the heavens was noted more than a thousand years ago. The earnest study of cosmic explosions began less than a hundred years ago. Over time astronomers have come to appreciate the central role of supernovae in synthesizing new elements (and making life as we know possible).
The Palomar Transient Factory (PTF), an innovative 2-telescope system, was designed to explicitly chart the transient sky with a particular focus on events which lie in the nova-supernova gap. PTF can find an extragalactic transient every 20 minutes and a Galactic (strong) variable every 10 minutes. The results so far: discovery and spectral classification of 2300 supernovae, identification of an emerging class of ultra-luminous supernovae, insights into the progenitors of type Ia supernovae, discovery of luminous red novae, the most comprehensive UV spectroscopy of Ia supernovae, discovery of low energy budget supernovae, clarification of sub-classes of core collapse and thermo-nuclear explosions, mapping of the systematics of core collapse supernovae, detection of gamma-ray bursts entirely via their optical afterglow, identification of a trove of eclipsing binaries (including a planet around a newly born star) and identification of a number of the curious AM CVns.

# Abstracts of Highlight Talks

Highlight

# Helioseismology with SDO

L. Gizon[1,2]

[1] *Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen*
[2] *Georg-August-Universität Göttingen, Institut für Astrophysik, Friedrich-Hund-Platz 1, 37077 Göttingen*

The Helioseismic and Magnetic Imager onboard the Solar Dynamics Observatory provides full-disk observations of solar oscillations at a spatial resolution of 1 arcsec ($4096^2$ pixel Dopplergrams at 45 s cadence). HMI/SDO started observing in May 2010 and has been operating continuously since then. It enables helioseismology at high solar latitudes, higher than previously accessible to MDI/SOHO (1996-2011). HMI/SDO is also of higher optical quality and has a higher sensitivity to small amplitude seismic signals. I will present recent HMI/SDO helioseismology results that inform us about the internal dynamics of the Sun and the origin of differential rotation. In particular, I will discuss how the statistical properties of near-surface convection are affected by rotation and depend on latitude. I will conclude with a few words on Solar Orbiter (ESA M-Class mission, 2017 launch), which will observe the dynamics and magnetism of the polar regions of the Sun seen from an orbit inclined out of the ecliptic plane.

Highlight

# Variability of young stars: magnetic activity and accretion

B. Stelzer

*INAF - Osservatorio Astronomico di Palermo*

I will present an overview on the multiple aspects of stellar variability with focus on young stars.
Variability is a key characteristic of late-type stars. The major cause is magnetic activity but at ages $< 10$Myr accretion signatures are also important and sometimes dominant.
Magnetic activity phenomena comprise radiation from the radio to the X-ray band, including a wide range of optical emission lines, and go back to a stellar dynamo. The faster rotation of young stars is associated with scaled-up activity, e.g. 1000 times higher X-ray luminosity is detected from pre-main sequence stars with respect to main-sequence stars. Flares, representing rapid release of magnetic energy through reconnection events, are the most prominent activity signatures. Another ubiquituous type of variability related to magnetic activity is rotational modulation produced by inhomogeneous surface brightness related to the presence of cool star spots, while dynamo cycles are observed mostly on old, inactive stars. Next to these activity-related variability features the accretion process induces variations either due to changes in the intrinsic mass transfer or due to geometric effects as accretion streams/curtains rotate in and out of the line of sight. The most extreme accretion events are the sporadic and poorly understood bursts known as EXOr and FUOr phenomena which are likely responsible for assembling a significant amount of the final stellar mass.

Highlight

## Planet formation in post common envelope binaries

Dominik R. G. Schleicher
*Institut für Astrophysik Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany*

Recent observations based on the light travel time method suggest the presence of massive gas giants around compact binary systems. Such systems must have gone through a common envelope phase when the more massive star became a red giant. Particularly good data are present for the close binary system NN Serpentis, suggesting that the observed orbits are incompatible with planet formation before the common envelope phase. In this talk, I will briefly review the main arguments against a pre-common envelope origin and discuss the possible formation of planets from the material ejected during the common envelope phase. The model predictions are compared with currently available data.

Highlight

# Modeling Type Ia Supernova Explosions

F. K. Röpke

*Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Germany*

There is strong evidence that Type Ia supernovae (SNe Ia) are thermonuclear explosions of white dwarf stars. The exact nature of the progenitor system, however, is still enigmatic and direct observation is lacking. Although the most prominent application of SNe Ia in astrophysics – as distance indicators in cosmology – rests on the remarkable homogeneity of this class of objects, observations confirm the existence of various sub-classes with diverging characteristics. Together with other observational findings and theoretical estimates on the rate of SNe Ia, this challenges the long-time standard model that explains SNe Ia as explosions of white dwarfs approaching the Chandrasekhar mass limit by accreting from a normal companion star. I will discuss recent progress in three-dimensional simulations that follow the explosion stage for different scenarios. Mapping the results of such hydrodynamical simulations into radiative transfer calculations allows to predict observables from the models. By comparing to astronomical data it becomes possible to associate certaingparmentier sub-classes of SNe Ia with potential progenitor systems. This is an important step towards a theoretical foundation of the use of these objects as cosmological probes as well as for understanding their role in galactic chemical evolution.

Highlight

## Supernova SN2014J

R. Diehl[1,2], T. Siegert[1], M. Krause[2,1], J. Greiner[1,2], *et al.*

[1] *Max-Planck-Institut für extraterrestrische Physik, D-85741 Garching, Germany*
[2] *Excellence-Cluster "Origin & Structure of Universe", D-85748 Garching, Germany*

SN2014J is the closest supernova of type Ia that occured in the last 40 years, and thus provides an oportunity for unprecedented observational coverage. This will help to uncover the still unknown origins of these supernovae. For the first time, this source is sufficiently nearby so that also gamma-rays are contributing to those investigations. This is important, as the primary source of supernova light are gamma-rays from radioactive decay of about 0.5 $M_\odot$ of $^{56}$Ni produced in typical supernovae of this type. The INTEGRAL gamma-ray observatory of ESA has followed the supernova emission for almost 5 months, and the characteristic line gamma-rays from the $^{56}$Ni decay chain through $^{56}$Co have been measured. We discuss the observations in context, and implications of gamma-ray line intensities, Doppler shifts and broadenings, for this particular supernova and explosion physics in general.

Highlight

# How environment drives galaxy evolution: lessons learnt from satellite galaxies

A. Pasquali

*Universität Heidelberg, Zentrum für Astronomie,*
*Mönchhofstr. 12-14, 69120 Heidelberg*

It is by now well established that galaxy evolution is driven by intrinsic and environmental processes, both contributing to shape the observed properties of galaxies. A number of early studies have shown that the star formation activity of galaxies depends on their local density, and, on the theoretical side, models of galaxy evolution have indicated that galaxies residing in the same environment do not evolve similarly. Contrary to their central (most massive) galaxy of a group/cluster, satellite galaxies are stripped off their gas and stars, and have their star formation quenched by their environment. Large galaxy surveys like SDSS now permit us to investigate in detail environment-driven transformation processes by comparing centrals and satellites. In this talk I will summarize what we have so far learnt about environmental effects by analysing the observed properties of central and satellite galaxies at z $\sim$ 0 in SDSS, as a function of their stellar mass and the dark matter mass of their host halo.

Highlight

# Gamma-ray bursts and their host galaxies

T. Krühler

*European Southern Observatory, Alonso de Córdova 3107, Vitacura, Casilla 19001, Santiago 19, Chile*

Because long gamma-ray bursts (GRBs) are tightly linked to core-collapse supernovae, GRBs, their afterglows and host galaxies offer a unique opportunity to probe the interstellar medium and the environments where stars form throughout the observable Universe. The luminous afterglow in particular is a powerful messenger that pin-points and lights-up distant galaxies and star-forming regions that can not be studied by other means. Neutral hydrogen, different metal ions, molecules, and dust, for example, all leave a characteristic imprint on the afterglow emission. The hot and ionized gas in H II regions and the stellar content of the GRB's host can then be probed with conventional techniques once the afterglow has faded. Due to this extensive set of information, GRB hosts are powerful laboratories with which to study GRB progenitor models, the star-formation history of the Universe, its enrichment with metals and the evolution of galaxies. I will review and discuss recent progress and highlights from GRB afterglow and host studies from an observational point of view.

Highlight

# Supermassive Black Holes - Jet signatures

S. Britzen[1]

[1] *Max-Planck-Institut fuer Radioastronomie, Auf dem Huegel 69, 53 121 Bonn, Germany*

Detailed studies of the enormous and highly variable jet emission of supermassive Black Holes and supermassive binary Black Holes help us to understand these fascinating phenomena. I will present examples of how the combined analysis of high resolution VLBI observations and multi-wavelength radiation provides us with insight into the physics of these objects. Highest resolution "Event Horizon Telescope" observations will probably soon tell us more about the jet orign and launching mechanism at the very centers of nearby Active Galactic Nuclei.

Highlight

# TANAMI: Multiwavelength and Multimessenger Observations of Active Galaxies

M. Kadler

*Institut für Theoretische Physik und Astrophysik, Universität Würzburg*

Extragalactic jets launched from the immediate vicinity of supermassive black holes in radio-loud active galactic nuclei (AGN) are key objects in modern astronomy and astroparticle physics. AGN jets carry a fraction of the total gravitational energy released during the accretion of matter onto supermassive black holes and are prime suspects as possible sources of ultrahigh-energy cosmic rays and the recently detected extraterrestrial neutrinos at PeV energies. TANAMI (Tracking Active galactic Nuclei with Austral Milliarcsecond Interferometry) is a multiwavelength monitoring program of AGN jets of the Southern sky combining high-resolution radio VLBI imaging and higher-frequency observations at IR, optical/UV, X-ray and gamma-ray energies. I will review recent results of the TANAMI program, highlighting AGN candidate neutrino-emitters in the error circles of the IceCube PeV neutrino events.

Highlight

# The Cherenkov Telescope Array (CTA)

S. Funk[1,2] for the CTA Consortium

[1]*SLAC National Accelerator Laboratory, Menlo Park, US*
[2]*Kavli Intitute for Particle Astrophysics and Cosmology (KIPAC), Stanford University, Stanford, US*

The Cherenkov Telescope Array (CTA) is an observatory that will study extreme processes in the Universe that produce very-high-energy gamma rays. Building on the past decade of experience from H.E.S.S., MAGIC, and VERITAS, CTA will feature dozens of imaging atmospheric Cherenkov telescopes of three different sizes to detect gamma rays with energies between 30 GeV and more than 100 TeV. The observatory will be an order of magnitude more sensitive than the current generation of instruments. CTA will have a broad science portfolio of both astrophysics and fundamental physics. These include elucidating the origin of cosmic rays, and the mechanism of particle acceleration in shocks and jets, such as in active galactic nuclei, gamma-ray bursts and supernova remnants.

# Abstracts of Contributed Talks

## Splinter A

Contributed Talk

Splinter A

# Analysis of plage magnetic fields using a spatially coupled 2D inversion

D. Buehler[1], A. Lagg[1], S. K. Solanki[1,2], M. van Noort[1]

[1] *Max Planck Institute for Solar System Research*
[2] *School of Space Research, Kyung Hee University*

The properties of magnetic features (MFCs) within a plage region in the vicinity of a sunspot were investigated at high spatial resolution. Stokes spectra of the 6302Å line pair recorded by the spectropolarimeter aboard Hinode were inverted using an extended version of the SPINOR code. The code preformed a spatially coupled inversion of the Stokes spectra using three log(tau) nodes in optical depth. No magnetic filling factors was employed. The inversion results reveal that plage is composed of magnetic flux concentrations (MFCs) with typical field strengths of 1520 G at $log(\tau) = -0.9$ and inclinations between $10° - 15°$. The MFCs expand by forming magnetic canopies composed of weaker and more inclined magnetic fields. The expansion and average temperature stratification of isolated MFCs can be approximated well with an empirical thin plage flux tube model. The highest temperatures of MFCs are located at their edges in all $log(\tau)$ layers. Whilst the plasma inside MFCs is nearly at rest, each is surrounded by a ring of downflows of on average 2.4 km/s at $log(\tau) = 0$, and peak velocities of up to 10 km/s, which are supersonic. The downflow ring of an MFC weakens and shifts outwards with height, tracing the MFC's expansion. Such downflow rings often harbour magnetic patches of opposite polarity to that of the main MFC with average field strengths of 280 G at $log(\tau) = 0$. These opposite polarity patches are situated beneath the canopy of their main MFC. We found evidence for a strong broadening of the Stokes profiles in MFCs and particularly in the downflow ring surrounding MFCs (expressed by a microturbulence in the inversion). This indicates the presence of strong unresolved velocities. Larger magnetic structures such as sunspots cause the field of nearby MFCs to be more inclined.

Contributed Talk

Splinter A

# Observations of small-scale structure

M. Collados

*Instituto de Astrofísica de Canarias*

GREGOR has recently started its scientific operation at the Observatorio del Teide (Tenerife) with the final setup and verification of its common-use instruments (BBI, GRIS and GFPI). With its 1.5 m diameter, GREGOR has become the largest solar telescope equipped with the most complete instrumentacion for broad-band imaging, narrow-band tunable imaging and grating spectropolarimetry. With these observational capabilities, GREGOR is expected to deliver data with unprecedented quality. In this talk, some high-spatial resolution aspects will be highlighted where GREGOR may give novel results, from the quiet photosphere to photospheric active regions, as well as for chromospheric structures.

Splinter A

# Observation of MHD Waves in Solar Spicules: Hinode/SOT and Soho/Summer data

H. Ebadi[1]

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Transversal oscillations of solar spicules are investigated observationally. The fundamental mode and its first harmonic period ratio are determined. Evidences to the reconnection like origin of spicules are illustrated. Main dynamical properties of spicules are derived from magneto seismology of waves propagating through them.

Contributed Talk

Splinter A

# Asymmetries in Stokes Profiles

M. Franz[1], R. Schlichenmaier[1], M. Collados[5], J. Borrero[1], C. Denker[2], S. Solanki[3], H. Balthasar[2], T. Berkefeld[1], A. Hofmann[2], F. Kneer[6], A. Lagg[3], H. Nicklas[6], D. Orozco[5], K. Puschmann[2], R. Rezaei[1], D. Schmidt[1], W. Schmidt[1], M. Sigwarth[1], M. Sobotka[5], D. Soltau[1], J. Staude[2], K. Strassmeier[2], R. Volkmer[1], O. von der Lühe[1]

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With the start of scientific data acquisition of GRIS@Gregor, solar observation in the near infrared (1 to 2 $\mu$m) is now possible with a striking spatial resolution of 0".2 to 0".3. Especially the Fe lines around 1.56 $\mu$m provide an advantage over lines in the visible, since they sample the atmospheric conditions of a thin layer in the deepest part of the photosphere.
In this contribution we study strongly asymmetric in Stokes V profiles with three, or even four lobes, in a systematical way to infer the configuration of the penumbral magnetic field in the deep photosphere.
We use GRIS observation from a sunspot close to disk center to measure the amount of three lobed Stokes V profiles. We first explain such profiles using a two layer solar atmospheric model and then estimate the amount of penumbral magnetic field of opposite polarity, cf. Franz & Schlichenmaier (2013). Sunspots observed away from disk center show numerous Stokes V profiles with four lobes. We interpret such profiles within the framework of the uncombed penumbral model and estimate magnetic field strength as well as plasma velocity within the individual flow channels.

Franz, M. & Schlichenmaier, R. 2013, A&A, **550**, A97

Contributed Talk

Splinter A

# Influence of sunspot magnetic field on the evolution of penumbral bright grains

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Penumbral bright grains are the heads of penumbral filaments and show apparent motions towards the sunspot umbra. In stable sunspots, penumbral bright grains disappear around the stationary umbra/penumbra boundary. As shown by analysis of Hinode spectropolarimetric data, the stable umbra/penumbra boundary is defined by a critical value of the vertical component of the magnetic field. This value is only weakly (if at all) dependent on the sunspot size, and is around 1900 G. We use spectropolarimetric data observed with the GFPI instrument attached to the VTT along with G-band images to study the behaviour of penumbral bright grains in a forming penumbra. Right after the appearance of these structures, we identify their apparent motion towards the umbral core. This motion is analogous to that of penumbral bright grains in developed penumbrae. However, their apparent motion in forming penumbra causes a shift of the umbra/penumbra boundary towards the umbral core. This might be related to the fact, that the formation of penumbra occurs in regions with vertical component of the magnetic field around 1150 G. This value gradually increases as the umbra/penumbra boundary moves towards regions with stronger and more vertical magnetic field. Several hours later, the umbra/penumbra boundary reaches a region with the vertical component of the magnetic field around 1900 G, i.e., the value found on stable umbra/penumbra boundaries. At this time, we still observe apparent motions of penumbral bright grains towards the umbral core, but the umbra/penumbra boundary is stationary.

Contributed Talk

Splinter A

# High-Resolution Sunspot Observations

C. Kuckein[1], H. Balthasar[1], C. Denker[1], A. Diercke[1,2],
S.J. González Manrique[1,2], P. Kummerow[1,2], R.E. Louis[1],
N. Bello González[3], J.M. Borrero[3], M. Franz[3], S. Hoch[3], C. Kiess[3],
J. Löhner-Böttcher[3], A. Nesis[3], R. Rezaei[3], R. Schlichenmaier[3],
W. Schmidt[3], M. Schubert[3], D. Soltau[3], O. von der Lühe[3], A. Lagg[4],
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A medium-sized, unipolar, axis-symmetric sunspot was observed in the blue continuum ($\lambda$450.6 nm) on 2014 March 27 with the Blue Imaging Channel (BIC) of the GREGOR Fabry-Pérot Interferometer (GFPI) at the 1.5-meter GREGOR solar telescope. The observations were split into three 30-minute time-series with 200 image sequences containing 25 short-exposure images each, which are appropriate for image restoration. We combined three consecutive image sequences (75 images) to obtain one restored continuum image maintaining the original 10-second cadence. We computed various measures of the image quality over the full time-series to evaluate the performance of the imaging and adaptive optics (AO) systems. The normalized Fried-parameter and differential image motion were used to characterize the AO-correction across the field-of-view under varying seeing conditions. Local correlation tracking (LCT) was employed to measure horizontal proper motions in and around the sunspot. We investigated how frame selection, image restoration, and straylight correction affect the LCT results, which were compared to horizontal flow maps based on data of the Solar Dynamics Observatory.

Contributed Talk

Splinter A

# Early Science with the GREGOR Fabry-Pérot Interferometer – Overview

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The “early science phase” of the the 1.5-meter GREGOR solar telescope at Observatorio del Teide, Tenerife, Spain started in May 2014. We provide a summary of a 50-day observing campaign with the GREGOR Fabry-Pérot Interferometer (GFPI) in July/August 2014. The instrument is a dual-etalon spectropolarimeter with a spectral resolution of $R \approx 250,000$ over the wavelength range from 530–860 nm. Imaging spectroscopy with the GFPI included several photospheric Fe I lines ($\lambda\lambda$543.4, 557.6, 617.3, 630.2, and 709.0 nm) as well as the chromospheric H$\alpha$ ($\lambda$656.3 nm) and infrared Ca II ($\lambda$854.2 nm) lines. Adaptive optics combined with image restoration facilitates observations close to the diffraction limit of the GREGOR telescope. The field-of-view (FOV) of $50'' \times 38''$ is sufficiently large to cover sunspots and significant portions of active regions. The spectroscopic data are accompanied by G-band ($\lambda$430.7 nm) and blue continuum ($\lambda$450.6 nm) filtergrams of the Blue Imaging Channel (BIC), which covers a much larger FOV of $75'' \times 93''$, thus providing context information and access to horizontal proper motions using optical flow techniques.

Contributed Talk

Splinter A

# A two dimensional view of spicules from He 1083 nm triplet observations

D. Orozco Suárez[1],[2]

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Solar spicules are thin and very dynamic, jet-like chromospheric structures that can be clearly seen at the limb. Their rapid evolution makes the characterization of their magnetic properties extremely difficult. The main reason has to do with the long integration times needed for recording full Stokes measurements in suitable lines and the lack of spatial resolution and image stability during limb observations. In this talk I show He 1083 nm triplet spectropolarimetric data taken at the solar limb during excellent seeing conditions with the German VTT. It has been possible, for the first time, to infer the dependence of the magnetic field vector of spicules with height. We expect to record similar observations with GREGOR at unprecedented resolution.

Contributed Talk

Splinter A

## Photosphere and chromosphere of a sunspot light bridge

R. Rezaei

*Kiepenheuer-Institut für Sonnenphysik, Freiburg*

We study the thermodynamic and magnetic structure of several light bridges in the leading sunspot of active region NOAA 12049. The sunspot was located very close to disk center and had a heliocentric angle of 5 degrees. We observed the Stokes parameters of seven photospheric iron lines at 1565 nm range with the GRIS instrument at GREGOR solar telescope. Simultaneous to GREGOR observations, IRIS satellite also recorded the same region in near-UV part of the spectrum. The IRIS spectra consists of the two singly ionized magnesium lines at 280 nm, along with spectral lines of C II, Si IV, and O IV representing the transition region above the chromosphere. Both instruments have slit-jaw system, which helps not only to align the data, but also to follow fast evolution of the umbral chromosphere.
The photospheric magnetic field vector was retrieved from an LTE inversion of the measured Stokes profiles. We used the SIR code with varying degrees of freedom to invert the Stokes parameters. Using the AZAM code, we converted the inclination and azimuth from line-of-sight to the local reference frame. Maps of photospheric magnetic fields show the typical properties of a light bridge: reduced field strength and more inclined field lines with a distinct azimuth pattern compared to the nearby umbra.
There are different types of light bridge in the umbra: a granular light bridge with a continuum intensity comparable to quiet sun and a width of larger than 1000 km, a penumbral light bridge with intermediate continuum intensity and a dark lane along its axis, and several umbral light bridge. We find strong downflows and enhanced chromospheric activity in the penumbral light bridge. The downflows lanes in this light bridge are narrower than the photospheric width of the light bridge in continuum intensity map. The chromospheric jets are primarily seen on one side of the light bridge.

Contributed Talk

Splinter A

# Light Bridge Fine Structure with GREGOR

R. Schlichenmaier[1], O. von der Lühe[1], S. Hoch[1], D. Soltau[1], T. Berkefeld[1], and the GREGOR Team[1,2,3,4,5,6]

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Sunspots are the largest manifestation of magnetic fields in the solar photosphere. Their appearance is characterised by different modes of radiatively driven magneto-convection: In sunspot penumbrae, magneto-convection takes place in inclined magnetic fields generating elongated bright and dark filamented. In the cooler umbra, the magnetic field is predominantly vertical and strong, suppressing vigorous convection. Here, radiative losses drive small magneto-convective cells, which are observed as umbral dots. In light bridges the magneto-convective mode seems to be more complex, as they exhibit a versatile structure. In this contribution, we study their intensity morphology at the smallest observable spatial scales.
With the Broad Band Imager at the new 1.5 m GREGOR telescope in Tenerife, we observed various sunspots with filters around 486 and 589 nm. We acquired bursts of images with an exposure time of 1ms, i.e., short enough to freeze the smearing effects of the seeing. Assuming statistical properties of the seeing, KISIP was used to reconstruct images, achieving a spatial resolution of better then 0.1 arcsec. We will present these images and discuss various aspects of their characteristic morphological structure: E.g., we see dark canals with a ubiquitous width of 0.09 arc sec, at various intensity levels, but we also see structureless umbral features as large as 0.3 arc sec. The observed features partially undergo rapid evolution on a time scale smaller than 1 minute.

Contributed Talk

Splinter A

## Simulation of magnetic structure in the photosphere

M. Schüssler

*Max-Planck-Institut für Sonnensystemforschung, Göttingen*

The talk will give an overview of results from 3D MHD simulations of magneto-convection in the upper convection zone and photosphere of the Sun. Special emphasis will be upon magnetic flux concentrations (from small magnetic elements to sunspots), flux emergence, and small-scale dynamo action.

Contributed Talk

Splinter A

# Brightness of the Sun's small scale magnetic field: proximity effects

I. Thaler [1], H. Spruit[2]

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The net effect of the small scale magnetic field on the Sun's (bolometric) brightness is studied with realistic 3-D MHD simulations. The direct effect of brightening within the magnetic field itself is consistent with measurements in high-resolution observations. The high 'photometric accuracy' of the simulations, however, reveal the existence of compensating brightness effects that are hard to detect observationally. The influence of magnetic concentrations on the surrounding nonmagnetic convective flows (a 'proximity effect') reduces the brightness by an amount exceeding the brightening by the magnetic concentrations themselves. The net photospheric effect of the small scale field ($\approx -0.34\%$ at a mean flux density of 50 G) is thus negative. We conclude that the main contribution to the observed positive correlation between the magnetic field and Total Solar Irradiance must be magnetic dissipation in layers around the temperature minimum and above (which are not included in the simulations). This agrees with existing inferences from observations.

Contributed Talk

Splinter A

# Is the Sun Really Gaseous?

Alexander Unzicker

*Pestalozzi-Gymnasium München*

It is established for almost a century that the sun consists of gaseous matter, thus it seems bold to put such a fundamental part of our knowledge into question. However, observational and theoretical findings, particularly put forward by Pierre-Marie Robitaille in a series of articles[1], suggest that liquid metallic hydrogen, a topical issue in condensed matter physics, may constitute a viable alternative for the surface of sun. There is no doubt such a hypothesis is highly controversial, since it would require a re-interpretation of a vast amount of astronomical data. It will however be shown that the arguments offered by Robitaille in favor of his model are elaborate, well-documented and often persuasive. A hypothesis presented in such a manner has to be discussed by scientific standards. The talk explicitly invites sound and factual counterarguments.

[1] *http://www.ptep-online.com/index_files/issues.html*

Contributed Talk

Splinter A

## Selfconsistent magnetostatic modelling of the solar atmosphere from Sunrise/IMAX measurements

T. Wiegelmann and Sunrise-Team

*Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen*

Our aim is to model the 3D magnetic field structure of the upper solar atmosphere. We use high-resolution photospheric magnetic field measurements from Sunrise/IMAX as boundary condition for a magneto-static magnetic field model. The high resolution of IMAX allows us to resolve the interface region between photosphere and corona, but modelling this region is challenging for the following reasons. While coronal magnetic field models are force-free (the Lorentz-force vanishes), this is not the case in the mixed plasma $\beta$ environment in the photosphere and lower chromosphere. In our model, pressure gradients and gravity forces are taken self-consistently into account and compensate the non-vanishing Lorentz-force. Above a certain hight (about 2Mm) the non-magnetic forces become very weak and consequently the magnetic field becomes almost force-free.

# Abstracts of Contributed Talks

## Splinter B

Contributed Talk

Splinter B

# A new correction of stellar oscillation frequencies for near-surface effects

Warrick H. Ball[1], L. Gizon[2,1]

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Space-based observations of solar-like oscillations present an opportunity to constrain stellar models using individual mode frequencies, but current stellar models have inaccuracies near the surface that introduce systematic differences in the frequencies. These *surface effects* must be corrected to reduce the systematic error that is induced on the underlying mode parameters. We introduce two parametrizations of the surface effect based on formulae given by Gough (1990). The first new parametrization is a term proportional to $\nu^3/\mathcal{I}$ and the second has an additional term proportional to $\nu^{-1}/\mathcal{I}$, where $\nu$ and $\mathcal{I}$ are the frequency and inertia of an oscillation mode.
We first show that these parametrizations accurately correct model frequencies for two calibrated solar models. We then use the new parametrizations to fit parameters of the planet-hosting CoRoT target HD 52265, and compare our results with fits using the widely-used correction proposed by Kjeldsen et al. (2008). All three methods yield consistent results but that fit using the new parametrizations is of significantly better quality. We also present preliminary results of fits to other stars from the CoRoT and Kepler fields, consolidating the usefulness of the new parametrizations.

Contributed Talk

Splinter B

# Photometric Variations in Massive Stars using the *Most* Satellite

H. Pablo

*University of Montreal*

Variations in O stars have been extremely difficult to study. They have been largely missing from the high precision photometry missions such as *Kepler* and the variations are typically fairly long time scales on the order of days to weeks. For this reason it has been difficult to pin point the source of this variability whether it be from spots pulsations, binarity or other sources. However, there exists a fairly large sample of these stars within the *MOST* archive. This sample includes 28 unique O and OB stars 5 of which are binary systems (4 of which are new). In addition, most of these stars were virtually unknown outside of this sample. This gives us an opportunity to look at how common variability is on the milli-magnitude level in O stars. In addition, for a couple of unique objects I will discuss the sources of this variability and how this information can be improved upon using the BRITE constellation project.

Contributed Talk

Splinter B

# Asteroseismology of B stars: Effect of the model input physics on the determination of stellar parameters

A.Thoul

*University of Liege*

Asteroseismology is a powerful tool to explore the interior structure of the stars. In recent years, it has been used to study the interiors of stars of various masses and in various stages of evolution, using data obtained from ground-based observations and data obtained with the space missions. Very good numerical tools are needed to interpret the high quality photometric data of these space missions; in particular very good stellar evolution and stellar oscillation codes are of the utmost importance. Asteroseismic studies of stars are usually performed assuming that the numerical codes produce exact frequencies; they are then compared to the observed spectra to infer some information about the star, such as its age, mass, effective temperature, surface gravity, depth of the surface convective zone (for solar-type stars), extent of the convective core (for intermediate- and large-mass stars).
However, the physics implemented in numerical codes is not always perfectly known and contains some uncertainties. Here we will look at the effects of using different published values for the nuclear reaction rates, initial compositions, opacity tables, values for the overshooting parameter, prescriptions for the behavior of the overshooting at the convective core boundary, atmosphere models. We assess the effects of the uncertainties in the physics implemented in a stellar evolution code on the stellar evolution tracks and oscillation frequencies, and relate those uncertainties to "theoretical error bars" on the stellar parameters deduced from asteroseismology in the particular case of main sequence B stars.

Contributed Talk

Splinter B

# Asteroseismology of hot B subdwarfs: reaching the 1% accuracy level on stellar mass and radius

V. Van Grootel[1], S. Charpinet[2], G. Fontaine[3], P. Brassard[3], E.M. Green[4], & S.K. Randall[5]

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Hot B subdwarf (sdB) stars are core-helium burning objects with an extremely thin residual H-rich envelope. Asteroseismic modeling of sdB stars provides measurements of their fundamental parameters with a very good precision. In particular, the masses and radii determined from asteroseismology are found to typically reach a precision of 1% containing various uncertainties associated with their inner structure and the underlying microphysics (composition and transition zones profiles, nuclear reaction rates, etc.). I will show by the seismic modeling of the pulsating sdB star in the eclipsing binary PG 1336-018 (for which the mass and the radius are independently and precisely known from the modeling of the reflection/irradiation effect and the eclipses observed in the light curve) that the sdB stellar parameters inferred from asteroseismology are precise, accurate, and robust against model uncertainties.
I will also briefly present our brand new generation of sdB models, which include a much more detailed treatment of the innermost regions (including extra-mixing processes in the He-burning core). Such detailed modeling is necessary to exploit the full potential of the gravity-mode pulsations of the sdB stars observed by the *Kepler* space mission.

Contributed Talk

Splinter B

# Determining Fundamental Stellar Properties with Asteroseismology and Interferometry

T. R. White

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The asteroseismic scaling relations for the frequency of maximum power, $\nu_{\rm max}$, and the large frequency separation, $\Delta\nu$, provide an easy way to directly determine the masses and radii of stars with detected solar-like oscillations. With the vast amount of data available from the CoRoT and Kepler missions, the convenience of the scaling relations has resulted in their wide-spread use. But how valid are the scaling relations when applied to stars substantially different from the Sun, such as F stars and red giants? Verifying the scaling relations empirically requires independent measurements of radius and mass. I report on the latest results of our campaign to directly measure the radii of asteroseismic targets with interferometry to test the scaling relations.
Furthermore, I will discuss our results for HD 185351, believed to be a so-called 'retired' A star, that is, a giant that had been an A-type star on the main sequence. Radial velocity studies of retired A stars have been used to determine the rate of planet occurrence around higher mass stars, something that is difficult to do with fast-rotating main-sequence stars. However, it has been questioned whether the stars used in these radial velocity surveys really have the high masses that have been claimed. Through combining interferometry, asteroseismology and other observational constraints, we have been able to confirm the high mass of HD 185351.

# Abstracts of Contributed Talks

## Splinter C

Contributed Talk

Splinter C

# Cosmic Ray Acceleration and Transport in the Galaxy: H.E.S.S. Observations

W. Domainko

*Max-Planck-Institut für Kernphysik, Heidelberg*

H.E.S.S. has surveyed the Galactic plane in very-high energy (E>100 GeV) gamma rays. During this survey a considerable number of sources in this energy regime have been found. Most of these objects represent cosmic particle accelerators. In this talk selected sources will be reviewed. Furthermore, the transport of cosmic rays from these accelerators to their environment will be discussed.

Contributed Talk

Splinter C

# STEREO observations of solar energetic particle events with wide longitudinal distributions

N. Dresing[1], R. Gómez-Herrero[2], B. Heber[1], A. Klassen[1], O. Malandraki[3], W. Dröge[4], Y. Kartavykh[4]

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[4] *Institut für Theoretische Physik und Astrophysik, University of Würzburg, Germany*

The two STEREO spacecraft perform Earth-like orbits around the Sun with an increasing longitudinal separation to the Earth of  22 degrees per year. A 360 degree view of the Sun was reached in February 2011, providing multi-point in-situ and remote-sensing observations of unprecedented quality. Together with close to Earth observatories, the STEREO spacecraft build an optimal platform to investigate the longitudinal variations of solar energetic particles (SEPs)with minimal radial gradient effects.

While solar activity finally began to rise after the very deep minimum in 2010 to 2011, the STEREO spacecraft had reached a sufficient longitudinal separation to detect and investigate events with large longitudinal spreads. The mechanisms producing these unexpected wide particle distributions are subject to recent research. Comprehensive observations and modeling tools are put forth to disentangle source and transport processes. The efficiency of perpendicular diffusion in the interplanetary medium versus coronal transport, as well as the role of coronal shocks, EUV waves, and CMEs will be discussed.

Contributed Talk

Splinter C

# Transport of Cosmic Rays Near the Heliopause

R.D. Strauss[1], H. Fichtner[2]

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When Voyager 1 supposedly crossed the heliopause, i.e. the outermost boundary of the heliosphere, the spacecraft observed charged particle intensities that for both heliospheric ('anomalous') and galactic cosmic rays, exhibited significant anisotropies. Beyond the heliopause, the anomalous cosmic ray intensity peaked at a pitch-angle of 90°, while it was a minimum there for galactic particles. These anisotropies might reflect the pitch-angle dependence of the perpendicular diffusion coefficient: if this dependence is chosen appropriately, the observed anisotropies can be reproduced (at least qualitatively) very naturally. If true, this explanation is providing a valuable constraint for the theory of perpendicular diffusion.

Contributed Talk

Splinter C

# New theoretical perspectives on astrophysical plasma turbulence

Frank Jenko[1,2]

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As is widely appreciated, astrophysical plasma turbulence exhibits certain similarities but also striking differences with respect to Navier-Stokes fluid turbulence. Among the new features are the presence of wave dynamics, kinetic dissipation processes, particle acceleration, and small-scale reconnection. Some novel insights on the nature and role of such effects will be discussed, together with applications to the solar wind and other systems.

Contributed Talk

Splinter C

## Energetic Particle Transport in Space Plasmas: Theory and Modeling

T. Laitinen

*Jeremiah Horrocks Institute, University of Central Lancashire, UK*

Charged particles are accelerated up to relativistic energies in high-energy events from small-scale flares at the Sun to supernova remnant shock waves and other energetic astrophysical phenomena. These Cosmic Rays propagate in turbulent plasmas of the intergalactic, interstellar and heliospheric plasmas, to be observed with in-situ instruments in spacecraft and neutron monitors on Earth. To understand the sources and evolution of Cosmic Ray fluxes, we need to understand how they interact with the plasma turbulence. In this talk, we review the current understanding of Cosmic Ray transport in turbulent plasmas. We will present recent developments in theory and simulations, and discuss the current challenges.

Contributed Talk

Splinter C

# Wave-Particle-Interaction in Kinetic Simulations

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The transport of energetic particles in the solar wind is governed by the interaction of these particles with magnetic irregularities. One of the dominant processes is the resonant scattering of relativistic protons and low frequency plasma waves, such as Alfvén waves, which drives both diffusion and acceleration of the particles.
Due to the non-linearity of the interaction of electro-magnetic fields and charged particles in the plasma, a test particle approach is often employed to study the whole system. This method allows performing computer simulations using magneto-hydrodynamic (MHD) models for the background plasma and a kinetic description for a small number of test particles. In this case, the trajectories of test particles can be traced to gain understanding of scattering processes. Analytical expressions to describe pitch angle diffusion can be found via quasi-linear Vlasov theory (QLT), but these results only hold for a limited range of parameters.
A different approach is possible by using particle-in-cell (PiC) codes, which are able to describe background plasma and energetic (test) particles self-consistently. For validation, we have reproduced results from MHD simulations using our PiC code *ACRONYM* and compared our findings to QLT predictions for pitch angle diffusion. Although computationally expensive, the PiC method offers new insights into resonant scattering processes, since the interaction of protons and waves in a wide range of frequencies can be probed. We are able to show resonant pitch angle scattering with waves in the dispersive regimes of the parallel propagating L- and R-modes, where the MHD method is no longer applicable and the QLT description becomes incomplete.

Highlight

Splinter C

# Anomalous Transport

G. Zimbardo[1]

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The transport of particles in astrophysical plasmas can be anomalous in the sense that the mean square displacement can grow either sublinearly of superlinearly with time. This is possible when the underlying random walk is characterized by either long memory effects or long range correlations, or both. I will present the results of numerical simulations of particle transport in the presence of magnetic turbulence which exhibit both superdiffusion and subdiffusion, and discuss the turbulence parameters which correspond to those anomalous regimes. Then I will show how information on anomalous transport can be obtained from the analysis of in situ spacecraft data. The influence of anomalous transport on solar energetic particle propagation and on diffusive shock acceleration will also be discussed, and examples as the solar wind termination shock and electron acceleration at supernova remnant shocks will be considered.

# Abstracts of Contributed Talks

## Splinter D

Contributed Talk

Splinter D

## Magellanic Clouds Massive Stars and Feedback Survey Spotlight on variables

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As part of our Magellanic Clouds Massive Stars and Feedback Survey (MCSF) we imaged the Small Magellanic Cloud (SMC) on 7 occasions between summer 2009 and winter 2010 in B, R and H$\alpha$. Two additional observations in summer 2011 give us access to variations on longer timescales. For the Large Magellanic Cloud (LMC) the observations were limited to a single visit per year but in return with a full spatial coverage of 64 square degrees.

With the full spatial coverage of the Magellanic Clouds we are able to study the variabilities of a nearly complete census of the massive stars in the Magellanic Clouds, e.g., the variations of the blue and red supergiants in the SMC. The additional H$\alpha$ photometry will also give us information about changes in the emission line intensity for a large sample of Be/Oe.

The survey has been designed to obtain high quality photometry of even the brightest stars in both galaxies. We therefore included images with short exposure times which will allow us to add additional data points to the current giant eruption of the LMC LBV R 71 as well as to generally study the variability of the LBVs and Alpha Cygni variables (e.g. RMC 40) on timescales of months. Combined with the databases of OGLE, ASAS and Pi of the Sky, as well as several ongoing digitalizations of historic photographic plates, the resulting light curves can be analyzed over the last decades and even up to more than a century.

Contributed Talk

Splinter D

# Discovery of an OB Runaway Star inside SNR S147

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We present first results of a long term study: Searching for OB–type runaway stars inside supernova remnants (SNRs). We identified spectral types and measured radial velocities (RV) by optical spectroscopic observations and we found an OB runaway star inside SNR S147. HD 37424 is a B0.3V type star with a peculiar velocity of 74.0±8 km s$^{-1}$. Tracing back the past trajectories via Monte Carlo simulations, we found that HD 37424 was located at the same position as the central source PSR J0538+2817 30±4 kyr ago. This position is only ∼4 arcmin away from the geometrical center of the SNR. So, we suggest that HD 37424 was the presupernova binary companion to the progenitor of the pulsar and the SNR. We found a distance of $1333^{+103}_{-112}$ pc to the SNR. The age is 30±4 kyr and the total visual extinction towards the center is 1.28±0.06 mag. The zero age main sequence progenitor mass should be greater than 13 $M_\odot$. We calculated the presupernova binary parameters for different progenitor masses. The values found for the Roche Lobe radii suggest that it was an interacting binary in the late stages of the progenitor.

Contributed Talk

Splinter D

## SXP 1062: A slowly rotating pulsar of the SMC

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Neutron stars (NSs) are the end products of the evolution of massive stars ($\geq 8\,\mathrm{M}_{\odot}$) after its explosion as a Supernova (SN). The majority of massive stars are born in binary systems. However, only a small fraction ($\sim 10\,\%$) survive to this SN explosion leaving a normal star and a compact object in a binary system. At some point during binary evolution, the compact object will accrete matter from its companion becoming a High Mass X-ray Binary (HMXB). Most of HMXBs consist of a NS and a Be-type star, objects so-called Be X-ray binaries (BeXs). The wind and disc of the Be star feed the NS making it an X-ray pulsar, i.e., a rotating NS emitting X-ray radiation modulated by its spin period, $P_{\mathrm{SPIN}}$. SXP 1062 is a BeX discovered in April-March 2010 with XMM-Newton and Chandra. This is located in the wing of the Small Magellanic Cloud (SMC). The X-ray pulsar had a $P_{\mathrm{SPIN}} = 1062\,\mathrm{s}$, and a period derivative $\dot{P} \sim 100\,\mathrm{s\,yr^{-1}}$ being one of the slowest rotating X-ray pulsars of the SMC. Moreover, this is the first BeX firmly associated with a SN Remnant.
Following the canonical model, $P_{\mathrm{SPIN}} > 1000\,\mathrm{s}$ can be achieved only if $B > 10^{14}\,\mathrm{G}$ or $\dot{M} < 10^{12}\,\mathrm{g\,s^{-1}}$. Therefore, some authors have proposed SXP 1062 to be a magnetar to explain both, its large spin period and the high spin period derivative. However, the new accretion scenario known as "Quasi-spherical accretion" allows long $P_{\mathrm{SPIN}}$ and high period derivatives even for standard magnetic fields. This model predicts specific correlations between the spin period derivative and the X-ray luminosity.
We present preliminary results of Chandra, Swift and XMM-Newton observations where we try to explain the binary evolution and behavior of this peculiar X-ray pulsar.

Contributed Talk

Splinter D

# WN stars in the Magellanic Clouds

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Detailed and comprehensive studies of the WN stars in the Small Magellanic Cloud (SMC) and the Large Magellanic Cloud (LMC) are presented, using optical spectra as well as UV spectra if available. We derived the fundamental stellar and wind parameters for more than 100 massive stars, encompassing almost the whole WN population in the Magellanic Clouds (MCs). The obtained physical properties are free from uncertainties inferred from unsure distances, due to the well known distances to the MCs. The observations are fitted with synthetic spectra, using the Potsdam Wolf-Rayet model atmosphere code (PoWR). For this purpose, large grids of line-blanket models for different hydrogen abundances have been calculated, covering a wide range of stellar temperatures and mass-loss rates. Since the samples are nearly complete, we can perform a statistical study of the WN properties in the MCs without selection bias. Current stellar evolution tracks, even when accounting for rotationally induced mixing, still partly fail to reproduce the observed ranges of luminosities and initial masses. Moreover, stellar radii are generally larger and effective temperatures correspondingly lower than predicted from stellar evolution models because of subphotospheric inflation. To investigate the impact of the low LMC metallicity and the even lower SMC metallicity, we compare our new results to our previous analysis of the Galactic WN population.

Contributed Talk

Splinter D

# The winds of hot stars

W.-R. Hamann, A. Sander, R. Hainich, H. Todt, M. Steinke, L.M. Oskinova

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Stellar winds are ubiquitous in hot stars. Wolf-Rayet stars are known to have strongest winds which dominate the formation of their whole spectra. The spectra of (massive) O- and B-type stars indicate less strong mass loss. Stellar winds are also found in hot low-mass stars, especially in hydrogen-deficient central stars of planetary nebulae.

Quantitative spectral analyses of stars with winds require adequate atmospheric models. The Potsdam Wolf-Rayet (PoWR) code solves the non-LTE radiative transfer in the photosphere and wind, accounting for complex model atoms and iron line blanketing. Initially designed for Wolf-Rayet type models, the code is applicable for all kinds of hot stars. Pressure broadening can be taken into account, as well as the detailed influence of radiation pressure on the density stratification of the hydrostatic layers, or rotational broadening.

PoWR models have been extensively applied for analyzing Wolf-Rayet stars in the Galaxy, the Magellanic Clouds, or M31. The empirical Hertzsprung-Russell diagrams are partly in contradiction to theoretical tracks of massive-star evolution. Empirical mass-loss rates are important input parameters for calculating such tracks. The precise determination of mass-loss rates suffers from the effects of wind inhomogeneities (“clumping”).

Self-consistent hydrodynamic modeling of radiation-driven stellar winds works best for OB-type supergiants. Wolf-Rayet winds require the effects of multiple scattering. Main-sequence stars, at the other extreme, tend to have weaker winds than theoretically expected (“weak-wind problem”).

Hot stars emit X-rays, whose origin is debated. The analysis of high-resolution X-ray spectra allows to constrain the location of their formation.

Hot stars eject lots of radiation, material, and kinetic energy. This feedback governs the evolution of circumstellar nebulae, clusters, and galaxies.

Contributed Talk

Splinter D

# Impact of different Balmer line Stark broadening theories on the spectroscopic parameter determination in early-type stars

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The wings of the Balmer lines are the principal spectral indicator for the surface gravity in early-type stars and therefore dominate the determination of atmospheric and thus also stellar parameters. A comprehensive study of the impact of different Balmer line broadening theories on spectroscopic analyses is desirable because it would allow the respective systematic uncertainties to be quantified. For 63 mid B-type to late O-type stars, the deviation in atmospheric parameters caused by using synthetic Balmer lines based on two different broadening theories and tables is investigated. We consider the unified theory (VCS tables, Vidal et al. 1973) and the Model Microfield Method (SH tables, Stehlé & Hutcheon 1999). In order to determine if one set of tables is favored compared to the other, we derive the atmospheric parameters with both sets and apply four evaluation criteria, (i) the quality of spectral fits, (ii) the consistency of the derived evolutionary status, (iii) the comparison of derived spectroscopic distances to Hipparcos parallaxes, (iv) one eclipsing, double-lined binary as benchmark. Effective temperatures and surface gravities differ systematically as well as significantly. The values obtained by using the SH tables exceed their VCS counterparts by 0.7–1.7% and 0.11–0.16 dex, respectively. We also inspected the derived chemical composition and find no significant differences. The evaluation criteria remain inconclusive as to which theory to favor because roughly one half of the test sample would be better represented by VCS, the other half by SH.

Contributed Talk

Splinter D

# Eta Carinae in 3D

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Understanding the evolution of massive stars is critically dependant on the short transitional stages, such as the Luminous Blue Variable (LBV) Phase. As massive stars are responsible for many of the heavy elements and the enrichment of the interstellar medium, a full understanding is necessary to comprehend the evolution of galaxies. We present here an analysis of the composition of the circumstellar material of Eta Carinae with special regards to the N to H ratio, as well as the kinematic structure in the fields for which integral field spectroscopy (IFS) data was available. For this analysis we are utilizing optical imaging as well as IFS data of Eta Carinae and its surroundings. The imaging data were taken in the H$\alpha$, [O I] and [S II] filters with different velocity offsets with the FORS1 instrument at the VLT, while the spectroscopic data with a spectral range of 638,3 nm to 662,6 nm and a spectral resolution of $R = 46000$ was acquired during the commissioning of the ARGUS unit of the FLAMES spectrograph at the VLT. For this first detailed analysis of IFS data of Eta Carinae, we have developed a Python-based solution for the data reduction which produces velocity maps and [N II]/H$\alpha$-ratio maps as the end result. These maps allowed us to study the ejecta in previously unachieved detail with high spatial and velocity resolution, and aided in the discovery of new, previously undetected components in the surroundings of Eta Carinae. This data also permits connecting the components of the ejecta to the light curve of Eta Carinae by calculating the time of ejection from the measured velocities, and will therefore contribute to the understanding of the evolution of massive stars.

Contributed Talk

Splinter D

# Spectral decomposition of hot subdwarf binaries

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*Dr. Karl Remeis-Sternwarte, Bamberg*

We present a spectroscopic analysis of binary stars consisting of a hot subdwarf and a G/F-type main-sequence companion using data provided by the SDSS and BOSS spectrographs. The usage of standard stellar spectra from the MILES and CAT libraries as well as spectra of well known hot subdwarfs allows us to decompose the spectrum of the binary system and hence find the contribution of each star to the combined flux. In order to obtain the best fitting combination of parameters of both stars we use a standard $\chi^2$ fitting routine. The analysis reveals $T_{eff}$, log g and the metal abundance for each single star. The long-term goals are to study technical possibilities in the spectroscopy of multiple-star systems and the development of a fast method for their decomposition.

Contributed Talk

Splinter D

# HD 188112, a He-core white dwarf in a binary system, pre-SN Ia candidate ?

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HD 188112 is a bright (V=10.2) and nearby star (∼80 pc, Hipparcos parallax) that is found below the Extreme Horizontal Branch in the log $g$ - $T_{\mathrm{eff}}$ plane (21 500 K, log $g = 5.6$). The spectroscopic parameters, combined with the Hipparcos parallax measurement lead to a mass of 0.24 $M_{\odot}$ for the star, too low to sustain helium-core burning. The star is part of a binary system with an orbital period of $\sim$ 14.5 hr and a semi-amplitude of 188 km/s, setting a lower limit for the mass of HD188112 unseen companion to 0.73 $M_{\odot}$. If the total mass of the system is high enough, it would qualify as a pre-supernovae Ia candidate. I will present preliminary results from the analysis of the STIS FUV and NUV spectra of HD 188112 as well as our updated velocity curve. The $v\sin(i)$ broadening of metallic lines was determined with the sharp UV metallic lines, giving us a more precise determination of the companion mass. We also measured abundances for a few metallic species, including Mg, Si and Fe.

Contributed Talk

Splinter D

# Post-AGB evolution of low- and intermediate-mass stars. Preliminary Results

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We present preliminary results from an ongoing project aimed at computing grids of models for post-AGB stars and CSPN for different stellar populations. These grids of models are a necessary input for a wide range of studies, e.g. radiation driven wind simulations of PN, determination of the masses of the central stars, to determine the stellar evolution history of a given central star and many more. We will discuss the progress made and compare the results with old sequences and discuss possible consequences.

Contributed Talk

Splinter D

# Self-consistent studies of line-driven hot-star winds with Monte Carlo radiation hydrodynamics

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In the study of radiatively-launched mass outflows, Monte Carlo radiative transfer techniques have a long and successful history (e.g. Abbott & Lucy 1985, Lucy & Abbott 1993, Vink et al. 1999, Long & Knigge 2002, Noebauer et al. 2010). In particular, Monte Carlo techniques are ideal for modelling and studying line-driven hot-star winds due to the ease with which complex microphysics such as a multitude of atomic line interactions or the multiple scattering phenomenon (e.g. Vink et al. 2000) may be treated. We have taken a step beyond pure radiative transfer calculations by interfacing a Monte Carlo radiative transfer scheme with a finite-volume hydrodynamical method to assemble a new approach to astrophysical radiation hydrodynamical problems (Noebauer et al. 2012). This technique, which builds upon the indivisible packet approach and on the volume-based Monte Carlo estimator strategy of Lucy 1999, 2002, 2005 is ideally suited to tackle the line-driving problem and determine the structure of hot-star winds self-consistently.
I will give an overview of our numerical radiation hydrodynamical algorithm, particularly highlighting its utility for the line-driven mass outflow environment. I will present first one-dimensional radiation hydrodynamical calculations of hot-star winds and compare them with the CAK (Castor et al. 1975) and the modified-CAK approach (Pauldrach et al. 1986). Finally, I will discuss the potential of our approach for multidimensional studies of irregular, clumpy hot-star winds and of outflows from accretion discs.

Contributed Talk

Splinter D

## X-ray emission from massive stars

Lidia M. Oskinova

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X-ray observations of hot stars obtained during the last decade improved our understanding of these objects and brought up unexpected findings. These discoveries highlight the importance of stellar magnetic fields, wind structuring, and binarity. However many fundamental questions about the high-energy processes in massive star remain unanswered. High-resolution spectroscopy, time monitoring, and imaging in X-rays are needed to study stellar winds and their impact on galactic ecology. In this meeting, the most important progress in the X-ray studies of Wolf-Rayet, LBV, O, B, and A-type stars and massive star clusters will be reviewed and the opportunities presented by new facilities will be discussed.

Contributed Talk

Splinter D

## Fate and compact remnants of massive single and binary stars

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We investigate the evolution of massive single stars and stars that are a member of a binary system and aim at describing a correlation between the ZAMS masses and the final fate, i. e. neutron star or black hole, of the stars. Stars in close binary systems are assumed to lose their hydrogen rich envelope due to Roche lobe overflow or a common envelope phase after core hydrogen burning and, by omitting details of the interaction process and parameters of the binary system, are mimicked in this work by pure He stars. The evolution of the binary stars is followed both with and without wind mass loss, while the latter one is motivated by modelling low metallicity environments. We analyze the final masses of the iron cores and determine their most likely fate in terms of a single parameter that illustrates the progenitor compactness at the pre-supernova stage as introduced by O'Connor & Ott (2011). We find that the type of central carbon burning, convective up to 21 $M_\odot$ and radiative for stars with higher masses, correlates both with the structure and the remnant mass. However, additional, yet uncertain, effects set in for stars heavier than 30 $M_\odot$ as the distribution relating ZAMS masses and compactness parameters becomes more erratic. For single stars, the compactness parameter indicates that the formation of neutron stars is the most likely fate for stars with ZAMS masses between 16-21 $M_\odot$ and between 31 to 38 $M_\odot$. He stars, with He main sequence masses between 4 to 21 $M_\odot$, without wind mass loss end their lives as neutron-stars, only for the largest objects, with masses above 18 $M_\odot$, black hole formation becomes possible. Those He stars that lose substantial amounts of mass during core helium burning are expected to leave a neutron star remnant over the mass range considered here.

Contributed Talk

Splinter D

# The Evolutionary Status of Galactic BA-type Supergiants

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Massive OB-type stars in the mass range of about 8 to 30 $M_\odot$ cross the Hertzsprung-Russell diagram (HRD) during their post main-sequence evolution. They become the visually brightest normal stars in star-forming galaxies during the BA-type supergiant phase. This makes BA-type supergiants favourable objects for quantitative spectroscopy with large ground-based telescopes in galaxies out to distances beyond the Local Group. Yet, it is not clear which evolutionary stage they represent. In principle, three scenarios are possible: i) they may have evolved directly from the main sequence, i.e. they are on the first crossing of the HRD from blue to red, ii) they can be highly evolved objects close to core He-burning termination after a previous red supergiant stage, or iii) for masses below $\sim$10 $M_\odot$ they can be on a blue loop.
We discuss observational constraints on the evolutionary status of a sample of 35 Galactic BA-type supergiants. High-resolution spectra with high-S/N ratio have been analysed using a hybrid non-LTE analysis technique, providing atmospheric and fundamental stellar properties, as well as surface abundances. The derived CNO abundances follow tightly the nuclear path predicted by simple analytical considerations as well as by state-of-the-art stellar evolution models. Implications on the evolutionary status in view of several contemporary grids of evolution models for massive stars (from the Geneva, Bonn and Rome groups) are drawn.

Contributed Talk

Splinter D

# The enigmatic hot subdwarf B pulsator LS IV-14°116

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The formation of hot subdwarfs is shrouded in mystery. While it is commonly accepted that they are compact, evolved, Extreme Horizontal Branch stars that lost too much of their H-envelope before or at the He-flash to sustain H-shell burning, the details of their evolution and in particular the cause of the extreme mass loss remain unclear. Given the diversity of observed properties among hot subdwarfs, it is likely that different types of hot subdwarf have different evolutionary histories, which may also vary according to the environment they are found in (e.g. Galactic field, globular clusters).
All subdwarf B (sdB) stars studied so far are chemically peculiar. The majority of field sdBs show spectra dominated by Hydrogen, with small amounts of Helium and heavier elements. A smaller number show spectra with significant amounts of Helium. These objects in particular are challenging to explain, since diffusion processes in these very compact stars should drain the atmospheres of all but trace amounts of heavier elements on a timescale much shorter than their lifetime.
LS IV-14°116 is an intermediate Helium-rich sdB exhibiting a very strange abundance pattern with Ge, Sr, Y and Zr enhanced by factors of up to 10,000 compared to Solar. It is also the only He-sdB known to pulsate. In contrast to the two types of H-rich sdB pulsators known, the pulsations observed in LS IV-14°116 cannot be explained in a satisfactory way by current models, and the origin of the instabilities remains unclear. One idea brought forward to explain the strange atmospheric abundances was a strong magnetic field, which would also influence the pulsation driving (as is the case e.g. for roAp stars).
Here, we present new FORS spectro-polarimetry observations of LS IV-14°116 and attempt to shed some light on the unusual properties of this star.

Contributed Talk

Splinter D

# Hot H-deficient (pre-) White Dwarfs

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We report on the identification of a large number of hot, hydrogen-deficient white dwarfs in the Sloan Digital Sky Survey Data Release 10. We present the results of a NLTE spectral analysis and review the formation channels for these objects. We also present preliminary results of the study of their Galactic distribution.

Contributed Talk

Splinter D

## Hydrodynamic modelling of massive star atmospheres

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Since 30 years the theory of radiatively driven winds by Castor, Abbott, and Klein (CAK theory) and its extensions have been successfully applied to O and B star winds. For Wolf-Rayet stars with their stronger winds however, the CAK predictions turn out not to be adequate because multiple scattering of photons is not accounted for. With the help of stellar atmosphere models such as the Potsdam Wolf-Rayet model code (PoWR) we are able to calculate the full radiative force without often used approximations (e.g. Sobolev). With that being given, we can iteratively solve hydrodynamic equation throughout the stellar atmosphere and obtain a consistent wind velocity field. The results of this hydrodynamically consistent method, which is valid for both, OB and WR stars, are compared to the classical beta-law approach. The differences in the emergent spectra are discussed.

Contributed Talk

Splinter D

# HD 271791: nucleosynthesis in a core collapse supernova

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Some young, massive stars can be found in the Galactic halo. As star formation does not occur in the halo, they must have been formed in the disk and been ejected shortly afterwards. There are several scenarios for the origin of such objects. One explanation is a supernova in a binary system. The companion is ejected and becomes a runaway star. HD 271791 is the kinematically most extreme runaway star known (galacic restframe velocity 725 +- 195 km/s). Moreover, an analysis of the optical spectrum showed an enhancement of the alpha elements. This indicates an origin in a supernova. As such high velocities are not reached in classical binary supernova scenarii, a very massive but compact primary, probably of Wolf-Rayet type is required. The star is a perfect candidate for studying nucleosynthesis in a core collapse supernova because of the contamination of its surface layers with supernova ejecta of its former very massive primary. The goal of this project is to determine the abundances of a large number of elements from the alpha process, the iron group, and heavier elements by a quantitative spectral analysis of the optical and the UV with detailed stellar atmosphere models taking into account deviations from the local thermal equilibrium (NLTE). We intent to verify whether core collapse supernova are a site of the r-process element production. The first step was to include all atomic data available for this elements in the UV spectrum synthesis. Now we are able to determine abundances of iron group and heavier elements from the UV, at the moment in LTE later also in NLTE. The abundance analysis is done differential with bright B type comparison stars. Here we want to state the current status of the project.

Contributed Talk

Splinter D

# A new HW Vir Binary from the Palomar Transient Factory

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Hot Subdwarf B stars are core helium-burning stars with thin hydrogen envelopes which can be found on the extreme horizontal branch and dominate the population of faint blue stars in the Milky Way. Their formation mechanism is still not completely understood. About half of the known sdBs reside in close binary systems, the others appear to be single. Eclipsing binaries are of utmost importance because fundamental stellar parameters can be derived.
Here, we report the discovery of an eclipsing binary - PTF1J072456+125301- being an sdB ($V = 17.2^m$) star with a faint, low-mass companion. Up to now, only very few of these so called HW Vir systems have been found.
We conducted an analysis of photometric data derived from the Palomar Transient Factory (PTF), supplemented by time-resolved spectroscopy at the Palomar Observatory.
From the light curve, the orbital period of 0.09977 d and the inclination of the system of 83.56° is derived. From the radial velocity curve, we determine a semi-amplitude of $K_1 = (101.25 \pm 3.2)$ km s$^{-1}$. The resulting sdB-mass is 0.526 $\mathrm{M}_{sol}$, close to the canonical mass for a star of that type. The companion only contributes to the optical light of the system through a distinct reflection effect. Its mass is about 0.174 $M_{sol}$. From the analysis of blue spectra, we found an effective temperature $T_{eff}$=33900 K, log g=5.75 and $\log(n_{He}/n_H)$=-2.02 for the primary.

Contributed Talk

Splinter D

# A comprehensive X-ray, light curve, and non-LTE wind analysis of the massive multiple system delta Ori A

T. Shenar[1], L. Oskinova[1], W.-R. Hamann[1], M.F. Corcoran[2]
and the Delta Ori collaboration

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There is mounting evidence in recent decades that the majority of massive stars are born in close binary or multiple systems. Due to their mutual interaction, components of close multiple systems evolve differently than single stars. At the same time, binary systems provide the unique opportunity for an accurate determination of stellar parameters and a detailed investigation of stellar winds. To constrain binary evolution models, it is essential to fully exploit the large amount of data which can be obtained from neighboring multiple systems. We present a comprehensive light curve, X-ray and non-LTE wind analysis of the massive multiple system delta Ori A, comprising a close, partially eclipsing OB binary system, and a more distant OB type tertiary. Delta Ori A one of the closest eclipsing systems, and thus allows for high resolution spectroscopy in all spectral domains, and in particular a detailed investigation of variability in X-ray spectra, highly resolved in frequency and orbital phase. The non-LTE analysis of the three stellar components is performed with the state-of-the-art model atmosphere code PoWR. The obtained spectroscopic stellar parameters are compared to those obtained from the light curve analysis. This study, performed over various spectral ranges using independent methods, allows for a determination of the stellar and orbital parameters of the system with an unprecedented accuracy, and provides crucial insights on stellar winds, the role and formation mechanisms of X-rays in massive stars, and stellar evolution in binary and multiple systems.

Contributed Talk

Splinter D

# The LBV nebula of He 3-519 – smooth and spherical ?

Kerstin Weis

*Astronomisches Institut, Ruhr-Universität Bochum*

He 3-519 is one of roughly a dozen well known LBVs in our Galaxy. The LBV phase is a transitional state massive stars may pass while evolving from main-sequence to Wolf-Rayet stars. LBVs show a photometric as well as spectroscopic variability, shifting between a hotter and cooler phase with a few years. During their cool state LBVs are close to the Humphreys-Davidson limit (or analog the Eddigton / Omega-Gamma stability limit). LBVs show stronger stellar winds with a high mass loss rate and in some cases even have spontaneous giant eruptions. As a consequence of both (winds and/or giant eruptions) LBVs form small ($< 5$ pc) gaseous circumstellar nebulae.
He 3-519 is one of the few nearly spherical/elliptical galactic LBV nebulae of which nearly 70% are bipolar. High-resolution long slit echelle observations and HST images indicate however that the nebulae show small spatial and kinematic deviations from a really perfect sphere. A morphologic and kinematic analysis of the nebulae around He 3-519 will be presented and comparison to photometric data of the central star. Last but not least the results will be put into context with the other bipolar galactic nebulae.

Contributed Talk

Splinter D

# Nature and Origin of Hypervelocity Stars

E. Ziegerer[1], U. Heber[1], S. Geier[2], A. Irrgang[1], C. Heuser[1], S. Kreuzer[1], M. Volkert[1]

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Hypervelocity stars (HVS) move so fast that they are unbound to the Galaxy. The spatial and velocity distribution of HVSs provides significant constraints on the shape and density distribution of the Galactic dark matter halo. When they were first discovered in 2005, dynamical ejection from the super massive black hole in the Galactic Centre (GC) was suggested as their origin. However, this theory is still not proven by observations. In fact, in some cases proper motion measurements exclude an origin in the GC. Most of the known HVSs are of late B spectral type. Therefore, the major problem is that the evolutionary state of most HVS candidates is still ambigious - either they are distant (intrinsically bright) massive main sequence stars (MS) with short lifetimes or closer (intrinsically faint) low mass blue horizontal branch stars (BHB), sufficiantly long-lived to have travelled from the GC. This degeneracy occurs from the coincidence that the main sequence and horizontal branch overlap at the particular temperature of late B type stars of about 10000K. Hence, we lack crucial information on their estimated distances which is the most important parameter for an analysis of their kinematics. In order to reveal the true nature of these stars, a spectroscopic and photometric analysis needs to be performed yielding the atmospheric parameters and - together with a comparison to theoretic evolutionary models - the evolutionary state and therefore the distance. The full 6D phase space information can be achieved when also their spectroscopic radial velocity and proper motion are known.

# Abstracts of Contributed Talks

## Splinter E

Contributed Talk

Splinter E

# GRB Analyses by ESA Gaia and Astronomical Photographic Databases

R. Hudec[1,2]

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[2] *Czech Technical University in Prague, Prague, Czech Republic*

I will briefly discus the potential of ESA satellite Gaia and astronomical photographic databases for study of GRBs. Apart from photometry with both databases, the additional potential for GRB analysis is offered by low dispersion spectroscopy provided by Gaia BP and RP photometers (but in fact ultra–low dispersive spectrographs) as well as by low–dispersion photographic surveys. The wide–field low–dispersion spectroscopy offers unique GRB investigations such as detection and study of highly redshifted triggers.

Contributed Talk

Splinter E

# GRB 111209A: The longest GRB, the most luminous GRB-SN

D. A. Kann[1] on behalf of the GROND group

[1] *Thüringer Landessternwarte Tautenburg*

GRB 111209A is the longest Gamma-Ray Burst (GRB) ever detected, with a total duration of $\approx 25$ ks. Extensive follow-up with the seven-channel GROND instrument reveals a highly variable afterglow light curve that transitions into an UV-luminous supernova (SN). This SN is found to be more luminous and bluer than any GRB-SN discovered so far. Spectroscopy shows it resembles the spectra of super-luminous SNe more than the typical broad-lined Type Ic SNe. I will also compare the properties of the SN with larger samples.

Contributed Talk

Splinter E

# The host galaxy of the short burst GRB 100628A: a nearby star-forming spiral or a more remote giant elliptical?

A. Nicuesa Guelbenzu[1], S. Klose[1], E. Palazzi[2], J. Greiner[3], M. J. Michałowski[4], on behalf of a larger collaboration

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GRBs are divided into long and short with the borderline at 2 seconds. Observational evidence and theoretical models have shown that long bursts are due to the collapse of very massive stars. On the other hand, the origin of a short GRB might be related to the merger of two compact stellar objects, two neutron stars or a neutron star and a black hole. The first optical afterglow of a short GRB was discovered in May 2005. Since then, despite substantial observational efforts, by August 2014 only about 25 redshifts are securely known for the short-GRB population.
In this talk I report on the results of a comprehensive observing campaign to reveal the birthplace of the short GRB 100628A. The burst had a duration of $0.036 \pm 0.009$ s and was followed by a faint X-ray afterglow. No optical afterglow was discovered, only its seven arcsec wide (radius) X-ray error circle is known. We used the multi-color imager GROND at ESO/La Silla, ESO/VLT spectroscopy and ATCA radio-continuum observations to search for its potential host galaxy.

Contributed Talk

Splinter E

# Properties and Progenitors of Supernovae associated with long Gamma-Ray Bursts

E. Pian[1,2]

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[2] *Scuola Normale Superiore di Pisa, Italy*

Bright core-collapse supernovae are often found accompanying long GRBs, and the best studied ones all belong to the most envelope-stripped variety (Type Ic). Their kinetic energies cover a wide range, but they can reach the largest values ever measured for Type Ic supernovae (few times $10^{52}$ erg). These numbers are tantalizingly similar to the rotational energy of a millisecond solar mass neutron star, encouraging a magnetar scenario. Whether a collapse to a black hole is still possible is matter of observational research. I will review some of the latest pieces of progress in this field.

Contributed Talk

Splinter E

# Two recent GRB supernovae observed with GROND and VLT

S. Schmidl[1], S. Klose[1], A. Nicuesa Guelbenzu[1], D.A. Kann[1], J. Greiner[2], T. Krühler[3], F. Olivares E.[4], on behalf of the GROND team and J. Fynbo[5]

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Long GRBs at low redshift ($z < 1$) can be accompanied by an observable type Ic Supernova. In the Swift era (2005+) typically 1-2 GRB-SNe are spectroscopically confirmed per year, resulting in a total sample size of only about 15 events so far.
Here I report about 2 recent GRB Supernovae (GRB 120714B at z= 0.40, GRB 130831A at z = 0.48), which were followed-up by GROND at the 2.2m telescope on La Silla and were spectroscopically confirmed with the VLT by our team. I discuss the light curves from the first hours up to several months after the burst in all 7 GROND bands (g'r'i'z'JHK). In addition, I present the results obtained from our VLT spectra around the time of the corresponding SN peak.

Contributed Talk

Splinter E

# X-ray absorption excess in GRB afterglow spectrum: Absorption by turbulent ISM

M. Tanga, P. Schady

*MPE Garching*

With increasing sample of long duration gamma-ray bursts (GRBs) it has been observed that the column densities of gas inferred from UV/optical/NIR spectra and that from soft X-ray spectra often differ by an order of magnitude, with the later being higher. GRB host galaxies contain large column densities of neutral gas and a fraction are damped Lyman-$\alpha$ systems (DLAs) or sub-DLAs. Absorption features due to low ionised species such as $Zn_{II}$, $Fe_{II}$, $S_{II}$, $Si_{II}$ and highly ionised species such as $C_{IV}$, $N_V$ and $O_{VI}$ are regularly seen in the GRB UV/optical afterglow spectra. Soft X-rays probe the total gas column densities and ultra-highly ionised species such as $C_V$, $N_{VI}$ and $O_{VII}$ are thought to be the primary absorbers. The hot gas resides within the circumburst medium, GRB host inter-stellar medium (ISM) and extragalactic systems. We aim to estimate the column densities of neutral & ionised gas within the GRB host ISM.
GRB redshift distribution as observed by *Swift* peaks at $z \sim 2$ and ISM of starbust galaxies at $z > 2$ is known to be multiphase & turbulent. Since GRBs are associated with massive stars, supernovae (SN), trace star formation and high SN rate the ISM of the GRB hosts is likely to be turbulent. $C_{IV}$, $N_V$ and $O_{VI}$ ions cannot be produced in the ISM by photoionisation and can only be formed due to collisional ionisaiton (CIE) when ISM is in equilibrium.
We consider data cubes obtained from simulations of multiphase & turbulent ISM driven by SN with gas under CIE conditions, pass random line of sight through them and estimate the column densities of the neutral & ionised C, N and O and compare with those observed within GRB host ISM.
A complete understanding of the GRB afterglow spectrum and its absorption features shall progress the study of GRB hosts, shed light on the circumburst environment and possibly establish GRBs as cosmological probes.

Contributed Talk

Splinter E

## Gamma-ray burst afterglow jet dynamics

Hendrik van Eerten

*Alexander von Humboldt Fellow, MPE Garching*

Gamma-ray bursts are the brightest explosions in the universe, resulting from massive star collapse or neutron star mergers. Gamma-ray burst afterglows are produced ranging from X-rays to radio by non-thermal emission from a relativistic blast wave interacting with the environment surrounding the burster. The dynamics of these afterglow jets can be understood theoretically using large-scale relativistic hydrodynamics simulations. Advances in our understanding of complex afterglow dynamics, such as sideways jet spreading and forward-shock / reverse-shock systems, allow for a direct comparison between physical models and broadband afterglow data. Because simulation-derived power law emission spectrum templates are scale-invariant, iterative fitting of high-resolution numerical simulations is possible. In this talk I describe the effects both of energy injection into the blast wave and of lateral spreading on the afterglow light curve.

Contributed Talk

Splinter E

# Synchrotron Cooling in the Hardest Gamma-Ray Bursts Observed by the *Fermi* Gamma-Ray Burst Monitor

H.-F. Yu[1,2], J. Greiner[1,2], H. van Eerten[1], J. M. Burgess[3,4], et al.

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[4] *Department of Physics, KTH Royal Institute of Technology, AlbaNova, SE-106 91 Stockholm, Sweden*

We study the time-resolved spectral properties of the hardest gamma-ray bursts (GRBs) observed by the Gamma-Ray Burst Monitor (GBM) onboard the *Fermi* Gamma-Ray Space Telescope. We fit the Band function to all spectra and obtain the distributions for the low-energy power-law index $\alpha$, the high-energy power-law index $\beta$, the peak energy in the observed $\nu F_\nu$ spectrum $E_{\mathbf{p}}$, and the difference between the low- and high-energy power-law indices $\Delta s = \alpha - \beta$. We also apply a physically motivated synchrotron model to test for consistency with a synchrotron origin for the prompt emission and obtain the distributions for the two break energies $E_{\mathbf{b,1}}$ and $E_{\mathbf{b,2}}$, the middle segment power-law index $\beta$, and the Planck function temperature $kT$. Using the distributions of $\Delta s$ and $\beta$, the electron population index $p$ is found to be consistent with the "both" case where fast- and slow-cooling scenarios cannot be distinguished. The synchrotron function requires the synchrotron injection and cooling break (i.e., $E_{\mathbf{min}}$ and $E_{\mathbf{cool}}$) to be close to each other within a factor of 10, often in addition to a Planck function. A synchrotron model is found consistent with the majority of time-resolved spectra for the eight hardest *Fermi* GBM bursts, as long as both the cooling and injection break are included and the leftmost spectral slope is lifted either by inclusion of a thermal component or when an evolving magnetic field is accounted for.

# Abstracts of Contributed Talks

## Splinter F

Poster

Splinter F

# Gravitational Dynamics of the Milky Way's Halo

M. Fink, A. Irrgang, U. Heber

*Karl-Remeis-Observatory Bamberg*

Numerical calculations of stellar trajectories are an important tool in the ongoing search for Hyper Velocity Stars. These stars stick out from the main stellar population through their hugely deviating kinematics, especially high absolute velocities. With their extreme trajectories they can be used as probes for the Milky Way's gravitational field and mass distribution. To calculate these trajectories we use the analytical model potential of the dark halo first suggested by Allen & Santillan (1991). Here, we will consider the next order of magnitude of disturbances to this simple model, which are the satellite galaxies orbiting the Milky Way. According to their gravitational influence, the most important ones are identified using the dwarf galaxy catalogue of Alan W. McConnachie (2012). It is found, that the Large and Small Magellanic Clouds, the Sagitarius Dwarf Galaxy, and the Canis Maior overdensity have a large scale impact on the shape of the Galactic potential, so these are considered more closely in terms of their orbits.

Contributed Talk

Splinter F

# Search for Dark Matter with Charged Particles

H. Gast

*I. Physikalisches Institut B, RWTH Aachen University*

Dark matter particles annihilating in the halo of our Galaxy have been predicted to inject charged particles into the sea of cosmic rays. Rare anti-particles with comparatively low backgrounds induced by interactions of primary cosmic rays with interstellar matter are therefore promising channels for the indirect search for Dark Matter. I will discuss the positron, anti-proton, and anti-deuteron channels. Particular emphasis will be put on the latest results from the Alpha Magnetic Spectrometer (AMS-02) installed on the International Space Station. Its high-precision data on the positron and electron fluxes provide detailed insights into the origin and propagation of cosmic rays.

Contributed Talk

Splinter F

## Indirect search for dark matter towards the centre of the earth with the ANTARES neutrino telescope

Andreas Gleixner

*Friedrich-Alexander-Universität Erlangen-Nürnberg*

The ANTARES neutrino telescope is a water Cherenkov detector in the Northern Hemisphere. The detection principle is based on the observation of Cherenkov light emitted by muons resulting from charged-current interactions of muon neutrinos in the vicinity of the detection volume. One of the main scientific goals of ANTARES is the indirect detection of dark matter. Good dark matter candidates are WIMPS, as provided by Supersymmetry in the form of neutralinos. These WIMPS could accumulate in massive astronomical objects like the Sun, the Earth or the Galactic Centre, were they could self-annihilate. The particles produced by the WIMP pair-annihilations could then decay and produce, among other particles, neutrinos. Therefore, an indirect search for dark matter can be performed by looking for an excess neutrino flux from these astronomical objects. In this talk, an ongoing analysis with ANTARES of a potential WIMP accumulation in the centre of the Earth will be presented.

Contributed Talk

Splinter F

# Dark-matter dominated ultrafaint dwarf galaxies – a chemical abundance view

Andreas Koch[1], R. Michael Rich[2]

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Within the last eight years, the galaxy luminosity function has been traced to ever fainter magnitudes. With mass-to-light ratios of up to several thousands, the lowest-luminosity systems – the ultra-faint dwarf spheroidal (dSphs) galaxies – are candidates for the most dark matter dominated systems known in the Universe. However, their sizes and faintness often prohibit a clear-cut classification as old and metal-poor dSphs, extended star clusters, or condensations in tidal streams. In this talk, I will present evidence from chemical element abundance ratios that clearly characterise some of these faint systems as true, dark-matter dominated dSphs, which have experienced fascinating star formation and chemical enrichment histories.

Contributed Talk

Splinter F

# The Dark Matter distribution in the Galaxy

M. Steinmetz and the RAVE collaboration

*Leibniz-Institut für Astrophysik Potsdam (AIP)*

The Radial Velocity Experiment (RAVE) is a kinematically unbiased all-sky spectroscopic survey to measure radial velocities and stellar atmosphere parameters (temperature, surface gravity) and abundances of nearly half a million stars using the 6dF multi-object spectrograph on the 1.2-m UK Schmidt Telescope of the Anglo- Australian Observatory (AAO). Almost 580 000 spectra have been taken in the Ca-triplet region (8410-8790Å) for 480 000 southern hemisphere stars in the magnitude range $9 < I < 13$ at a resolution of $R = 7500$. The radial velocities measured in this survey are accurate to better than 2 kilometers per second. RAVE has meanwhile published four data releases. The most recent data release published in early 2014 features stellar atmospheric parameters (effective temperature, surface gravity, overall metallicity), radial velocities, individual abundances and distances determined for some 420 thousand stars; it is currently the largest and most homogeneous data set available for Galactic archeology studies.
One key application of the RAVE survey is to measure the local dark matter density in the solar suburb. We use the kinematics of ≈200000 giant stars that lie within ±1.5 kpc of the plane to measure the vertical profile of mass density near the Sun. We find that the dark mass contained within the isodensity surface of the dark halo that passes through the Sun ($(6\pm0.9)\text{Ã}^{-}10^{10}\mathrm{M}_\odot$), and the surface density within 0.9 kpc of the plane ($(69 \pm 10)\ \mathrm{M}_\odot\mathrm{pc}^{\text{âˆ}'2}$) are almost independent of the (oblate) halo's axis ratio $q$. If the halo is spherical, 46 per cent of the radial force on the Sun is provided by baryons, and only 4.3 per cent of the Galaxy's mass is baryonic. The dark-matter density at the location of the Sun is $0.0126q^{\text{âˆ}'0.89}\mathrm{M}_\odot\mathrm{pc}^{\text{âˆ}'3} = 0.48q^{\text{âˆ}'0.89}\ \mathrm{GeV\,cm}^{\text{âˆ}'3}$. Out results are consistent with a relatively low value for the total mass of the Galaxy's dark matter halo ($1.3 \pm 0.1 \times 10^{12}\mathrm{M}_\odot$), consistent with other findings based on the dynamics of stars and dwarf galaxies in the Milky Way halo.

# Abstracts of Contributed Talks

## Splinter G

Contributed Talk

Splinter G

# Astropy and the VO

M. Demleitner

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Programmatic – as opposed to client-based – access to the facilities of the Virtual Observatory's has so far been reserved to experts or one-off curl-based hacks. With astropy, its affiliated packages and some python programming, it is now becoming accessible to the average, Python-speaking astronomer, too. In this talk, we will briefly present some recipies that can be re-used to quickly create smart, interactive astronomy applications that seamlessly integrate standard clients, remote services, and custom logic provided by the local astronomer.

Contributed Talk

Splinter G

# The Bamberg photographic plate archive - the digitization project

H. Edelmann, N. Jansen, U. Heber, H. Drechsel, J. Wilms, I. Kreykenbohm

*Dr. Remeis-Observatory Bamberg & ECAP, Astronomical Institute of the Friedrich Alexander University of Erlangen-Nuremberg, Germany*

Regular observations of star fields are the common procedure to search for variable stars. In former times these observations have been done mostly using photographic emulsions, usually applied onto glas plates. Many collections of such plates are stored within German observatories; e.g. the Dr. Remeis-Observatory at Bamberg accomodates about 40.000. The oldest photographic plates stored at the Bamberg archive are from the early 1910s.
These plates are not only interesting for a historian, but also from a scientist's point of view they are still an important tool in order to hunt e.g. for long time variable or high proper motion stars, or to better calculate the orbits of asteroids and comets. The study of the predecessors of eruptive, cataclysmic or explosive variable stars, and other optical transients, is also only possible using these (very) old observations.
However, some of the photographic emulsions already begin to decompose and dissolve from their glas plates. The best way to preserve these observations, and to give the community acces to the data, is digitization. In collaboration of the Leibnitz astrophysical institute at Potsdam, the Hamburg observatory at Hamburg, and the Remeis-Observatory at Bamberg, a DFG funded project was initiated in 2012 in order to digitize all photographic plates stored at each institute, and integrate the resulting data into the Virtual Observatory.
We report about the second year of operation at the Dr. Remeis-Observatory at Bamberg.

Splinter G

# The plate archive of the Argelander-Institut in Bonn

M. Geffert[1],

[1] *Argelander-Institut für Astronomie der Universität Bonn*

The plate archive in Bonn ("´Sammlung Historischer Himmelsaufnahmen"´, [SHH]) is a collection of some 15.000 photographic plates taken in Bonn, Göttingen and Hoher List observatory from 1899 to 1990. Moreover there exist small numbers of plates from other observatories like Boyden, ESO and Rozhen.
We have started to do an inventory of all plates, which at the moment are distributed over several rooms in our institute. At the same time we are performing astrometric and photometric tests of the plates taken with the different telescopes.
Our general purpose is, to use the plates for science, didactic (work with students from schools) and for public outreach:

- We started a new determination of the absolute proper motions of 35 open star clusters with an accuracy of 0.3 mas/yr. All plates were scanned in four orientations with an EPSON 4990 in order to avoid systematic errors. The proper motions were related to 80 Tycho2 stars. Here we present the first results of four star clusters.
- In January, June and October students from schools are working 14 to 21 days in our institute. They do exercises and little research with scans of the plates. As a first result we have published light curves of Mira stars in the BAV. The final goal is a catalogue of historical photometric data of variable stars with respect to Gaia photometry.
- Digitized observations were used for topics for public talks (e.g. Messier 42). Moreover we are involved in art-projects using the old plates. A first exhibition was performed in November 2013 and other will follow in 2015.

In our opinion, a historical plate collection enables a large number of interesting activities, which go beyond the poor scientific use of the plates.

Contributed Talk

Splinter G

# Astronomical Photographic Data Archives

R. Hudec[1,2]

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[2] *Czech Technical University in Prague, Prague, Czech Republic*

There are more than 7 millions astronomical photographic plates/negatives worldwide, representing unique database for astronomical photometry, astrometry and spectroscopy over the time period of more than 100 years. The recent digitization efforts together with use of dedicated software and powerful computers offer the possibility for extended data mining in these archives for the first time. I will review the astronomical photographic data archives and recent efforts to digitize and analyze them. In addition, I will present and discuss some examples of astrophysical analyzes with these data.

Contributed Talk

Splinter G

# GLORIA GLObal Robotic-telescopes Intelligent Array for e-Science

R. Hudec[1,2]

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[2] *Czech Technical University in Prague, Prague, Czech Republic*

GLORIA stands for "GLObal Robotic-telescopes Intelligent Array". GLORIA is the first free and open- access network of robotic telescopes in the world. It is a Web 2.0 environment where users can do research in astronomy by observing with robotic telescopes, and/or by analysing data that other users have acquired with GLORIA, or from other free access databases, like the European Virtual Observatory (http://www.euro-vo.org).
The community is the most important part of GLORIA. Access will be free to everybody who has an Internet connection and a web browser. Therefore it will be open, not only to professional astronomers, but also to anyone with an interest in astronomy.

Contributed Talk

Splinter G

# Spectral Redshift Estimates Using k Nearest Neighbors Regression

S.D. Kügler, K.L. Polsterer, M. Hoecker

*Heidelberg Institute for Theoretical Studies (HITS)*

In astronomy, new approaches to process and analyze the exponentially increasing amount of data are inevitable. While classical approaches (e.g. template fitting) are fine for objects of well-known classes, alternative techniques have to be developed to determine those that do not fit. Therefore a classification scheme should be based on individual properties instead of fitting to a global model and therefore loose valuable information. An important issue when dealing with large data sets is the outlier detection which at the moment is often treated problem-orientated.
In this paper we present a method to statistically estimate the redshift $z$ based on a similarity approach. This allows us to determine redshifts in spectra in emission as well as in absorption without using any predefined model. Additionally we show how an estimate of the redshift based on single features is possible. As a consequence we are e.g. able to filter objects which show multiple redshift components. We propose to apply this general method to all similar problems in order to identify objects where traditional approaches fail.
The redshift estimation is performed by comparing predefined regions in the spectra and applying a $k$ nearest neighbor regression model for every predefined emission and absorption region, individually.
We estimated a redshift for more than 50% of the analyzed 16,000 spectra of our reference and test sample. The redshift estimate yields a precision for every individually tested feature that is comparable with the overall precision of the redshifts of SDSS. In 14 spectra we find a significant shift between emission and absorption or emission and emission lines. The results show already the immense power of this simple machine learning approach for investigating huge databases such as the SDSS.

Contributed Talk

Splinter G

## Machine Learning in Astronomy: lessons learned from learning machines

K.L. Polsterer

*Heidelberg Institute for Theoretical Studies - HITS gGmbH*

In the last decades, the amount and size of astronomical data-sets was growing rapidly. Now, with new technologies and dedicated survey telescopes, the databases are growing even faster. VO-standards provide an uniform access to this data. What is still required is a new way to analyze and tools to deal with these large data resources. E.g., common diagnostic diagrams have proven to be good tools to solve questions in the past, but they fail for millions of objects in high dimensional features spaces. By applying technologies from the field of computer sciences this data can be accessed more efficiently. Machine learning is a key tool to make use of the nowadays freely available datasets. This talk exemplarily presents what we learned when using machine learning algorithms on real astronomical data-set.

Contributed Talk

Splinter G

# Making Archival Photographic Observations Accessible: the APPLAUSE Database and PyPlate Software

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Photographic plate collections worldwide contain large amounts of unexplored data on the variable sky. The challenge is to make these data accessible for research use, which means digitising plates and logbooks, extracting sources from images, calibrating extracted data, and finally, publishing the data in searchable form.
This talk will cover our experience from creating the APPLAUSE database that contains digitised photographic data from the Hamburg, Bamberg and Potsdam archives. A major issue is the heterogeneity of plate collections that makes it difficult to store all relevant metadata uniformly in a database and FITS image files. We have developed a Python software package, PyPlate, that handles metadata parsing and storing, extraction of sources from digital images, and calibration of celestial coordinates for all extracted sources. Methods for calibrating stellar magnitudes and spectra are being developed.

# Abstracts of Contributed Talks

## Splinter H

Contributed Talk

Splinter H

# VARLET and PHALET two wavelet based filter methods to separate stellar variation, orbital disturbances and instrumental effects from transit events in stellar light curves.

S. Grziwa, J. Korth, M. Paetzold

*Rheinisches Institut fuer Umweltforschung, Abteilung Planetenforschung*

The space telescopes CoRoT and Kepler provided a huge number of high-resolution stellar light curves. The light curves are searched for transit signals which may be produced by planets when passing in front of the stellar disc. Various flux variations by star spots, pulsation, flares, glitches, hot pixels…, however, dominate the stellar light curves and mask faint transit signals in particular of small exoplanets, which may lead to missed candidates or a high rate of false detections. Full automated filtering and detection algorithms only make it possible to manage the huge number of stellar light curves for the search for transits. This will become even more important in the future missions PLATO and TESS. The Rheinisches Institut fuer Umweltforschung (RIU-PF) as one of the CoRoT detection teams has developed two model independent wavelet based filter techniques VARLET and PHALET to reduce the flux variability in light curves in order to improve the search for transits. The VARLET filter separates faint transit signals from stellar variations without using a-priori information of the target star. VARLET distinguishes variations by frequency, amplitude and shape. VARLET separates the large-scale variations from the white noise. The transit feature, however, is not extracted and still contained in the noise time series which makes it now much easier to search for transits by the search routine EXOTRANS. The PHALET filter is used to separate periodic features with well-known periods independent of their shape. With PHALET it is possible to separate detected diluting binaries and other periodic effects (e.g. disturbances caused by the spacecraft motion). The main purpose, however, is to separate already detected transits to search for transits from additional planets in stellar systems.

Contributed Talk

Splinter H

# Absolute astrometry in the next 50 years

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With the Gaia astrometry satellite in orbit since December 2013 it is time to look at the future of fundamental astrometry and a time frame of 50 years is needed in this matter. A dozen science issues for a Gaia successor mission in twenty years are presented and in this context the possibilities for absolute astrometry with mas or sub-mas accuracies are discussed. In brief, the two Gaia-like missions would provide an astrometric foundation for all branches of astronomy from the solar system and stellar systems, including exo-planet systems, to compact galaxies, quasars and dark matterby data which cannot be surpassed the next 50 years. The presentation is based especially on the papers of respectively 31 and 12 pages: "Absolute astrometry in the next 50 years" at http://arxiv.org/abs/1408.2190 and "Exo-Jupiters and Saturns from two Gaia-like missions" at http://arxiv.org/abs/1408.4341.

Contributed Talk

Splinter H

## On type II migration of massive planets

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Massive planets that open a gap in the accretion disk are believed to migrate with exactly the viscous speed of the disk, a regime termed type II migration. Population synthesis models indicate that standard type II migration is too rapid to be in agreement with the observations. We have studied the migration of massive planets between $10^{-4}$ and $10^{-2}$ $M_\odot$ corresponding to 0.1 to 10 Jupiter masses, in order to estimate the migration rate in comparison to type II migration. We follow the evolution of planets embedded in two-dimensional, locally isothermal disks with non-zero mass accretion.
We find that the migration rate of planets is determined entirely by the disk torques acting on it. Hence, depending on the local disk mass, the migration rate can be faster or slower than type II migration, and it is completely independent of the viscous inflow velocity. So there is no classical type II migration regime. A migration independent of the disk's drift speed implies that material can cross the gap region during the migration process, which we also observe in our calculations.
In the talk we present our methods and main results and discuss the consequences of our findings.

Contributed Talk

Splinter H

# Orbital parameter estimation of extrasolar multi-planet systems by Transit Time Variation

J. Korth, S. Grziwa, M. Pätzold

*Rheinisches Institut für Umweltforschung, Abteilung Planetenforschung, an der Universität zu Köln (RIU-PF)*

Transit Time Variation (TTV) is the earlier or later occurrence of a planetary transit relative to the time of a reference transit. TTV may be dominantly caused by the gravitational perturbation of the orbit of the transiting planet by another still unknown planet(s) inside or outside of the orbit of the known transiting planet. Gravitational interactions perturb the velocity of the transiting planet in its orbit which manifests in the periodical perturbation of the revolution period. Measurements of the transit times and the identification of differences from a mean transit period may then indicate the presence of another unknown planet and is therefore proof for the existence of further planets. The estimation of the mass of the transiting planet and the orbital parameters of the undetected planet(s) are constrained by the amplitude of the periodical variation of the transit times. Simulations of known multi-planet systems which show TTV shall be presented. The resulting TTV amplitude is analyzed with regard to the main dependencies: mass of the perturbing planet and the orbit eccentricities.

Contributed Talk

Splinter H

# Detecting exoplanets beyond 1 m/s

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The discovery and characterization of planet-harboring systems largely depends on the radial velocity method which has now achieved precisions better than 1 m $s^{-1}$. For observations that are not photon noise limited, major contributors to the measurement uncertainty are fluctuations in stellar parameters and stability of the instrument.
We carried out measurements using a fiber-fed Fourier-Transform-Spectrograph to study the solar integrated disk. With time steps of 6 min, we obtained a signal-to-noise ratio above 100 at an instrument resolution of $10^6$ covering 570 – 2000 nm.
Our main results are presented which imply a precision of 80 cm $s^{-1}$, revealing a solar inherent RV-signal variation at the order of 5 m $s^{-1}$ which is likely to be associated with convection.
We discuss the instrument's capacity to study stability of calibration sources, individual instrument components, as well as strategies to disentangle stellar variability from the planetary signal.

Contributed Talk

Splinter H

# Transiting Sub-stellar companions of Intermediate-mass stars

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We use the CoRoT-survey to search for transiting close-in planets of intermediate-mass stars ($M_* = 1.3 - 2.1 M_\odot$). RV-surveys and direct imaging campaigns showed, that intermediate-mass main-sequence stars have more massive planets then solar-like stars. Even brown dwarfs have been found and many of these stars have planets with masses near the border between planets and brown dwarfs. In our study we concentrated on short-period planets for which a mass-determination is possible. Determining the fraction of close-in planets of intermediate-mass stars is important, because Spitzer observations show that the life-time of the proto-planetary disks of such stars is half as long as the life-time of disks of solar-like stars. The detection of close-in planets of intermediate-mass stars therefore would puts strong con- straints on the timescales of the formation and migration. Furthermore while determining the physical parameters of such close-in objects we can study the evaporation rate of planets. We already have identied transiting Jupiter-like planet candidates with short orbital periods and observed these candidates with high-resolution echelle-spectrographs at various Telescopes.

# Abstracts of Contributed Talks

## Splinter I

Contributed Talk

Splinter I

# The BlackGEM Array: searching for gravitational wave source counterparts to study ultra-compact binaries

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The rates and physics of ultra-compact binaries consisting of neutron stars and black holes are poorly known, mostly due to the lack of a good sample to study such systems. In two years from now, the interferometers LIGO and Virgo are expected to be able to directly detect the gravitational waves (GW) emitted by such binaries when they merge, opening up a completely new window on the sky to study ultra-compact binaries. The combination of a GW detection with electromagnetic observations would be especially powerful to characterise the systems and the merger events. Unfortunately, however, the electromagnetic counterparts will be hard to find. The sky localisation of the GW detections will be rather poor, with typical error boxes spanning 100 square degrees, and the optical sources are expected to be faint ($\sim$ 22nd magnitude) and not long lasting ($\sim$ 1 d). In this contribution we discuss the possibilities of finding the electromagnetic counterparts of these binaries, thereby paying particular attention to the dedicated BlackGEM array of optical telescopes that will be deployed at the ESO site in La Silla (Chile) in 2016. In the first phase, the array will consist of four 60-cm telescopes with a field of view of 2.7 square degrees each. Apart from going after GW triggers, the array will also perform a deep southern sky survey in Sloan u, g, r, i and z filters, down to 23rd magnitude in the g-band; and a survey to characterise the transient and variable sky on timescales of hours and days. The latter will be a valuable resource to search for transients and variable stars across the southern sky.

Contributed Talk

Splinter I

# Multidimensional simulations of mixing in Classical Nova envelopes

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Spectroscopic observations of the material ejected in classical nova outbursts reveal isotopic abundances that are highy non-solar, with enhancement in elements from the CNO cycles and even from the NeNa range. The timescales that are expected for the thermonuclear runaway to proceed ($\sim$ few $\times 10^2$ s) are not long enough to process the accreted material such that the observed abundaces can be explained. Consequently, mixing between the accreted material and the uppermost layers of the white dwarf must occur prior or during the runaway. Convective mixing, dredging up white dwarf material into the burning zone, is a possible explanation. However, this mechanism is hard to study realistically in a 1d stellar evolution framework.
We attack the problem by performing simulations in two and three dimensions of the burning region of a 1 $M_\odot$ CO white dwarf during a nova outburst for $\geq 400$ s. These are done with the SLH code, using implicit time steps and preconditioning for low Mach number flows, together with a nuclear reaction network.
We will discuss the results of our high-resolution simulations, focusing on the dredge-up efficiency of fuel from the white dwarf to the envelope and the corresponding rate of nuclear energy generation. Significant discrepancies from previous studies are observed.

Contributed Talk

Splinter I

# Theoretical Modelling of Type Ia polarisation spectra

M. Bulla, S. A. Sim

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Despite their importance in cosmology, Type Ia Supernovae (SNIa) present a puzzle, in that the nature of their progenitor/s is still unclear. Spectropolarimetry is a valuable tool in studying supernovae since it is able to provide information on geometry and so help address the question of what is actually exploding. Polarisation observation of SNIa have found a low continuum polarisation level but significant polarisation in the troughs of some absorption lines, suggesting that departures from spherical symmetry occur. Modern 3D explosion models predict asymmetries in the ejecta of varying degrees. Therefore including polarisation in modern multi-dimensional radiative transfer codes helps both to assess the validity of these models and to make comparisons between their predictions and polarisation observations. In this talk, I will present a method that allows us to compute polarisation spectra with low Monte Carlo noise and show the first results we have obtained by including this new technique in the three-dimensional, time-dependent radiative transfer code ARTIS (Applied Radiative Transfer In Supernovae). This will include validating the approach on simple geometries and applications to real explosion models.

Contributed Talk

Splinter I

# A Two-Parameter Classification for Progenitor Stars Exploding as Supernovae

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The study by Ugliano et al. (2012) for the first time systematically explored a large set of progenitor models ($>\sim 10$ $M_\odot$). These stars undergo central core collapse and will either form a black hole or give birth to a neutron star in a successful supernova explosion. It was found that the final outcome can vary within narrow intervals of the zero-age main-sequence mass of these stars. In order to be able to predict the readiness for an explosion of massive stars a variety of structural measures like core compactness, iron core mass, binding energies, etc. were assessed. None of these single parameters was found to clearly separate exploding and non-exploding cases. Here we demonstrate that two parameters deduced from the progenitor structure allow for a prediction of the outcome of stellar core collapse. For about 300 investigated progenitor models, we find that our criterion yields an almost perfect discrimination of the final fate of the stars, either ending in black hole formation or successful supernova explosion.

*Acknowledgements.* We thank Stan Woosley and Tuguldur Sukhbold for providing their new progenitor data. Partial funding by the Deutsche Forschungsgemeinschaft through grants SFB/TR7 “Gravitational Wave Astronomy” and EXC 153 “Origin and Structure of the Universe” and by the EU through ERC-AdG No. 341157-COCO2CASA are acknowledged.

Contributed Talk

Splinter I

## What do QPOs in giant flares of magnetars tell us about neutron stars

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Soft gamma-ray repeaters (SGRs) are repeatedly bursting sources that probably are highly magnetized neutron stars (magentars). In addition to the normal bursts, three of these objects had so called giant flares that are orders of magnitude more energetic. In the decaying tail of the giant flares, quasi-periodic oscillations (QPOs) have been observed. These QPOs are commonly interpreted as magneto-elastic oscillations of a highly magnetized neutron star (magnetar). Analogous to helio- or asteroseismology, we would like to use the oscillations of magnetars to gain insight into their interior properties like: the equation of state or their magnetic field structure. With current models we are able to put some constraints: the magnetic field is probably not confined to the crustal region and there should be at least one superfluid specie in the core of the neutron star. One of the main open question is how the oscillations could cause the modulation of the X-ray signal of during the giant flare.

Contributed Talk

Splinter I

# The Peculiar Motion of the Crab Pulsar: Neutron Star Kicks from Electron-Capture Supernovae

Alexandra Geßner, Hans-Thomas Janka

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Observations indicate that the Crab Nebula is likely to stem from a low-mass progenitor star ($< 10\,M_\odot$) that exploded in an electron-capture supernova (ECSN) in 1054. This sub-energetic core-collapse supernova (CCSN) left behind a pulsar with a transverse velocity of $\sim 120\,\mathrm{km\,s^{-1}}$. In theoretical studies of generic CCSN events, the gravitational and hydrodynamic interaction between anisotropically distributed supernova ejecta and the nascent neutron star have been found to reproduce the enormous pulsar space velocities of several $100\,\mathrm{km\,s^{-1}}$ observed in our galaxy (Scheck et al. 2006; Wongwathanarat et al. 2013). Acting within the first few seconds after core bounce, this mechanism crucially relies on the presence of rapidly growing hydrodynamic instabilities that cause large-scale asymmetries at early stages of the explosion as they occur in a typical CCSN.
Bearing in mind the stochasticity of growing hydrodynamic instabilities, we investigated the neutron star kick in numerous axisymmetric, parametrized ECSN explosion models with varying energetics based on the $8.8\,M_\odot$ progenitor with a core composed of oxygen, neon, and magnesium (O-Ne-Mg) provided by Nomoto (1987). None of the kicks from the exploding O-Ne-Mg core were found to exceed $6\,\mathrm{km\,s^{-1}}$ within the first second after core bounce. We deduce that the hydrodynamic and gravitational neutron star acceleration mechanism is unable to operate efficiently in ECSNe, due to the fundamental difference in the postshock explosion dynamics between ECSNe and higher-energetic CCSNe. Concerning the Crab pulsar, we conclude that this mechanism is unlikely to be responsible for its observed peculiar motion.
*Acknowledgements.* Support by the EU through ERC-AdG No. 341157-COCO2CASA is acknowledged.

Contributed Talk

Splinter I

# Challenges in Supernova Photometric Classification

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The problem of supernova (SN) photometric identification is a crucial issue which limits our ability to fully apply SN light curve data collected by large surveys in cosmological studies. Here, we present an updated view of SN photometric classification efforts, focusing on results from a machine learning approach based on Kernel Principal Component Analysis, Nearest Neighbour algorithm and Gaussian Process Regression. We present detailed comparison between our results and others from the literature, based on the same simulated data set. The method proved to be satisfactorily efficient, providing high purity rates when compared with standard algorithms, without demanding any information on astrophysical properties of the local environment, host galaxy or redshift. We also show outcomes from *Sloan Digital Sky Survey* II SN data released and discuss the quality of cosmological parameter estimation from a purely photometric sample.

Contributed Talk

Splinter I

# Type Iax supernovae from deflagrations in WDs

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Type Iax supernovae (SNe Iax, formerly called 2002cx-like supernovae) are a class of peculiar hydrogen-deficient SNe. Compared to SNe Ia, they are characterized by lower luminosities and lower ejecta velocities indicating less energetic explosions. Since the observationally derived ejecta masses are well below the Chandrasekhar mass, it has been discussed that SNe Iax should originate from incomplete deflagrations in white dwarfs (WDs) that fail to unbind the WD completely. Here, I will present a set of hydrodynamical explosion simulations exploring the possible outcome of deflagrations in WDs for different ignition conditions. Coupling these explosion models to radiative transfer simulations facilitates a direct comparison of the models to observational data.

Contributed Talk

Splinter I

## Interacting supernovae from photoionization-confined shells around red supergiant stars

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Betelgeuse, the nearby red supergiant, is a runaway star with a powerful stellar wind that drives a bow shock into its surroundings. This scenario is challenged by the discovery of a dense and almost static shell, three times closer to the star than the bow shock, that has been decelerated by some external force. The two physically-distinct structures cannot both be formed by the hydrodynamic interaction of the wind with the interstellar medium. We show that a model in which Betelgeuse's wind is photoionized by radiation from external sources can explain the static shell without requiring a new understanding of the bow shock. Pressure from the photoionized wind generates a standing shock in the neutral part of the wind and forms an almost-static, photoionization-confined shell. Other red supergiants should have significantly more massive shells than Betelgeuse, because the photoionization-confined shell traps up to 35% of all mass lost during the red supergiant phase, confining this gas close to the star until it explodes. After the supernova explosion, massive shells dramatically affect the supernova lightcurve, hence providing a natural explanation for many supernovae with circumstellar interaction signatures.

Contributed Talk

Splinter I

# Detonations of O-Ne White Dwarfs

K. Karquardt

*Universität Würzburg*

Type Ia Supernovae are believed to be thermonuclear explosions of white dwarfs in binary systems. The exact progenitor model is still unclear, and the details of the explosion mechanism(s) are a matter of active debate. As an alternative to the common models, which assume carbon-oxygen white dwarfs to explode, we have simulated detonations of sub-Chandrasekhar mass oxygen-neon white dwarfs and carbon-oxygen-neon hybrid white dwarfs. From our hydrodynamical simulations we have calculated synthetic spectra and light curves with a radiative transfer code. The spectra and light curves are compared to carbon-oxygen sub-Chandrasekhar mass explosion models and to observations.

Contributed Talk

Splinter I

## Modeling neutrino-driven supernova explosions in 3D

T. F. Melson, H.-T. Janka

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The need for modeling core-collapse supernovae in three dimensions (3D), i. e. without symmetry restrictions, is uncontroversial. However, simulations including state-of-the-art neutrino treatment did not explode so far. We present the first successful supernova explosion of a 9.6 solar mass progenitor simulated with the VERTEX code in 3D and compare the result with likewise exploding models in spherical symmetry (1D) and axial symmetry (2D). The 3D simulation has been performed on an axis-free Yin-Yang grid which we have applied here for the first time in production. The explosion in 1D is expected because of the shell structure of the progenitor and its low mass. Therefore, not the explosion itself in all dimensions is remarkable but the observation that the explosion energy in 3D is about ten percent higher than in 2D whereas the explosion times are equal.
We thank Florian Hanke and Andreas Marek for their support of this project. Partial funding by the Deutsche Forschungsgemeinschaft through grants SFB/TR7 "Gravitational Wave Astronomy" and EXC 153 "Origin and Structure of the Universe" and by the EU through ERC-AdG No. 341157-COCO2CASA are acknowledged.

Contributed Talk

Splinter I

# Gravitational Settling of $^{22}$Ne in Type Ia supernovae

A. Michel

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In this talk, I will discuss the influence of "gravitational settling" of $^{22}$Ne on models of sub-Chandrasekhar Type Ia Supernovae. Gravitational settling refers to the sinking of a nuclear species (in this case $^{22}$Ne) due to its neutron excess in comparison with the surrounding material. This process leads to an enrichment of neutron rich $^{22}$Ne towards the center of the white dwarf. We have calculated simplified explosion models where the detonation is ignited in the central region. During the nucleosynthesis in the central regions, the models with significant settling produce more neutron rich, stable iron-group isotopes (such as $^{54}$Fe and $^{58}$Ni) instead of radioactive $^{56}$Ni. In the outer layers, the situation is reversed – less $^{54}$Fe and $^{58}$Ni are synthesized. To highlight the observational consequences I will present synthetic light curves and spectra for our model at different epochs. The consequences of $^{22}$Ne settling on late-time, nebular spectra should be further studied, as it has been suggested that a core of stable iron-group elements is required to reproduce typical observations.

Contributed Talk

Splinter I

# Investigating the Origins of Type IIn Supernovae through their Light Curves

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Type IIn supernovae (SNe) are SNe in which narrow lines emitted due to the interaction between SN ejecta and its dense circumstellar media (CSM) are observed. We show our results of light curve (LC) modeling for Type IIn SNe. We develop a simple analytic LC model for Type IIn SNe powered by the CSM interaction. By applying our LC model to many observed Type IIn SN LCs, we constrain their SN ejecta and dense CSM properties to investigate the origins of Type IIn SNe (progenitors, mass-loss mechanisms, etc.). Especially, we show that the estimated CSM properties can be used to deduce the mass-loss histories of Type IIn SN progenitors in about a few decades before their explosions. We find that their mass-loss rates are typically higher than $10^{-3}$ $M_\odot$ yr$^{-1}$. We also find that the mass-loss rates of Type IIn SN progenitors may tend to increase as they get closer to the time of the explosions. In addition to the analytic modeling, we focus on the rise times and peak luminosities of Type IIn SNe to get independent constraint on their SN and CSM properties. We argue that Type IIn superluminous SNe whose peak luminosities are brighter than -21 mag in the optical bands require not only high mass-loss rates of the progenitors (more than 0.1 $M_\odot$ yr$^{-1}$) but also high explosion energies ($\sim 10^{52}$ erg) to explain their large peak luminosities and long LC durations at the same time.

Contributed Talk

Splinter I

# The companion candidate near Fomalhaut - a neutron star at 9 to 20 pc ?

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We present evidence for a neutron star at some 9 to 20 pc distance only. The directly detected planetary mass companion candidate close to the young, nearby star Fomalhaut is a subject of intense discussion. While the detection of common proper motion led to the interpretation as Jovian-mass companion, later non-detections in the infrared raised doubts. Recent astrometric measurements indicate a belt crossing or highly eccentric orbit for the object, if a companion, making the planetary interpretation potentially even more problematic. In this study we discuss the possibility of Fomalhaut b being a background object with a high proper motion. By analysing the available photometric and astrometric data of the object, we show that they are fully consistent with a neutron star: Neutron stars are faint, hot (blue), and fast moving. Neutron stars with a surface temperature of 112,000 K to 126,500 K (with small to negligible extinction) at a distance range of 9 to 20 pc would be consistent with all observables, namely with the photometric detections in the optical, with the upper limits in the infrared and X-rays, as well as with the astrometry (consistent with distances of 9 to 20 pc and high proper motion as typical for neutron stars) as well as with non-detection of pulsation (not beamed). We consider the probability of finding an unrelated object or even a neutron star nearby and mostly co-aligned in proper motion with Fomalhaut A: This is definitely well possible.

Contributed Talk

Splinter I

# Progenitors of Type Ia Supernovae in the sub-Chandrasekhar Mass Double Detonation Scenario

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Type Ia supernovae (SNe Ia) have been an important tool for astronomy for quite some time, however, the nature of their progenitors remains somewhat mysterious. Recent theoretical studies indicate a possibility of producing thermonuclear detonations of carbon-oxygen white dwarfs (CO WDs) at masses less than the Chandrasekhar mass through accretion of helium rich matter. These detonations, initiated by ignition of the accumulated helium layer, leading to detonation of the CO core (double detonation scenario), would, depending on mass accretion rate, mass and initial temperature of the WD, spectrally resemble either a normal SN Ia or a peculiar one (type Iax).
This talk will discuss the probability of binary systems comprised of one CO WD and one hydrogen deficient helium star experiencing detonations featuring SN Ia spectra as well as chart the initial conditions leading to helium detonations independent of the resulting spectra.
Preexisting data obtained through simulations of single, constantly accreting, CO WDs is used as a "black box" in a binary simulation framework. The black box approach includes ignitions of the accumulated helium layer on the WD without leading to the detonation of the CO core, step-wise change of temperature of the WD under appropriate conditions and change of the core mass depending on mass transfer rate.
We present evidence that the parameter space leading to detonations is non-coherent, that, within its confines, SN Ia spectra do occur but are expected to be extremely rare ($< 1\%$) and that, depending on the initial mass ratio, mass loss due to nova outbursts might be an acceptable indicator as to whether a system will experience helium induced detonation of the WD at some point in its evolution.

Contributed Talk

Splinter I

# TWO-DIMENSIONAL CORE-COLLAPSE SUPERNOVA SIMULATIONS WITH THE ISOTROPIC DIFFUSION SOURCE APPROXIMATION FOR NEUTRINO TRANSPORT

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The neutrino mechanism of core-collapse supernova is investigated via non-relativistic, two-dimensional (2D), neutrino radiation-hydrodynamic simulations. We use the Isotropic Diffusion Source Approximation (IDSA) scheme for the transport of electron flavor neutrinos, which decompose the transported particles into trapped particle component and streaming particle component. Heavy neutrinos are described by a leakage scheme. Unlike the "ray-by-ray" approach by other multi-dimensional IDSA implementations in spherical coordinate, we use cylindrical coordinate and solve the trapped particle component in multi-dimensions, improving the proto-neutron star resolutions and the neutrino transport in angular and temporal directions. We perform 1D and 2D simulations from the pre-bounce collapse phase to several hundred milliseconds post-bounce with 11, 15, 21, and 27 $M_\odot$ progenitors from Woosley et al. with the DD2 equation of state. We obtain explosions for all considered 2D models within approximately 200 milliseconds after bounce and find that explosions are mostly dominated by the neutron-driven convection, although weak standing accretion shock instabilities are observed as well.

Contributed Talk

Splinter I

## Type Ia Supernovae from double degenerate binary systems

R. Pakmor

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The progenitor system and explosion mechanism of Type Ia Supernovae is still unknown. The double degenerate scenario, in which the explosion is somehow caused by the interaction or the merger of two white dwarfs in a binary system has been disfavoured for a long time on theoretical grounds. It was believed that the remnant of the merger of such a binary system would lead to an accretion induced collapse rather than a ending as a SN Ia. However, only recently we were able to show that a binary system can already ignite and explode just before or during the merger and that the resulting explosion resembles observed SNe Ia very well. I will discuss recent results from first principle models of mergers of two white dwarfs and show how the tiny helium shell around carbon-oxygen white dwarfs can lead to robust ignition of a carbon detonation in the more massive white dwarf.

Contributed Talk

Splinter I

# IMPACT OF NEUTRINO FLAVOR OSCILLATIONS ON THE NEUTRINO-DRIVEN WIND NUCLEOSYNTHESIS OF AN ELECTRON-CAPTURE SUPERNOVA

Else Pllumbi[1], Irene Tamborra[2], Shinya Wanajo[3], Hans-Thomas Janka[1], and Lorenz Hüdepohl[1]

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Neutrino oscillations, especially to light sterile states, are known to affect the nucleosynthesis yields because of their feedback effect on the electron fraction. We perform nucleosynthesis calculations for neutrino-driven wind trajectories from the neutrino-cooling phase of an 8.8 $M_\odot$ electron-capture supernova computed in hydrodynamical simulations where sophisticated neutrino transport is applied and discuss the impact of both active-active and active-sterile oscillations. The approach we use in order to investigate the impact of neutrino oscillations on the nucleosynthesis of the considered neutrino-driven wind is similar to what was done in Tamborra et al. (2012), with the important difference that we take into account weak magnetism corrections in the neutrino beta processes as well as the alpha-effect on the Ye evolution, and we investigate a larger set of time slices. For the adopted supernova progenitor, we find that oscillations (also to the sterile state) affect the element formation on a negligible level. We conclude that neutrino oscillations, also to sterile states, cannot contribute to making the supernova outflows neutron rich enough to activate the r-process.

Contributed Talk

Splinter I

# Evidence for Environmental Bias on Type Ia Supernova Luminosity and its Consequences on the Estimation Cosmological Parameters

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on the behalf of the Nearby Supernova Factory

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Type Ia supernovae are a key tool in modern measurements of the cosmological parameters, especially the direct measurement of the Hubble constant, $H_0$ and the dark energy equation of state parameter, $w$. Yet there progenitor remains largely in understood. It is now well-established that contemporary lightcurve-based two-parameter methods of standardizing Type Ia supernovae for cosmology leave residuals that depend on properties of their host galaxies. While initially found using global galaxy properties such as mass, star-formation rate and metallicity, such residuals have now been shown to be just as strong in when segregating SNe Ia by the amount of star formation occurring local to the SN position. I will present evidence for this bias in Type Ia standardization using nearby SNe Ia along with different star-formation metrics and lightcurve fitters, and demonstrate how it is likely to have biased current measurements of the cosmological parameters based on Type Ia SNe.

Contributed Talk

Splinter I

# X-ray diagnostics of Type Ia supernovae: The radioactive decay of $^{55}$Fe

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Although Type Ia supernova explosions (SNe Ia) are now routinely observed in the optical wavelength regime, a clear distinction between competing explosion scenarios based on the optical emission alone is difficult. We show that the X-ray line flux of the Mn $K_\alpha$ line at 5.9 keV from the decay of $^{55}$Fe is a promising diagnostic tool to distinguish between different SNe Ia explosion models. Using radiation transport calculations, we compute the line flux for two three-dimensional explosion models representing the single degenerate and the double degenerate evolutionary channel: a near-Chandrasekhar mass delayed detonation and a violent merger of two (1.1 and 0.9 $M_\odot$) white dwarfs. Due to explosive nuclear burning at higher density, the delayed-detonation model synthesises $\sim$3.5 times more radioactive $^{55}$Fe than the merger model. As a result, we find that the peak Mn $K_\alpha$ line flux of the delayed-detonation model exceeds that of the merger model by a factor of $\sim$4.5. Since in both models the 5.9 keV X-ray flux reaches its maximum at five to six years after explosion, a single measurement of the X-ray line emission at this time can place a constraint on the explosion physics that is complementary to those derived from earlier phase optical spectra or light curves. By performing detector simulations of current and future X-ray telescopes, we investigate the possibilities of detecting the X-ray line at 5.9 keV and discuss the optimal observation strategies.

Contributed Talk

Splinter I

# Ultra-stripped Type Ic Supernovae

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Recent discoveries of weak and fast optical transients raise the question of their origin. We investigate the minimum ejecta mass associated with core-collapse supernovae (SNe) of Type Ic. We show that mass transfer from a helium star to a compact companion can produce an ultra-stripped core which undergoes iron core collapse and leads to an extremely fast and faint SN Ic. In this talk, a detailed example is presented in which the pre-SN stellar mass is barely above the Chandrasekhar limit, resulting in the ejection of only $0.05 - 0.20\ M_{\odot}$ of material and the formation of a low-mass neutron star. We compute synthetic light curves of this case and demonstrate that SN 2005ek could be explained by our model. We estimate that the fraction of such ultra-stripped to all SNe could be as high as 0.001-0.01. We argue that the second explosion in some double neutron star systems (for example, the double pulsar PSR J0737−3039B) was likely associated with an ultra-stripped SN Ic. Finally, we present new results of an ongoing systematic investigation of progenitors of electron capture SNe versus iron core collapse SNe in close binaries.

# Abstracts of Contributed Talks

Splinter J

Contributed Talk

Splinter J

## Synthetic X-ray observations of superbubble simulations

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Superbubbles are observed to be sometimes bright in soft X-rays, sometimes not. Supported by the correlation to shell kinematics, this is generally believed to be related to recent supernova explosions.
We use plasma emission models to analyse the X-ray emission of superbubbles simulated by 3D hydrodynamics simulations. Instabilities play a dominant role. Together with the non-uniform energy input they lead to smaller superbubbles where shocks can more easily produce X-ray emitting gas. We show that X-ray luminosity and spectrum similar to observed superbubbles may be reproduced. Our superbubbles are X-ray bright for typically $10^6$ yr, and obey the observed correlation with shell kinematics. The mechanism is however insufficient to account for the soft X-ray emission in star-forming galaxies.

Contributed Talk

Splinter J

# Wind bubbles within H II regions

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Interstellar bubbles around O stars are driven by a combination of of the star's wind and ionizing radiation output. The wind contribution is uncertain because the boundary between the wind and interstellar medium is difficult to observe. Mid-infrared observations show arcs of dust emission around O stars that could indicate the edge of an asymmetric stellar wind bubble, distorted by density gradients and/or stellar motion. We present two-dimensional simulations investigating the evolution of wind bubbles and H II regions around massive stars moving through a dense, uniform medium with velocities ranging from 4 to 16 $\mathrm{km\,s^{-1}}$. The H II region morphology is strongly affected by stellar motion and the wind bubble is also very aspherical from birth, even for the lowest space velocity considered. Wind bubbles do not fill their H II regions (filling factors of 10-20 per cent), at least for a main sequence star with mass $M_\star \sim 30\,M_\odot$. X-ray emission from the wind bubble is soft, faint, and comes mainly from the turbulent mixing layer between the wind bubble and the H II region. The wind bubble loses most of its energy by turbulent mixing with cooler photoionized gas. Comparison with the H II region RCW 120 shows that its dynamical age is $< 0.4$ Myr and that stellar motion of $\leq 4\ \mathrm{km\,s^{-1}}$ is allowed, implying that the driving star is unlikely to be a runaway star but more likely formed in situ.

Contributed Talk

Splinter J

# The chemical composition of the local interstellar dust

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Accurate and precise abundances have been determined for a sample of ∼30 early B-type stars in the solar neighbourhood, facilitating to establish a cosmic abundance standard. This allows the present-day chemical composition of the dust in the diffuse ISM and in the Orion H II region to be determined via comparison with gas-phase abundances from the literature. Work based on UV spectroscopy has shown that the local ISM out to 1.5 kpc from the Sun is chemically homogeneous to the 10%-level. On the other hand, a determination of the chemical composition of the dust component turned out to be hampered by the lack of a suited standard, which facilitates the dust composition to be derived as the difference between the reference and gas-phase abundances. The chemical composition of the 4.5 Gyr old Sun may not be characteristic for the pristine composition of the local ISM, while the abundance scatter of young F&G stars and of early B-type stars reported in the literature so far is substantial. We applied sophisticated non-LTE models and an iterative analysis technique to study chemical abundances of a sample of ∼30 early B-type stars out to distances of ∼500 pc from the Sun. Many sources of systematic error were identified and avoided in the process, providing results of unprecedented accuracy and precision. Thus a present-day *cosmic abundance standard* is established. The dust composition of the local diffuse ISM and of the Orion H II region is derived on the basis of literature data on gas-phase abundances. According to this, the dust in the diffuse ISM is relatively carbon-poor and silicate-rich, challenging many contemporary dust models. Most of the oxygen is bound in silicates (checksum of Mg+Si+Fe vs. O), but some extra O may be bound in an unidentified dust constituent. The absence of carbonaceous dust within the Orion H II region implies graphite to be a minority species. Most of the carbon resides in PAHs, organic refractory material and possibly amorphous carbon, which are more prone to photodissociation.

Contributed Talk

Splinter J

# Probing the properties of the cold turbulent tenuous plasma with observations of radio pulsars

S. Osłowski

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One of many phases of the galactic interstellar medium is the cold tenuous plasma. Regular radio pulsations from spinning neutron stars enable studies of this phase of the ISM. This pulsed polarised emission is affected by the cold plasma through frequency dispersion, Faraday rotation, refractive and diffractive scintillation, and scattering. While these effects are mostly a nuisance for high precision timing experiments, they provide an easy way to study the cold plasma, or at least its electron content and the magnetic field along the line of sight to pulsars. In this talk I will outline how observations of pulsars provide measurements of the electron density in the Galaxy, probe magnetic fields, and allow us to study the spectrum of turbulence in the interstellar medium. I will present previous results from various observatories as well as present ongoing efforts based on observations with the German station of LOFAR, the low-frequency pathfinder for the Square Kilometre Array.

Contributed Talk

Splinter J

# Filamentary structures in low-mass star forming regions: the case of the Serpens Core

Veronica Roccatagliata[1]

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*Herschel* observations have revealed that filamentary structures are ubiquitous in low and high-mass star forming regions as well as in regions with no ongoing star formation. This suggests that their appearance is not only related to star formation activity but it is rather the result of global processes in the molecular cloud itself (e.g., gravitational, thermal and dynamical instabilities and/or turbulence).
At a distance of about 400 pc, the "Serpens Core" is an ideal laboratory to study the nature of filaments in low-mass star forming regions. In our recent analysis of *Herschel* data we resolved a network of filaments converging on the central young cluster.
In my talk I will present *Herschel* observations of Serpens and compare these to hydrodynamical simulations of turbulent molecular clouds.
When feedback is included in the same simulations the less massive filaments are destroyed and pillar structures are created. This is what we observed in the Carina Nebula Complex, a high-mass star forming region.
I will finally compare the properties of the filamentary network in Serpens to those of the prominent pillars in Carina.

Contributed Talk

Splinter J

# Molecular gas in Intermediate-Velocity Clouds

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Intermediate-Velocity Clouds (IVCs) are HI clouds in the lower galactic halo that are thought to be related to a galactic fountain process. IVCs are predominantly atomic with a small fraction of molecular hydrogen ($H_2$). However, a few molecular IVCs (MIVCs) are observed with a significant amount of $H_2$. MIVCs are identified by their far-infrared (FIR) excess, e.g. more FIR emission than inferred from the HI emission alone. Using the HI-FIR correlation with data from the Effelsberg-Bonn HI Survey and the Planck Satellite, we deduce the $H_2$ distribution towards large galactic latitudes. For two particular neighbouring IVCs, a FIR-dim and a FIR-bright cloud, we obtained high-resolution HI data with the Westerbork-Synthesis Radio Telescope and additional $^{12}CO(1\to0)$ and $^{13}CO(1\to0)$ observations with the IRAM 30 m telescope. We study the small-scale structure of the different types of clouds as well as the $X_{\mathrm{CO}}$-factor. MIVCs show significantly lower $X_{\mathrm{CO}}$-factors than the canonical value known for the Milky Way disk.

Contributed Talk

Splinter J

# "Observing" a physical model for obscuring structures in Seyfert cores based on radiation pressure

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In this contribution we present time-resolved images and spectral energy distributions for geometrically thick obscuring structures which are thought to enshroud the central engines of nearby Seyfert nuclei. The 3D dust continuum radiative transfer simulations are based on the radiation-driven dynamical model for the central obscurer by Wada (2012). When comparing the results to high spatial resolution SEDs as well as observed relations for nearby Seyfert galaxies, we find that a model which comprises of a clear three-component structure gives the best comparison with the data: a thin disc with spiral and filamentary high density features, a surrounding fluffy component (the obscurer) and a low density outflow along the rotation axis. Dramatic differences are found depending on wavelength: whereas the mid-infrared images are dominated by the elongated appearance of the outflow cone (reminiscent of recent interferometric observations), the long wavelength emission is mainly given by the cold and dense disc component.

Contributed Talk

Splinter J

# The astrochemistry package KROME in 3D simulations

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We present the astrochemistry package KROME for the modeling of astrochemistry in numerical simulations. KROME provides a python pre-compiler that allows to generate Fortran modules to solve any given chemical network, and offers a number of built-in chemical networks, ranging from the primordial Universe to present-day molecular clouds. It further provides interfaces to 3D (magneto-)hydrodynamics codes such as ENZO, FLASH and RAMSES. In this talk, we will give a basic introduction to the package and highlight some recent applications in 3D simulations.

# Abstracts of Contributed Talks

## Splinter K

Contributed Talk

Splinter K

# A Variable-Density Absorption Event in NGC 3227 mapped with *Suzaku* and *Swift*

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Active Galactic Nuclei (AGN) are known to be powered by gas accretion onto their central supermassive black holes (SMBHs). However, several questions remain regarding the detailed structure of the gas that is surrounding the nucleus at various distances to the SMBH and obscuring our line of sight. X-ray spectral observations over the past decade support the paradigm of clumpy circumnuclear gas. Eclipse events across multiple Seyferts and timescales allow us to explore the properties of the clumps over a wide range of radial distances from the broad line region (BLR) to beyond the dust sublimation radius. We present a new, yet rare time-resolved X-ray spectroscopy of an eclipse event in NGC 3227 from a *Swift* and *Suzaku* campaign over several weeks in 2008. We resolve the density profile of this cloud to be highly irregular and variable, in contrast to a previous symmetric and centrally-peaked event mapped with RXTE in the same object. We conclude that we have mapped a filamentary, moderately ionized, non-dusty cloud in the outer BLR that covers ∼90% of the line of sight to the central engine. Our results show for the first time a variety of profile shapes within the same source and thus provide an excellent opportunity to further test models describing the formation and dynamics of individual clouds or filaments.

Contributed Talk

Splinter K

# FACT - Longterm Monitoring of AGN at Very High Energies

D. Dorner[1], M. Balbo[2], A. Biland[3], T. Bretz[3], J. Buss[4], S. Einecke[4], J. Freiwald[4], C. Hempfling[1], G. Hughes[3], M.L. Knoetig[3], T. Krähenbühl[3], W. Lustermann[3], K. Mannheim[1], K. Meier[1], S. Müller[4], D. Neise[4], A. Neronov[2], A.-K. Overkemping[4], A. Paravac[1], F. Pauss[3], W. Rhode[4], T. Steinbring[1], F. Temme[4], J. Thaele[4], S. Toscano[2], P. Vogler[3], R. Walther[2]

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The First G-APD Cherenkov Telescope (FACT) was built on the Canary Island of La Palma in October 2011 as a proof of principle for silicon based photosensors in Cherenkov Astronomy. The scientific goal of the project is to study the variability of active galactic nuclei (AGN) at TeV energies. Thanks to the use of silicon based photosensors, FACT can observe during strong moon light enlarging the duty cycle of the telescope compared to other instruments in this energy band. This makes it ideal for longterm monitoring. Observing a small sample of sources whenever possible, an unbiased data sample is collected. This allows to study the variability of the selected objects on timescales from hours to years. To provide quick flare alerts to the community and trigger multi-wavelength observations, a quick look analysis has been installed onsite providing results publicly online within the same night. In June and July 2014, several flare alerts were sent. Results from the first two to three years of monitoring will be presented.

Contributed Talk

Splinter K

# FACT - Influence of the Observation Conditions on the Excess Rates

K. Meier[1], M. Balbo [2], A. Biland [3], T. Bretz [3], J. Buss [4], D. Dorner [1], S. Einecke [4], J. Freiwald [4], C. Hempfling [1], G. Hughes [3], M.L. Knoetig [3], T. Krähenbühl [3], W. Lustermann [3], K. Mannheim [1], S. Müller [4], D. Neise [4], A. Neronov [2], A.-K. Overkemping [4], A. Paravac [1], F. Pauss [3], W. Rhode [4], T. Steinbring [1], F. Temme [4], J. Thaele [4], S. Toscano [2], P. Vogler [3], R. Walther [2]

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One of the major goals of the First G-APD Cherenkov Telescope (FACT) is the long-term monitoring of active galactic nuclei at TeV energies. These observations provide complete and unbiased lightcurves as an ideal basis for studying the underlying physics of these extremely variable objects. In case of enhanced activity in one of the monitored objects, an alert to more sensitive instruments is sent. To send such triggers in almost real time, a quick look analysis on site has been set up providing excess rate curves. As the excess rate depends on the zenith distance and the level of night sky background light of the observation, these effects have been studied with data taken on the Crab Nebula. Results from this study will be presented.

Contributed Talk

Splinter K

# Is quasar variability driven by the accretion rate?

H. Meusinger[1], V. Weiss

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The wavelength dependence of the strength $V$ of the ultraviolet and optical variability of quasars is qualitatively in agreement with the expectations for a standard accretion disk with changing mass accretion rate $\dot{M}$. We study the correlation between $V$ and $\dot{M}$ for a sample of about 4000 quasars from the Sloan Digital Sky Survey with individual variability estimators from multi-epoch photometry in the stripe 82. $\dot{M}$ is estimated via a scaling relation for a standard accretion disk using the viral black hole masses $M$ from the Mg II line. We find significant anti-correlations between the variability and both the accretion rate, Eddington ratio, and luminosity. The strongest anti-correlation is indicated with $\dot{M}$. On the other hand, however, the observed variability time scales appear to much shorter than expected and, moreover, at far ultraviolet wavelengths the observed variability is much stronger than predicted by the standard model with varying $\dot{M}$. We further show that the relation between the spectral slope and the disk temperature parameter disagrees with the expectations from the simple multi-temperature black body model of the accretion disk. We suggest that strongly inhomogeneous accretion disks may provide an explanation of these results. As a side product, we find a strong trend of increasing accretion efficiency with $M$ that is most likely the result of selection effects in combination with the scaling relations and measurement errors.

Contributed Talk

Splinter K

# Dust reverberation-mapping

F. Pozo Nuñez [1], M. Ramolla[1], M. Haas[1], R. Chini[1,2], C. Westhues[1], K. Steenbrugge[2,3], L. Kaderhandt[1], M. Murphy[4]

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The existence of a dust torus that surrounds the broad-line region (BLR) and the central accreting super massive black hole (SMBH) plays a fundamental role in the framework of an unified model for active galactic nuclei (AGN). However, the geometry of the torus is not well constrained by observations. Here, we present the first results from an ongoing dust reverberation mapping campaign using robotic telescopes of the Universitätssternwarte Bochum near Cerro Armazones in Chile. We monitored the $z = 0.0377$ Seyfert-1 galaxy WPVS48 in the optical ($B$ and $R$) and near-infrared ($J$ and $K_s$) with a cadence of two days. The $J$ and $K_s$ emission, tracing the hot (∼1600 K) dust echo, lags the $B$ and $R$ variations by on average $\tau = 64 \pm 4$ days and $71 \pm 5$ days, respectively (restframe). WPVS48 lies on the known $\tau - M_V$ relationship. However, the observed lag $\tau$ is about three times shorter than expected from the dust sublimation radius $r_{sub}$ inferred from the optical-UV luminosity, and explanations for this common discrepancy are searched for. We discuss the implications of these results.

Contributed Talk

Splinter K

# Narrow-band Photometric Reverberation Mapping of Active Galactic Nuclei

M. Ramolla[1], M. Haas[1], F. Pozo Nuñez[1,2], C. Westhues[1], R. Chini[1,2]

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Narrow band photometric reverberation mapping is an efficient method to determine the size and geometry of the BLR of AGN as well as the host galaxy free luminosities. Establishing a tight luminosity - BLR-size relation may allow type-1 AGN to be used as cosmological distance probes. Modeling of feature-rich light curves reveals nearly face-on ring-like BLR geometries. The resulting larger AGN black hole masses challenge the black hole mass - bulge relation. In general, well sampled lightcurves are required. We obtained such data with robotic telescopes at the observatory of the Ruhr-University Bochum, located in the Atacama desert in Chile. I present an overview of the project status and results.

Contributed Talk

Splinter K

# The connection between radio and $\gamma$-ray emission from relativistic outflows of quasars

F.K. Schinzel

*Department of Physics & Astronomy, University of New Mexico, USA*

With the launch of the Fermi satellite a new window was opened for the study of relativistic outflows. Quasars with their relativistic jets pointed close to our line of sight make up most of the extragalactic point sources found in the $\gamma$-ray sky. This, together with multi-wavelength observations, allowed new insights into the internal workings of AGN jets and brought us closer to the understanding of high energy emission mechanisms. These results provide important input for the understanding of jet instabilities, high energy emission mechanisms, and magnetic field structures. I will provide a summary of recent results highlighting the archetypical flat spectrum radio quasar 3C 345 and 3C 279. The discussion will include results from variability studies from radio to $\gamma$-rays, monitoring of the spatial structure of their jets using high-resolution imaging at radio frequencies, and variability of observed polarization at radio and optical bands. I will also include a brief presentation of ongoing and future investigations to expand the sample of weak $\gamma$-ray emitting quasars with confirmed counterparts at radio wavelengths that were found among previously unassociated $\gamma$-ray sources and that most likely belong to the class of BL Lac type quasars.

Splinter K

# Fairall 51: X-ray variable absorber within Broad Line Region

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Fairall 51 is a polar-scattered Seyfert 1 galaxy, a type of galaxies believed to represent a bridge between unobscured type-1 and obscured type-2 objects. Fairall 51 has shown complex and variable X-ray absorption but only little is known about its origin. In our research, we observed Fairall 51 with the X-ray satellite Suzaku in order to constrain a characteristic time-scale of its variability. We performed timing and spectral analysis of four observations separated by 1.5, 2 and 5.5 day intervals. We found that the 0.5-50 keV broadband X-ray spectra are dominated by a primary power-law emission (with the photon index $\approx 2$). This emission is affected by at least three absorbers with different ionisations ($\log \xi \approx 1-4\ \mathrm{erg\,cm^{-2}\,s^{-1}}$). The spectrum is further shaped by a reprocessed emission coming from both the accretion disc and a distant scattering region. The accretion disc emission is smeared by the relativistic effects, from which we measured the spin of the black hole as $a \approx 0.8$. We found that most of the spectral variability can be attributed to the least ionised absorber whose column density changed by a factor of two between the first (highest-flux) and the last (lowest-flux) observation. A week-long scale of the variability indicates that the absorber is located at the Broad Line Region.

Contributed Talk

Splinter K

# Quasar host galaxies from Flux-Variation-Gradient analysis

C. Westhues[1], M. Ramolla[1] , M. Haas[1], R. Chini[1,2]

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To explore quasar evolution, one open issue is to determine the luminosity and mass of the host galaxy. The two filter gradient of varying fluxes of quasars allows us to disentangle host and AGN components by their color difference. We report on the successful application of this method to PG-quasar-data by Giveon et al. (1999) and own measurements of 3C334, taken at the Universitätssternwarte Bochum near Cerro Armazones in Chile. We give new estimates of the host galaxy and AGN contribution in quasars.

Contributed Talk

Splinter K

# Velocity resolved reverberation mapping in 3C 120

M. Zetzl[1], W. Kollatschny[1]

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In the center of active galactic nuclei (AGN) reside supermassive black holes surrounded by broad emission line regions (BLR). Even for the nearest AGN the BLR is spatially unresolved. For the understanding of the AGN activity the structure, geometry and stratification of the BLR and their connection to the accretion disk plays an important role. By means of investigation on continuum and line profile variability and observed rms line profile shapes we derive not only the distance of the line-emitting region from the central region but also the height above the midplane. To analyze continuum and line profile variations we use one- and two-dimensional reverberation mapping techniques. The ratio of the full width at half maximum (FWHM) to the velocity dispersion ($\sigma_{\text{line}}$) characterizes broad emission line profiles in AGN. Based on this ratio we model the rotational and turbulent velocities in the BLR to get their stratification. There is the following trend: The height of the line emitting region above the midplane decreases with increasing rotation velocity.

# Abstracts of Contributed Talks

## Splinter L

Contributed Talk

Splinter L

## The progress of LOFAR to science quality data and first results from nearby galaxies

B. Adebahr[1] , A. Horneffer[1], D. D. Mulcahy[2], R. Beck[1]

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The LOFAR interferometer is capable of observing the sky between 30 MHz and 280 MHz with a field of view of several degrees and a resolution of less than an arcsecond. This makes it a superb instrument for observing large parts of the sky as well as deep imaging of individual objects. Anyhow, the calibration of such large fields of view in combination with the low observing frequencies are challenging.
Within the last year the establishment of the LOFAR Calibration and Imaging Tiger Team and its advisory group as well as the engagement of other commssioners have led to major progress in transforming LOFAR into a science ready telescope. Handling the enormous amounts of data and imaging large fields with arcsecond resolution needed new calibration techniques and a restructuring of the exisiting software. These efforts now result in the first publications with surprising scientific results.
This talk is going to explain the recent technical development within the LOFAR community and show the first scientific results focusing on nearby galaxies.

Contributed Talk

Splinter L

## Galactic winds in low mass galaxies

D.J. Bomans, T. Kuhnig, M. Langener, S. Blex

*Astronomical Institute, Ruhr-University Bochum*

Due to their low potential well, low-mass galaxies are prone to outflows and galactic winds driven by star formation. The magnetized nature of these large scale outflows is especially noteworthy, since dwarf irregular galaxies are the best local proxies for high redshift proto-galaxies and a prime candidate for the source of the magnetization of the intergalactic medium. A potentially important additional observation is that all the dwarf galaxies with detected ordered magnetic field are star-bursting and/or subject to gravitational interaction or gas infall. This may be an observational selection effect, but also may hint at the importance of enhanced turbulence in these galaxies.
We present here a sample of low mass galaxies with high star-formation rate. The galaxies show previously undetected, extended radio continuum emission, correlated with H$\alpha$ loops and filaments, strongly indicating large-scale magnetized outflows and galactic winds. These observations are only a taster for future SKA observations of low mass galaxies, which will allow exploring the effects of burst age, burst strength, mass and interaction properties. The data will also shed light on the mechanisms governing the amplification and dispersion of magnetic fields in low mass galaxies and will also provide critical data for the effects of magnetic fields during galaxy formation and early evolution.

Contributed Talk

Splinter L

# EoR-LOFAR project: QSO HII regions

K. Kakiichi, B. Ciardi

*Max Planck Institute for Astrophysics*

LOFAR and SKA will open up the observational window to study the Epoch of Reionization (EoR) through the radio interferometric observation of cosmological 21cm signal. Because of the extreme faintness of cosmological signal buried in foregound and noise, assessing the observability and data analysis strategy of 21cm signal prior to real-world 21cm experiments are critical ingredients for successful EoR study. The imaging of the high-redshift QSO environment is one of possible observables, which imprints large coldspots in 21cm tomography. The observability depends on possible scenarios of reionization. We present the detailed study of possible reionization scenarios of the high-redshift QSO environment using cosmological radiative transfer simulations both including contributions from galaxies and QSOs. The observability and possible detection strategies using radio interferometry, particular with LOFAR, is also discussed.

Contributed Talk

Splinter L

# Studies of giant pulses with LOFAR and the SKA

N. Lewandowska, D. Elsaesser, K. Mannheim

*University of Wuerzburg*

Radio giant pulses are currently known as one of the brightest objects in the Universe. Detected for the first time in the case of the Crab pulsar, nowadays a small number of pulsars is known to emit giant pulses. Their properties include an apparently non-periodical occurrence at fixed phase ranges, flux densities up to 1000 times higher than regular pulses, short pulse widths down to 0.4 ns, high brightness temperatures of up to $10^{39}$ K and power-law intensity distributions. Due to these characteristics they present a challenge from the theoretical point of view. Since pulsars in general are known as relatively weak objects at radio wavelengths, the characteristics of giant pulses make giant pulse emitting pulsars useful tools with regard to the discovery of new pulsars and for the investigation of open questions related to coherent emission mechanisms and plasma mechanisms. With the advent of the SKA telescope, extensive possibilities will be given to search for pulsars in other galaxies. Its large angular surface and wide field of view will make the detection of weak pulsar signals over a wider spatial range possible providing crucial information about existing supernova remnants in other galaxies indicating their star formation rates.

Within the framework of this talk results from a multifrequency study of Crab pulsar giant pulses will be presented. An overview of the characteristics in other giant pulse emitting pulsars will be given together with an outlook on potential future studies with the SKA.

Poster

Splinter L

# High-Resolution TANAMI Observations of Centaurus A

C. Müller[1,2], M. Kadler[1], R. Ojha[3], C. Großberger[2], M. Perucho[4], E. Ros[5], R. Schulz[1,2], J. Trüstedt[1], J. Wilms [2]

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Centaurus A is the closest radio-loud active galaxy. Very Long Baseline Interferometry (VLBI) enables us to study the jet-counterjet system on unprecedented small linear scales, providing essential high-resolution data on jet emission and propagation within the inner parsec of an AGN jet. We will present the results of a kinematic study performed within the framework of the AGN monitoring program TANAMI. Over 3.5 years, the evolution of the central-parsec jet structure of Cen A was monitored with VLBI. These observations reveal complex jet dynamics which are well explained by a spine-sheath structure supported by the downstream acceleration occurring where the jet becomes optically thin. Both moving and stationary jet features are tracked. A persistent local minimum in surface brightness suggests the presence of an obstacle interrupting the jet flow, which can be explained by the interaction of the jet with a star at a distance of 0.4pc from the central black hole.

Contributed Talk

Splinter L

# Pulsars at low frequencies

S. Osłowski and J.P.W. Verbiest

*Faculty of Physics, Bielefeld University*

Pulsars are the nature's best clocks and are sometimes dubbed the Universe's gift to physics. This is because these quickly spinning highly-magnetised neutron stars are excellent and versatile laboratories. They are the only objects for which all four fundamental forces are relevant. A plethora of experiments are possible with the methodology of measuring the arrival time of a pulse train known as pulsar timing as well as some other methods. Examples of possible experiments include: tests of of relativistic gravity; studies of the Solar System; determining properties of the interstellar medium; constraining the equation of state of dense matter; studying highly-mangetized plasmas; spacecraft navigation; detection of gravitational waves; and derivation of pulsar-based time standard.
LOFAR, a low-frequency pathfinder of the Square Kilometre Array provides an excellent tool to undertake many of such experiment. While the discovery of pulsars and the early observations were undertaken at low frequencies, people have moved to observing pulsars at higher frequencies. Now there is a renewed interest around the world in low-frequency observations with LOFAR being one of the existing low-frequency facilities. In this talk I will discuss how LOFAR contributes to the studies of pulsars, focusing on the usage of German LOFAR stations. Finally, I will outline how the SKA will expedite the pulsar astronomy and thus fundamental physics and what lessons we learned from LOFAR in the context of SKA.

Contributed Talk

Splinter L

# The far-infrared - radio correlation: Star formation and magnetic field amplification in galaxies

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The presence of magnetic fields is well-established in the interstellar medium of galaxies, which can be probed via the far-infrared - radio correlation even at high redshift. The relation corresponds to a correlation between the star formation rate and the magnetic field strength in galaxies. In this talk, I will show how such a correlation can be obtained as a result of turbulent magnetic field amplification. For this purpose, I will present recent studies on turbulent magnetic field amplification at high Mach numbers, and show how the latter leads to a natural relation between the star formation rate and the magnetic field strength. For this purpose, I will assume that supernova explosions are the main drivers of turbulence, and derive the expected turbulent velocities and magnetic field strength as a function of the star formation rate. I will discuss the potential evolution of this correlation with redshift, and show that we expect a breakdown in the correlation when the timescale for inverse Compton scattering becomes shorter than the timescale for synchrotron emission. The evolution of this correlation and hence the magnetic field can be tested with the SKA and its pathfinders in the coming years.

Contributed Talk

Splinter L

# Exploring the Evolution of Galactic Magnetic Fields

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Observations show that magnetic fields contribute significantly to a galaxys energy budged and that they influence astrophysical processes like for example star formation crucially. The origin of these strong fields is believed to lie in magnetohydrodynamical dynamos. In early evolutionary phases of a galaxy, the turbulent dynamo probably plays a key role in amplifying weak magnetic seed fields of the order of $10^{-20}$ G up to dynamically important values of several $10^{-6}$ G. The growth rates of this dynamo, which describes the random stretching and folding of magnetic field lines in turbulent motions, can be calculated analytically for different realizations of turbulence. We model the astrophysical properties of young galaxies and predict the evolution of the unordered magnetic field component. As saturation of the dynamo in our semi-analytical model occurs after roughly several Myrs, we expect young galaxies to be already strongly magnetized. New radio telescopes like LOFAR and SKA will be able to observe magnetic fields in highly redshifted galaxies and thus make tests for our theoretical model of the evolution of galactic magnetic fields possible.

Contributed Talk

Splinter L

## Probing the Neutron Star Population with SKA

T. M. Tauris [1,2]

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[2] *MPIfR, Bonn*

Since their discovery in the late 1960's the population of known neutron stars has grown to about 2500. The last five decades of observations have yielded many surprises and demonstrated that the observational properties of neutron stars are remarkably diverse. The surveys that will be performed with SKA will produce a further tenfold increase in the number of Galactic neutron stars known. In this talk, I will outline what we can expect to learn from the much larger statistical samples available with SKA and which main scientific questions that will be addressed by this growing number of diverse classes that are populating the "neutron star zoo".

Contributed Talk

Splinter L

# Blazars at Low Radio Frequencies

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[8] *Dr. Remeis Sternwarte & ECAP, Universität Erlangen-Nürnberg, Bamberg, Germany*

We explore the low radio-frequency properties of the MOJAVE1 blazar sample using the LOFAR Multi-Frequency Snapshot Sky Survey (MSSS). We compare the 120-160MHz MSSS flux densities to simultaneously measured single dish and VLBA 15GHz flux densities from the OVRO and MOJAVE programs and to historical 151MHz measurements. We find the characteristically flat blazar spectrum to extend down to the LOFAR bands, demonstrating that the emission at these low radio frequencies is still dominated by relativistically beamed emission. Sources found by LOFAR in higher states than the historical average level tend to show steeper radio spectra than sources in low states suggesting substantial low-frequency variability. As most sources remain unresolved at the MSSS angular resolution, we are currently reimaging these data using baselines beyond the standard MSSS uv-range. This results in an angular resolution of 10arcsec. We present first LOFAR-MOJAVE images from this project. Deeper follow-up LOFAR observations with further improved angular resolution from the inclusion of international baselines can probe the unbeamed lobe contribution. This allows for tests of the AGN unification model and serves as a proxy of kinetic jet power and thus the power emerging from the central engine of powerful blazars into their environment.

Contributed Talk

Splinter L

# Tune into mass loss rates and nebula parameters of massive stars with SKA

Kerstin Weis, D. J. Bomans, R.-J. Dettmar

*Astronomisches Institut, Ruhr-Universität Bochum*

The stellar evolution of massive stars is highly dominated by mass loss via stellar winds. Mass loss rates around $10^{-6}\,\mathrm{M_\odot a^{-1}}$ are rather typical for massive star, and can be as high as $10^{-4}\,\mathrm{M_\odot a^{-1}}$. Therefore mass loss is a critical parameter to understand the evolution of massive stars as well as the impact of the wind to the interstellar medium. Determining the mass loss rate of stellar winds currently is achieved fitting optical and UV spectra with stellar atmosphere models, a timeconsuming and complex task. An additional complication using these fitting procedure traces back to the fact that stellar winds can be clumpy, a parameter difficult to model.

An alternative way to obtain mass loss rates however exits using data in the radio regime. SKA will be able to measure mass loss rates will from the free-free emission of stellar winds – a method with a weak dependency of the clumping factor. With the larger sensitivity of the upcoming SKA, mass loss rates could be measured fast and larger statistically significant surveys will be possible. As the wind velocities of massive stars changes in course of their evolution interactions of several stellar winds phases (faster and slower, in particular in the Luminous Blue Variable and Wolf-Rayet phase) can lead to a restructuring of the ambient medium and the formation of nebula. This again is detectable in radio emission and gives way to study the stellar mass loss history.

# Abstracts of Contributed Talks

## Astronomy & Education

Contributed Talk

Astronomy and Education

# Die App AudioHimmelsführungen

Lutz Clausnitzer

*Obercunnersdorf*

Was für die anderen Naturwissenschaften das Experiment bedeutet, ist in der Astronomie die Beobachtung: Erkenntnisgewinnung und Lernmotivation. Deshalb sollte sie eine tragende Säule eines jeden Astronomieunterrichts sein, unabhängig von seiner Organisationsform. Nachts eine Schulklasse an einem günstigen Beobachtungsplatz zu versammeln, um ihr den Sternhimmel näher zu bringen, ist allerdings nicht so einfach. Mit der Applikation AudioHimmelsführungen können Lehrer und Dozenten junge Menschen nun beauftragen, ihn an einem für sie geeigneten Ort mit ihrem Smartphone selbst zu erkunden. Das bringt sogar den Vorteil, dass sie die Audiodateien jederzeit unterbrechen, zurückspulen und wieder fortsetzen, und so die Aneignungsgeschwindigkeit selbst bestimmen können. Auch für die in den Führungen 2 bis 5 besprochenen Fernglasobjekte können sie sich die individuell erforderliche Zeit nehmen. Die 20-minütigen Himmelsführungen vermitteln in ihrer Gesamtheit einen grundlegenden, allgemein bildenden Einblick in die Astronomie. Die Zusatzfolge 6 setzt sich mit der Astrologie auseinander und soll insbesondere Lehrern behilflich sein, eine heikle, aber nicht ganz unwichtige Aufgabe zu erfüllen. Im Vortrag wird ein Smartphone an einen Beamer angeschlossen und die Handhabung der App live demonstriert. Das Konzept und der didaktische Einsatz der Führungen werden diskutiert und die zur App entwickelten Arbeitsblätter vorgestellt.
Web: http://www.lutz-clausnitzer.de/AudioGuideSky/audioguidesky.html

Contributed Talk

Astronomy & Education

# The solar impact on renewable energy on planet earth

C. Deitersen

*University Siegen, Department of Physics, Observatory*

In media the energy turnaround is a widespread topic. It is mainly discussed under economic or social issues. For a deeper understanding it is important to consider this topic both from physical and astronomical perspectives.
All renewable energy carriers are fed by solar energy. By using thermodynamics to determine limits on energy conversion rates and considering the natural devaluation of solar energy one can estimate the maximum possible efficiency of renewable energy power plants. It is especially possible to calculate the required surface area to satisfy a certain energy demand. Using these results to estimate the area needed to supply a country entirely by renewable energy it is obvious that there is a direct conflict between the area needed for different purposes such as e.g. food production, living spaces and the providing of energy.

Contributed Talk

Astronomy & Education

# Astronomy for blind and visual impaired students

S. F. Kraus, E. Krause

*University Siegen, Department of Physics, Observatory*

In the public opinion astronomical and astrophysical topics are perceived both as significant and attractive. Because of their importance they should be part of our general knowledge. Therefore these topics have to be integrated to school education. At the same time it should be considered to make these contents accessible for every student. This includes also blind students and those who are visually impaired, which is a major challenge.
It is desirable that these approaches exceed simple mechanical models and use the full spectrum of human perception. For example such models can make use of the thermoreception to illustrate lower temperatures as one of the fundamental properties of a sunspot. Another objective was the development of an instrument, which allows blind people to determinate the position of the sun on their own. This talk will give a short overview on some astronomical models and instruments for blind and visual impaired students.

Contributed Talk

Astronomy & Education

# Models for teaching planetary science

I. Militschenko, L. Bzduskova

*University Siegen, Department of Physics, Observatory*

Models often play a significant role, when dealing with astronomical and astrophysical contents. They visualize exemplary circumstances and situations that are generally not directly observable. Moreover, they have the important feature to facilitate an active examination of specific topics and subjects. Therefore, vividness and the individual initiative are equally essential and vital for the successful learning of younger students. Additionally the procedure of exemplary illustrating of certain selected contents from the field of planetary science is introduced. Models of differentiation, mantle convection, seafloor spreading and also of tides are demonstrated.

Contributed Talk

Astronomy and Education

# Astronomisches Beobachten: Ein Schlüssel zur Faszination an Naturwissenschaften

Andreas Müller

*Excellence Cluster Universe, Technische Universität München*

Die Beobachtung des klaren Nachthimmels unter optimalen Bedingungen ist ein intensives Erlebnis. Noch schöner und lehrreicher ist es, wenn man diese Erfahrung mit astronomischem Hintergrundwissen macht oder die Beobachtung unter Anleitung eines Astronomiekundigen erfährt. Dazu ist nicht unbedingt ein Teleskop erforderlich, weil vieles schon mit bloßem Auge zugänglich und erfahrbar ist. Die Sternbilder erzählen uns die Geschichten und Mythen des Himmels und verbinden uns auf wundersame Weise mit unseren Vorfahren und deren Erkenntnissen (z. B. Kalender und Ursprung der Wochentage). Das Beobachtungserlebnis ist jedem zugänglich: Schon mit Grundschulkindern kann man sich auf Sternschnuppenjagd im August machen oder die Strukturen der Mondoberfläche betrachten und erklären. Selbst am unbewölkten Tag lassen sich Sonnenbeobachtungen durchführen und so die Sonnenflecken, der Sonnenzyklus und die Physik der Sonne studieren. Der Astrophysiker Andreas Müller stellt Best-Practise-Beispiele für den Schulunterricht und die gemeinsame Beobachtung vor. Die Astronomie stellt somit eine Eintrittskarte in die moderne Naturwissenschaft dar, die schon in frühem Lebensalter gelöst werden kann.

Contributed Talk

Astronomy & Education

# The mass of 70 Ophiuchi – How to weigh a star in the classroom

S. Völker

*AG Fachdidaktik der Physik und Astronomie; Friedrich-Schiller-Universität Jena*

In common textbooks about astronomy the mass determination of visual binaries is often reduced to an application of Kepler's third law. This ist too much simplified, so that students get the impression that determining stellar masses is as easy as measuring the two semi-major axes in a picture.
In this talk I will present a project for students on mass determination of the visual binary 70 Ophiuchi, taking into account that the movement of the binary is superposed by its proper motion and the stellar parallax. Furthermore the difference between the apparent and the true orbit is discussed. The project uses real astronomical observation data. One data set was collected with the 40-inch refractor at Lick Observatory and the other is listed in the Washington Double Star Catalog.
Beside the astronomical knowledge students get an insight into the scientific method. This means, for example, the method of least squares and not the use of complicated professional software. Every step of the analysis can be done with common software like Microsoft Excel or GeoGebra and the students CAS calculator.

Contributed Talk

Astronomy & Education

# Astrophysics in the Classroom

Ulrich v. Kusserow

*Olbers-Gesellschaft e. V. Bremen*

There emanates a great fascination from a variety of astronomical phenomena as well for younger people. It is therefore tempting to integrate the debate about appropriate topics into motivating school teaching. Thermodynamics, electromagnetism, atomic and nuclear physics as well as Special Relativity are the desired teaching contents set out in the curricula for the high school physics classes. In this lecture it will be demonstrated how appropriate and interesting astrophysical processes in the field of Heliophysics can be introduced profitably as a motivation base in these classrooms.

Contributed Talk

Astronomy & Education

# Computing stellar structure with widespread software

A. Weber

*University Siegen, Department of Physics, Observatory*

Computing stellar structure with widespread software Adrian Weber (University Siegen, Department of Physics, Observatory) In order to understand the physics of stars it is necessary to study the stellar structure which is described by a system of partial differential equations. These equations can only be solved analytically in certain very simple cases, generally there are only numerical solutions. It is necessary to calculate any of these equations with the help of a computer. Without the knowledge of how to produce these solutions it is difficult to get a deeper understanding of this topic.
Within this talk it will be shown how to solve these equations of stellar structure by widespread software which would not require high programming skills. It is sufficient to use table calculation software (e.g. Microsoft Excel, Open Office Calc, ...) or modelling software which can be downloaded for free from the internet (e.g. Dynasys).

# Abstracts of Posters

# Abstracts of Posters

## Splinter A

Poster

Splinter A

## High-Resolution Imaging of an Emerging Flux Region

C. Denker[1], H. Balthasar[1], A. Diercke[1,2], S.J. González Manrique[1,2], C. Kuckein[1], P. Kummerow[1,2], R.E. Louis[1], N. Bello González[3], J.M. Borrero[3], M. Franz[3], S. Hoch[3], C. Kiess[3], J. Löhner-Böttcher[3], A. Nesis[3], R. Rezaei[3], R. Schlichenmaier[3], W. Schmidt[3], M. Schubert[3], D. Soltau[3], O. von der Lühe[3], A. Lagg[4], M. Verma[4,1], M. Collados[5], A. Pastor Yabar[5], J. Jurčák[6], M. Sobotka[6], and F. Kneer[7]

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The initial stages of newly emerging flux were observed with the Blue Imaging Channel (BIC) of the GREGOR Fabry-Pérot Interferometer (GFPI) at the 1.5-meter GREGOR solar telescope on 2014 July 18. The small bipolar region was labeled active region NOAA 12119 on the next day. The blue continuum observations ($\lambda$450.6 nm) were split into four 30-minute time-series with 60 image sequences containing 80 short-exposure images each, which are appropriate for image restoration. A spatial resolution close to the diffraction limit of the GREGOR telescope and a cadence of 30 s provide time-series of restored blue continuum images ideally suited for optical flow detection. The field-of-view of $75'' \times 93''$ covers the entire emerging flux region and the complex flow field associated with the growing and separating regions of opposite magnetic polarity. Auxiliary G-band images ($\lambda$430.7 nm) with a lower cadence allow us to track G-band brigthenings, which are often associated with small-scale magnetic flux elements. The temporal evolution of the magnetic flux is based on magnetograms of the Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamics Observatory (SDO).

Poster

Splinter A

# Temporal variations in small scale chromospheric fibrils observed by sunrise

R. Gafeira[1], A. Lagg[1], M. van Noort[1], S. K. Solanki[1,2]

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During the second flight of the Sunrise observatory in June 2013 an active region with emerging magnetic fields was observed for about one hour. These data contain very high spatial resolution images of unprecedented stability of the solar chromosphere, obtained with the narrow-band Ca II H filter at 396.8 nm. In this poster we present a study of solar fibrils to evaluate transversal and longitudinal intensity variations along the skeleton of these structures. The information derived from this study will allow us to characterize the properties of the fibrils, especially in the context of the types of magnetic waves and other disturbances travelling on the fibrils.

Poster

Splinter A

# Study of waves in sunspots

N. Bello González, J. Löhner-Böttcher

*Kiepenheuer-Institut für Sonnenphysik*

The highly dynamic magnetised solar atmosphere exhibits a wealth of oscillatory magnetohydrodynamic (MHD) modes. These MHD waves are thought to play an important role in the transport of energy to the chromosphere and corona since they are channeled by the magnetic fields. In this work we aim at investigating the oscillatory phenomena present in sunspots from an observational point of view. We have analysed a (1h) time series of multi-wavelength imaging and spectroscopic observations of NOAA 11823 taken at high spatial and temporal resolution with ROSA and IBIS at the DST. By means of wavelet analysis, we study the occurrence and characteristic periodicity of umbral oscillations as well as running penumbral waves at photospheric and chromospheric level. We find that, close to temperature-minimum heights, umbral flashes and horizontally diverging waves occur continuously with a periodicity of 2-3 minutes. We show that these phenomena, typically defined as two, actually correspond to the same propagating event. These and other questions like, e.g., are umbral flashes/penumbral running waves of chromospheric nature? How deep in the solar atmosphere can one find signatures of these waves? Are they triggered by the global p-modes in a highly magnetised atmosphere?, will be addressed.

Poster

Splinter A

# Cutoff Conditions in Solar Magnetic Flux Tube Waves

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The upper solar atmosphere is heated by waves and currents channeled by the magnetic field. In the lower atmosphere this field appears mostly in the form of small flux concentrations. In order to understand relevant observations and simulations better, it is useful to perform analytical studies of the wave properties for idealized cases. Of particular interest is the cutoff behavior exhibited by some wave types: only waves exceeding a certain cutoff frequency can transport energy into the upper atmosphere, while lower frequency waves become evanescent.

We have calculated these cutoff frequencies in closed form for both torsional and transverse waves along cylindrical flux tubes. Unlike most previous results, which were restricted to very thin tubes (by taking into account only the lowest order in a radial expansion) in an isothermal atmosphere, our method can be applied to more complicated cases. In particular, we showed that torsional waves are cutoff-free for thin tubes in an isothermal atmosphere, while a cutoff arises when the tubes become thicker or non-isothermal. We also studied transverse waves along thin tubes in a non-isothermal atmosphere. (Note, however, that recently Lopin et al. (2014) suggested that the transverse wave cutoff disappears in less thin tubes.)

The non-isothermal character of the solar atmosphere enters the cutoff frequencies with terms depending on the first and second temperature derivatives. This sensitivity to variations leads to a wiggly behavior of the cutoff - even for the rather smooth semiempirical reference atmosphere, but even more so for a realistic solar atmosphere permeated by fluctuations. Because of these effects and various unavoidable simplifications, analytically derived cutoffs can only provide a rough, but nevertheless useful, estimate of the propagation characteristics of flux tube waves.

Poster

Splinter A

# The Disk Passage of Sunspot NOAA 12121

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The disk passage of sunspot NOAA 12121 was observed with the GREGOR solar telescope during the time period 2014 July 22–31. On each day, data were acquired with the GREGOR Fabry Pérot Interferometer (GFPI) in the spectral lines Fe I $\lambda$630.15 nm and Fe I $\lambda$617.34 nm. On 2014 July 25 and 28, the seeing conditions were excellent so that longer time-series were recorded approaching the diffraction limit of the telescope. The seeing conditions on the other days were variable ranging from mediocre to very good so that only snapshots of high-quality images were possible. We present reconstructed images obtained with a G-band filter ($\lambda$430.7 nm) in the Blue Imaging Channel (BIC) attached to the GFPI. These images cover a filed-of view of $75'' \times 93''$ and were obtained with a cadence of 30 s. We study the evolution of the sunspot and put discuss our findings in the context of data from space missions such as the Solar Dynamics Observatory (SDO) and the Interface Region Imaging Spectrograph (IRIS).

# Abstracts of Posters

## Splinter B

Poster

Splinter B

# Spectroscopic Survey of $\gamma$ Doradus Stars

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We present the spectroscopic survey of $\gamma$ Doradus stars. The high-resolution, high signal-to-noise data were taken with FIES/NOT and HERMES/Mercator telescope (La Palma, Spain), FEROS/2.2-meter telescope (La Silla, Chile) and HERCULES/McLellan 1-meter telescope (Mt. John University Observatory, New Zealand).

Here we discuss results of the analysis of high-resolution spectra obtained with the FIES spectrograph. First, we performed spectral classification of sample objects by comparing their spectra with spectra of standard stars. Second, we determined atmospheric parameters (effective temperature, surface gravity, miroturbulence velocity), detailed chemical composition and rotational velocity of analysed $\gamma$ Doradus stars. To determine effective temperatures and surface gravities we used additional tools, like Spectral Energy Distribution method and photometric indices. Values derived with those methods were then improved by the analysis of Balmer hydrogen lines and lines of neutral and ionised iron.

The analysis of the whole sample of observed $\gamma$ Doradus stars will allow us to discuss main properties of these pulsating objects and find their observational instability domain on the H-R diagram.

Poster

Splinter B

# Pulsation study and the frequency analysis of a KEPLER eclipsing binary star KIC9159301

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We present the photometric study of one of KIC9159301.The photometric data was taken from KEPLER mission. The star, with the spectral type A7 is a member of a detached Algol type eclipsing binary and presents short period oscillations. 18 Long Cadence Light Curves of KEPLER data has been passed through a data reduction process and merged to take out the frequencies and oscillation modes. The goal is to identify the type of the oscillator and its location in pulsation HR diagram. The identification process is going to be completed using codes like PHOEBE 0.31a and Period04.

Poster

Splinter B

# Pulsation study and the frequency analysis of a KEPLER eclipsing binary star KIC8868650

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We present the photometric study of one of KIC8868650.The photometric data was taken from KEPLER mission. The star, with the spectral type K2 is a member of an eclipsing binary and presents short period oscillations. 18 Long Cadence Light Curves of KEPLER data has been passed through a data reduction process and merged to take out the frequencies and oscillation modes. The goal is to identify the type of the oscillator and its location in pulsation HR diagram. The identification process is going to be completed using codes like PHOEBE 0.31a and Period04.

Poster

Splinter B

# Magneto-acoustic wave propagation in Sunspots

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Observations of waves above the acoustic cut-off frequency in the vicinity of strong magnetic fields are often hard to interpret, since mode conversion and wave refraction do play a role.
Therefore we study the propagation of magneto-acoustic waves inside a sunspot in realistic solar surface simulations using the 3D MHD code STAGGER. First results of the importance of the different mechanisms will be shown.

Poster

Splinter B

# Mode coupling in the beta Cephei star 15 Canis Majoris

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15 Canis Majoris is a $\beta$ Cephei pulsating star with quite a high mass of about $14M_{\odot}$. Recent photometric (Handler, 2014, IAU Symposium 301, 417) and spectroscopic (Saesen & Briquet, priv. comm.) observations confirm four pulsational frequencies. Mode identification revealed one radial mode ($\nu_2$) and two well identified dipole modes ($\nu_1$, $\nu_4$). The spectroscopic investigation indicates that the dominant dipole mode ($\nu_1$) is a centroid mode, $m = 0$ (Seasen, priv. comm.). However, we could not find any model that would fit this dipole mode together with the radial mode.
To solve this problem we incorporated non-linear mode coupling. The frequency of a mode can be significantly altered due to the interaction with other modes of close frequencies. It turned out that with the mode coupling effect we managed to find the model fitting both the radial mode $\nu_2$ and the dipole mode $\nu_1$. Moreover, we derived also constraints on metallicity and rotational velocity of the star.

# Abstracts of Posters

## Splinter C

Poster

Splinter C

# Energetic particle transport: recent developments and applications

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The problem of energetic particle scattering in the turbulent electromagnetic fields of the interstellar medium and the Solar wind is of great importance due to the variety of applications of the resulting diffusion coefficients. Examples are diffusive shock acceleration, cosmic-ray observations, and, in the heliosphere, the evolution of Solar transients. However, the simple diffusive motion that had been assumed for decades has been shown to be in disagreement with both numerical and observational results. In recent years, therefore, the problem of high-energy particle propagation had been revisited both from the analytical and the numerical side using non-linear theories and Monte-Carlo simulations, respectively. Here, some recent developments in the kinetic description of high-energy particle propagation will be shown, some of which are of particular interest for the Solar wind. Novel applications include the steepening of energy spectra due to momentum diffusion, pitch-angle diffusion, curvature of the mean magnetic field, and diffusive shock acceleration.

# Abstracts of Posters

## Splinter D

Poster

Splinter D

# The Bochum plate collection and first steps in its exploration

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The Astronomical Institute of the Ruhr-University Bochum, the first for the new Universities founded in Germany in the 60ties and 70ties, is maybe not a very natural place to expect even a modest collection of photographic plates. Still, over the first $\sim 20$ years of the history of AIRUB, several sets of old plates and a sizeable number of plates from ESO and other observatories where brought to Bochum as part of various science programs.
After moving the plates to a single storage place in the institute we now started compiling a full inventory. The collection includes e.g. the plate collection of the Bochum Comet Halley campaign at La Silla, and apparently a part of the Bolivia objectiv prism survey. Already, several other promising data sets where found by us, too. As a result, we started experiments with plate scanning and used M. Gefferts scanning hardware at AIfA Bonn (the site of the “Sammlung Historischer Himmelsaufnahmen“).
First science projects focus on long-term variability, which is also linked to already ongoing programs at Bochum on the physics and evolution of very massive stars. We started to look at Magellanic Cloud plates in the Bamberg collection in connection with our Magellanic Cloud photometric survey MCSF, and have already first results from photometry on historic plates and new CCD data of the Tautenburg 2m telescope on massive stars in M33 (Burggraf et al. 2014) and M31.

Poster

Splinter D

## The runaway B-star pair HIP 29678 and HIP 22061

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Using a sample of runaway B-star candidates, i.e. young and massive stars away from star-forming regions, we analyse the mechanisms ejecting these stars from their corresponding birthplaces in the Galactic plane. The two rivalling ejection scenarios - disruption of a binary system by a supernova explosion versus acceleration through dynamical many-body interactions - are hereby distinguished via a high resolution spectroscopic as well as kinematic investigation. Here we demonstrate the spectroscopic and kinematic analysis (see Fig. 6) on the basis of the runaway stars HIP29678 and HIP22061, which are supposed to be accelerated by the dynamical channel.

Poster

Splinter D

## Abundance profiles of Blue Horizontal Branch stars

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Horizontal branch stars are core helium burning objects, in a late evolutionary stage of low and intermediate mass stars. These stars lose most of their outer, hydrogen rich envelopes after the red-giant branch, ignite helium in a degenerate core and settle on the horizontal branch. It has been observed that most of them populate either the red (cool; $T_{\rm eff} \approx 6\,000 - 12\,000$ K, including the red clump) or the blue (hot; $T_{\rm eff} \approx 16\,000 - 23\,000$ K) end of the horizontal branch. We have observed a small, but representative sample of blue horizontal branch stars and analyzed their spectra with NLTE model atmosphere techniques. We found that the stars show two characteristic abundance patterns: helium, carbon, nitrogen, oxygen, magnesium and sulfur are either enhanced or depleted by about an order of magnitude with respect to the solar mixture. The abundance patterns of our stars are remarkably different even though they share the same location in the HRD.

It is known that diffusion processes change the abundance stratification of these elements in blue horizontal branch stars and are most effective near $\sim 18\,000$ K. However, our findings are not in full agreement with the predictions of diffusion theory. The observations suggest that all the elements are settling in stars cooler than $21\,000$ K and radiative levitation may occur only in hotter and metal rich stars. The reason of these differences remain obscure, and can be due to internal processes as well as initiated by an external source. However, neither radial velocity variations, that would indicate binarity, nor infrared excess due to a debris disk have been observed.

Poster

Splinter D

# Runaway stars in supernova remnants G320.4-1.2 and G315.4-2.3. Spectral classification of young OB stars.

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Part I: Runaway stars
We search for runaway stars in supernova remnants G320.4-1.2 and G315.4-2.3 (two possible remnants of the SN 185 AD) in order to reconstruct the structure of the stellar system before the supernova event, and the dynamical processes which ejected one component out of the system during the event. Several promising candidates have been found so far. We are working on further observations to estimate precise velocity and age of the candidates.

Part II: OB stars
A number of young OB stars has a not sufficiently well known spectral type yet. We determine the exact type of such OB stars. The observations were made with the échelle spectrograph FLECHAS on the 0.9 m telescope of the University Observatory Jena during 2014. A total amount of 57 targets has been observed. The identification of the spectral types is in progress.

Poster

Splinter D

# A new HW Virginis system consisting of a pulsating sdB and a possible brown dwarf companion

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The formation of hot subdwarf stars (sdBs), which are core helium-burning stars located on the extended horizontal branch, is still not understood. Many of the known hot subdwarf stars reside in close binary systems with short orbital periods with either M dwarf or brown dwarf companion, or white dwarf companion. For those systems common envelope ejection is the most probable formation channel. Among these the so-called HW Virginis systems, which are eclipsing systems consisting of sdB+dM or BD companion, are of special importance because it is possible to constrain the parameters of both components tightly by combining spectroscopic and light curve analyses. In very few of the HW Virginis systems, moreover, pulsations of the sdB are visible, which makes the system even more interesting, as the results from the lightcurve analysis can be checked by asteroseismology.
Here we report on a new found HW Virginis system with a period of only 0.065 d. The lightcurve shows total eclipses and low-amplitude pulsations with periods of some minutes. The companion with a mass of 0.069 $M_\odot$ is near the limit for stellar hydrogen burning and could therefore be a brown dwarf.

Poster

Splinter D

# Hypervelocity Candidates of G and K type: Classification of Palladino et al. sample revised

M. Volkert, U. Heber, E. Ziegerer

*Dr. Karl Remeis-Sternwarte, Bamberg*

Various mechanisms can accelerate stars to such high velocities that they are ejected out of the Galactic gravitational potential. Such stars are called Hypervelocity Stars (HVSs). HVSs are a puzzling feature of the Galactic halo. By means of reconstructing their trajectories the potential of the Galaxy can be deduced. Until now all but one confirmed HVSs are massive B-type stars, so it is an interesting aim to search for less massive stars, like G- and K-type with high velocities. Such a search was recently carried out by Palladino et al. (2014). They discovered twenty G- and K-type stars with space velocities of more than 600 $kms^{-1}$ from the Sloan Digital Sky Survey (SDSS) and analysed their kinematics. The space velocity depends on the stars' radial velocity, proper motion and distance. These stars have unusual high proper motions. Moreover the Palladino et al. (2014) stars' are metal-poor and show $\alpha Fe$ enrichment characteristic of population II stars. So it is very exiting to have a closer look on them. In this work these stars are revisited with own proper motion measurements and with the potential models of the Galaxy described by Irrgang et al. (2013). The Results were somewhat surprising.

Poster

Splinter D

# The LBV nebula of He 3-519 – smooth and spherical ?

Kerstin Weis

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He 3-519 is one of roughly a dozen well known LBVs in our Galaxy. The LBV phase is a transitional state massive stars may pass while evolving from main-sequence to Wolf-Rayet stars. LBVs show a photometric as well as spectroscopic variability, shifting between a hotter and cooler phase with a few years. During their cool state LBVs are close to the Humphreys-Davidson limit (or analog the Eddigton / Omega-Gamma stability limit). LBVs show stronger stellar winds with a high mass loss rate and in some cases even have spontaneous giant eruptions. As a consequence of both (winds and/or giant eruptions) LBVs form small ($< 5\,\mathrm{pc}$) gaseous circumstellar nebulae.
He 3-519 is one of the few nearly spherical/elliptical galactic LBV nebulae of which nearly 70% are bipolar. High-resolution long slit echelle observations and HST images indicate however that the nebulae show small spatial and kinematic deviations from a really perfect sphere. A morphologic and kinematic analysis of the nebulae around He 3-519 will be presented and comparison to photometric data of the central star. Last but not least the results will be put into context with the other bipolar galactic nebulae.

# Abstracts of Posters
## Splinter E

Poster

Splinter E

# GLORIA Project Robotic Telescopes BART and D50 in Ondřejov and GRB Follow-Up

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GLORIA is the first free and open- access network of robotic telescopes in the world. It is a Web 2.0 environment where users can do research in astronomy by observing with robotic telescopes, and/or by analysing data that other users have acquired with GLORIA, or from other free access databases, like the European Virtual Observatory (http://www.euro-vo.org).
The two GLORIA robotic telescopes at the Ondrejov Observatory will be presented and discussed including their potential for GRB follow-up.

# Abstracts of Posters

## Splinter G

Contributed Talk

Splinter G

# Spectral Redshift Estimates Using k Nearest Neighbors Regression

S.D. Kügler, K.L. Polsterer, M. Hoecker

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In astronomy, new approaches to process and analyze the exponentially increasing amount of data are inevitable. While classical approaches (e.g. template fitting) are fine for objects of well-known classes, alternative techniques have to be developed to determine those that do not fit. Therefore a classification scheme should be based on individual properties instead of fitting to a global model and therefore loose valuable information. An important issue when dealing with large data sets is the outlier detection which at the moment is often treated problem-orientated.
In this paper we present a method to statistically estimate the redshift $z$ based on a similarity approach. This allows us to determine redshifts in spectra in emission as well as in absorption without using any predefined model. Additionally we show how an estimate of the redshift based on single features is possible. As a consequence we are e.g. able to filter objects which show multiple redshift components. We propose to apply this general method to all similar problems in order to identify objects where traditional approaches fail.
The redshift estimation is performed by comparing predefined regions in the spectra and applying a $k$ nearest neighbor regression model for every predefined emission and absorption region, individually.
We estimated a redshift for more than 50% of the analyzed 16,000 spectra of our reference and test sample. The redshift estimate yields a precision for every individually tested feature that is comparable with the overall precision of the redshifts of SDSS. In 14 spectra we find a significant shift between emission and absorption or emission and emission lines. The results show already the immense power of this simple machine learning approach for investigating huge databases such as the SDSS.

# Abstracts of Posters

## Splinter H

Poster

Splinter H

# Extrasolar planets around post-common envelope binaries

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Context: Close stellar binaries with a post-main sequence component such as a white dwarf must have gone through the stage of common envelope evolution which also includes stellar mass-ejection.
Aims: With regard to the system NN Serpentis we want to put further constraints on the survival of first-generation planets around post-common envelope binaries and discuss the formation of cicumstellar disks where second-generation planet formation could occur.
Methods: We use the FLASH code to perform full three-dimensional hydrodynamical simulations starting after the rapid-infall phase of the binary to follow the evolution of the expanding envelope together with the dynamics of the planetary system.

Notes

# Abstracts of Posters

## Splinter K

Poster

Splinter K

# The Gamma-Ray Emitting Radio-Loud Narrow-Line Sy 1 Galaxy PKS 2004-447 I. The X-ray View

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The discovery of an elusive sample of gamma-ray bright radio-loud narrow-line Seyfert 1 ($\gamma$-NLS1) galaxies revealed an intriguing new aspect of the AGN phenomenon. As part of the multiwavelength monitoring program TANAMI, we study the X-ray properties of the radio-loudest $\gamma$-NLS1 PKS 2004-447. We present new high-resolution X-ray observations with XMM-Newton and monitoring observations with Swift from 2012 until 2014, as well as archival data since 2004. These observations reveal a moderately variable unobscured X-ray spectrum, which is dominated by a power-law component, that can be interpreted as non-thermal emission from the relativistic jet. The previously reported soft X-ray excess of PKS 2004-447 is missing in the new X-ray observations. In comparison to other $\gamma$-NLS1 we find that the main difference among sources of this small sample is their X-ray luminosity, which spans almost two orders of magnitude.

Poster

Splinter K

# FACT - Flare Alerts from Observations at Very High Energies

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Active Galactic Nuclei (AGN) are highly variable objects which show flux variations at energies across the electro-magnetic spectrum. The timescales of the variations can range from minutes to years. Only in some cases, correlations between different wavelengths could be found which leaves the question about the origin of the high energy emission still unclear. To study this variability, longterm observations are mandatory, and to draw conclusions on the underlying physics, multi-wavelength observations (MWL) are vital.
Especially at very high energies, the data samples were rather sparse. Therefore one of the major goals of the First G-APD Cherenkov Telescope (FACT), a Cherenkov telescope operational on the Canary Island of La Palma since October 2011, is the longterm monitoring of a small sample of AGN at very high energies. The telescope also participates in MWL campaigns.
As MWL observations are very important for the interpretation of the data, a quick look analysis was set up on site to be able to alert other instruments. In June and July 2014, several flare alerts were sent to the community. Furthermore, the results of this automatic quick look analysis are publicly available on http://www.fact-project.org/monitoring to allow the community to follow the activity states of the observed sources.
Recent results from the quick look analysis will be presented.

Poster

Splinter K

# A Hard X-ray Survey of Radio-Selected Blazars

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The MOJAVE program has been monitoring a statistically complete sample of 135 radio-loud active galactic nuclei (AGN) of the northern hemisphere using the Very Long Baseline Array (VLBA). This sample, dominated by low-peaked blazars, is here characterized for the first time in the hard X-ray regime by the use of *Swift*/BAT. Here, we present the hard X-ray flux and luminosity distributions and discuss a partial correlation of (beamed) radio and X-ray fluxes as well as their luminosities. Previous *Swift*/BAT surveys revealed 49 hard X-ray emitting blazars all over the sky. MOJAVE-1, extended by the blazar list of the southern VLBI program TANAMI, exhibits a large portion of hard X-ray emitting blazars (127 out of 169), more than doubling the known population in this energy regime.

Poster

Splinter K

# First Statistical Tests for Clumpy-Torus Models: Constraints from *RXTE* monitoring of Seyfert AGN

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The AGN community is in the process of exploring a range of models to describe the morphology of the circumnuclear accreting gas in the vicinity of supermassive black holes. Models incorporating discrete clumps or filaments, as opposed to configurations hosting strictly homogeneous extended structures, are being tested. We present an analysis of multi-timescale variability in line-of-sight X-ray absorbing gas as a function of optical classification in a large sample of Seyfert AGN to derive the first X-ray statistical constraints for clumpy-torus models. We systematically search for discrete absorption events in the vast archive of *Rossi X-ray Timing Explorer* monitoring of 55 nearby type Is and Compton-thin type IIs. We detect 12 eclipse events in 8 objects, roughly tripling the number previously published from this archive. Event durations span hours to years. The column density profile for an eclipsing cloud in NGC 3783 is doubly spiked, possibly indicating a cloud that is being tidally sheared. Most of our detected clouds commensurate with the outer portions of the BLR, or the inner regions of infrared-emitting dusty tori. We discuss implications for cloud distributions in the context of clumpy-torus models.

Poster

Splinter K

# Statistical properties of a large sample of Kohonen-selected weak-line quasars

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We performed a neural network based search for weak emission line quasars (WLQs) among the spectra of $10^5$ quasars from the Sloan Digital Sky Survey. The selected sample consists of 365 quasars in the redshift range $z = 0.6 - 4.2$. The WLQs were found to have, on average, significantly higher luminosities, Eddington ratios, and accretion rates compared to ordinary quasars. The percentage of radio detected quasars and of core-dominant radio sources is significantly higher than for the control sample, whereas the mean radio-loudness is lower. The spectral energy distribution from the mid-UV to the near-IR shows a bluer continuum than usual. The composite WLQ spectrum is reasonably matched by an additional power-law component in relativistically boosted radio-quiet quasars, which may explain the high percentage of radio quasars. This, however, cannot be the dominant continuum source because the observed variability is relatively low. For an alternative explanation we assume that quasar activity consists of subphases with different accretion rates where a change towards a higher rate is probably accompanied by an only slow development of the broad line region. The higher luminosities and Eddington ratios can also be explained by hotter continua, i.e. higher accretion rates. The observed properties of the WLQs are thus consistently understood assuming the sample consists of a mix of quasars at the beginning of a stage of increased accretion activity and of beamed radio-quiet quasars.

Poster

Splinter K

# Sorting out the mess: Kohonen self-organising maps for multi-epoch photometry of SDSS quasars

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We report on tests of the software tool chain ASPECT to sort light curves for a large number of objects. ASPECT is based on an artificial neural network algorithm that uses unsupervised learning to produce a similarity map using the Kohonen-technique of self-organising maps (SOMs). Originally designed for the efficient computation of huge SOMs of up to about one million spectra, ASPECT was successfully tested for sorting the spectra from the Sloan Digital Sky Survey (SDSS), especially for the selection of weird quasar spectra. Here, we apply, for the first time, ASPECT to time series data. The relative similarity of light curves depends on the amplitudes, time scales, and the "phase shift". Instead of analysing the light curves itself, we compute the SOMs of the amplitude-normalized first-order structure functions, which is determined by the variability time scales and the light curve profile of the canonical shots. We present both results from simple simulated light curves as well as from the multi-epoch photometric data of more than 8000 SDSS quasars.

Poster

Splinter K

# The Gamma-Ray Emitting Radio-Loud Narrow-Line Seyfert 1 Galaxy PKS 2004−447 II. The Radio View

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The discovery of an elusive sample of gamma-ray bright radio-loud narrow-line Seyfert 1 ($\gamma$-NLS1) galaxies revealed an intriguing new aspect of the AGN phenomenon. We study the radio-loudest $\gamma$-NLS1 galaxy, PKS 2004− 447, as part of the multiwavelength monitoring program TANAMI. We show the first 8.4 GHz VLBI image, revealing a high brightness-temperature core and a prominent single-side radio jet on parsec scales. In comparison to other $\gamma$-NLS1s, PKS 2004−447 exhibits a unique persistent steep radio spectrum with moderate amplitude and spectral variability. The total radio emission is coming from a region smaller than $\sim$ 0.5 kpc, confirming previous suggestions of a classification of PKS 2004−447 as a Compact Steep Spectrum (CSS) source.

Poster

Splinter K

# CAFOS-Spectra of nearby Seyfert-1 galaxies

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In preparation of photometric reverberation mapping (PRM) campaigns of nearby Seyfert-1 galaxies, we have obtained spectra of 38 Seyfert-1 nuclei using CAFOS at the 2.2m telescope on Calar Alto in November 2012. The aim is to determine the strength and width of the Balmer lines. 21/8/9 sources show strong, intermediate and faint H$\alpha$, respectively, compared to the underlying continuum. Thus 29 sources have been selected for PRM. The velocity dispersion of the broad Balmer lines will serve as an ingredient – in combination with the PRM based BLR size – to estimate the black hole mass.

# Abstracts of Posters

## Splinter L

Poster

Splinter L

# High-Resolution TANAMI Observations of Centaurus A

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Centaurus A is the closest radio-loud active galaxy. Very Long Baseline Interferometry (VLBI) enables us to study the jet-counterjet system on unprecedented small linear scales, providing essential high-resolution data on jet emission and propagation within the inner parsec of an AGN jet. We will present the results of a kinematic study performed within the framework of the AGN monitoring program TANAMI. Over 3.5 years, the evolution of the central-parsec jet structure of Cen A was monitored with VLBI. These observations reveal complex jet dynamics which are well explained by a spine-sheath structure supported by the downstream acceleration occurring where the jet becomes optically thin. Both moving and stationary jet features are tracked. A persistent local minimum in surface brightness suggests the presence of an obstacle interrupting the jet flow, which can be explained by the interaction of the jet with a star at a distance of 0.4pc from the central black hole.

Poster

Splinter L

# All-sky imaging with low frequency aperture arrays and flux density calibration

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New large-N dipole aperture arrays like the first station of the Long Wavelength Array (LWA1) with 256 cross-dipole elements pose particular challenges especially for calibration and imaging. In the context of all-sky imaging we have developed new tools to facilitate the day-to-day operation, calibration, and imaging of cross-correlated data from this array. We will present recent scientific results together with sky maps that were produced for a range of frequencies which can be used to improve the accuracy of the existing global sky model below 100 MHz. In addition, we will showcase a newly developed GPU-based simulation code that allows the calculation of sensitivities for beam-formed data of LWA1. Together with an updated global sky model below 100 MHz we are now able to provide absolute flux density calibration for the total power measured by the beam-former despite significant levels of primary beam confusion, galactic diffuse emission, and other instrumental effects. The tools and results from this work have direct implications for facilitating single station use as in the case of individual LOFAR stations and to provide more realistic simulations for the expected sensitivities of large-N dipole aperture arrays as envisioned for the SKA.

Poster

Splinter L

# Tune into mass loss rates and nebula parameters of massive stars with SKA

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The stellar evolution of massive stars is highly dominated by mass loss via stellar winds. Mass loss rates around $10^{-6}\,\mathrm{M_{\odot}a^{-1}}$ are rather typical for massive star, and can be as high as $10^{-4}\,\mathrm{M_{\odot}a^{-1}}$. Therefore mass loss is a critical parameter to understand the evolution of massive stars as well as the impact of the wind to the interstellar medium. Determining the mass loss rate of stellar winds currently is achieved fitting optical and UV spectra with stellar atmosphere models, a timeconsuming and complex task. An additional complication using these fitting procedure traces back to the fact that stellar winds can be clumpy, a parameter difficult to model.

An alternative way to obtain mass loss rates however exits using data in the radio regime. SKA will be able to measure mass loss rates will from the free-free emission of stellar winds – a method with a weak dependency of the clumping factor. With the larger sensitivity of the upcoming SKA, mass loss rates could be measured fast and larger statistically significant surveys will be possible. As the wind velocities of massive stars changes in course of their evolution interactions of several stellar winds phases (faster and slower, in particular in the Luminous Blue Variable and Wolf-Rayet phase) can lead to a restructuring of the ambient medium and the formation of nebula. This again is detectable in radio emission and gives way to study the stellar mass loss history.

# Abstracts of Posters

## General Posters

Poster General

# VLBI Observations of NGC1052

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Because of its distance of only about 20Mpc and the orientation of its twin-jet system near the plane of the sky, the active galaxy NGC 1052 is the ideal target for mm-VLBI studies of jet formation on the smallest accessible scales. At cm wavelengths, NGC 1052 is well known for its prominent emission gap between the two jets due to free-free absorption in a circumnuclear torus obscuring the central engine. Our mm-VLBI observations at 43 GHz and 86 GHz peer through the absorber and reveal one strong central feature with a high brightness temperature of $T_{\mathrm{b}} > 2\times10^{11}$ K, well above the equipartition limit. Interpreting this as blended emission from the bases of both jets, their separation can be constrained to less than about 0.0014 pc or 90 Schwarzschild radii. We present results from four years of mm-VLBI monitoring observations, studying the variability and the symmetry of the twin-jet production.

Poster General

# Formation of phase lags at the cyclotron energies in the pulse profiles of magnetized, accreting neutron stars

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Accretion-powered X-ray pulsars show highly energy-dependent and complex pulse-profile morphologies. Significant deviations from the average pulse profile can appear, in particular close to the cyclotron line energies. These deviations can be described as energy-dependent phase lags, that is, as energy-dependent shifts of main features in the pulse profile. Using a numerical study we explore the effect of cyclotron resonant scattering on observable, energy-resolved pulse profiles. **Methods:** We generated the observable emission as a function of spin phase, using Monte Carlo simulations for cyclotron resonant scattering and a numerical ray-tracing routine accounting for general relativistic light-bending effects on the intrinsic emission from the accretion columns. **Results:** We find strong changes in the pulse profile coincident with the cyclotron line energies and demonstrate how phase lags at the cyclotron energies arise as a consequence of the effects of angular redistribution of X-rays by cyclotron resonance scattering in a strong magnetic field combined with relativistic effects.

Poster General

# The determination of the local rotation curve of the Galaxy based on the plate archive in Bonn

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The plate archive in Bonn ("Sammlung Historischer Himmelsaufnahmen", [SHH]) is a collection of some 15.000 photographic plates taken in Bonn, Göttingen and Hoher List observatory from 1899 to 1990. Due to the focal length, the quality and the limiting magnitude ($m_B$=$15^m$) these plates are very suited for the determination of accurate proper motions. While in the past the plates of the globular clusters were used for the determination of proper and space motions of globular clusters, the plates of open clusters were mainly used for relative proper motion work (membership, IMF).
We have started a new project on the determination of absolute proper motions of 35 open clusters for a more accurate determination of the local rotation curve of the Galaxy. Plates from the archive taken mainly with the Bonn refractor and taken with the Hainberg astrograph at Göttingen are used in this investigation. Here we present the first results of the clusters M16, NGC 2194, NGC 2420 and NGC 6819. Measurements and reductions are treated along the following guidelines:

- We used an EPSON 4990 scanner and scan all plates in four orientations in order to avoid systematic errors.
- First epoch plate measurements are combined with recent positions of the UCAC4 and the 2mass catalogue.
- In a first step, we determine relative proper motions. The accuracy of a single proper motion is of the order of 1.2 to 1.5 mas/yr. These proper motions are then linked via (in most cases) 80 to 100 stars to the Tycho 2 system.

The mean error of an absolute proper motion of one open cluster shows an accuracy of 0.3mas/yr.

Poster General

# Correction of Scintillation Noise in Fourier Tranfsform Spectroscopy

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The laboratory of the Institut für Astrophysik at the Georg-August-Universität Göttingen was recently upgraded with a Fourier-transform spectrometer. It is primarily used for the analysis of calibration sources for astronomical instruments, and also to record high resolution solar spectra. In Fourier-transform spectroscopy, a source of noise and errors are variations in the intensity of the source during the measurement. In solar spectroscopy, atmospheric seeing and thin clouds passing through the line of sight are a source of such variations. To examine and correct for the effects, the spectrometer was upgraded with an additional setup: A pellicle beam sampler is used to deflect part of the light entering the instrument onto a photodetector. The interferogram recorded by the spectrometer is divided by the recorded intensity prior to the Fourier-transformation into a spectrum. First results, using real and theoretical interferograms, show that noticable differences in signal-to-noise and lineshape can be seen for individual spectra with large variations ($> 10\%$). Otherwise, seeing is too weak and too slow compared with the modulation frequency of the spectrometer to have a measurable effect on the quality of the spectrum. In addition, a 5% decrease in the signal-to-noise-ratio has to be taken in to account due to the beam sampler reflecting an average of 8% of the incoming light.

Poster General

# GRS 1758−258 in the Soft X-rays: A Peculiar Microquasar with a Warped Disk?

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We present the spectral and timing evolution of GRS 1758-258, one of only three known persistent black hole binaries in our Galaxy, based on 11 years of RXTE-PCA observations. During this time, GRS 1758-258 entered a thermally dominated soft state seven times, showing a strong decline in the 3-20 keV flux rather than an increase. The spectral flux light curve does not contain any orbital modulations in the range of 1 to 30 days, but in the dynamic power spectrum significant peaks are drifting between 18.47 ± 0.25 and 18.04 ± 0.22 days. A possible interpretation of this drifting periodicity could be a radiation-driven warp in a precessing accretion disk. Simulations for the ASTRO-H mission (launch in 2015) show that with calorimeter resolution in the soft X-rays, it will be possible to detect changes in the accretion disk inclination as the warp precesses.

Poster General

# Potential magnetic field extrapolation in binary systems

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Magnetic fields have a decisive influence on the structural, dynamical and thermal properties of the coronae of cool stars. Since even in the case of the Sun direct observations of coronal magnetic fields are difficult to accomplish, extrapolation methods are frequently used to infer them from observed magnetic field distributions in the photosphere. The potential field source surface (PFSS) approximation has proven helpful in the description of large-scale solar and stellar (as well as planetary) magnetospheres, because it accounts for the existence of stellar winds through the assumption of magnetic fields becoming purely radial at a certain distance above the photosphere. Albeit more sophisticated extrapolation methods have been developed since, the PFSS approach remains significant, since the resulting magnetic field represents the stable, lowest-energy state consistent with given boundary conditions. Here, we extend the PFSS technique to the case of a binary star systems. We describe the theory and numerics of the two-centre extrapolation technique and demonstrate its applicability in the case of the close pre-main sequence binary V4046 Sgr, for which magnetic surface maps for both stellar components have been reconstructed based on Zeeman-Doppler imaging observations. Our results reveal a joint magnetosphere with complex magnetic field structures connecting the two components. Further observable diagnostic signatures of the coronae are discussed as well as the applicability of the method to the case of magnetic interaction between a host star and a close-in hot Jupiter.

Poster General

# Exploiting EB candidates with low-cost InGaAs FPAs

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The photometric precision that can be reached by a low-cost InGaAs camera manufactured by Xenics has been evaluated by the observation of dense stellar field that contain non variable sources. Differential photometry is used to determine the precision that can be achieved depending on the magnitude of the target. All observations were carried out at the 1.2m Oskar Luehning Telescope of the Hamburg Observatory. No filter was used to obtain the highest possible signal to noise ratio. The wavelength range is 0.9$\mu$m to 1.7$\mu$m. At the faint end ($m_{J,1}$=12.9 and $m_{J,2}$=11.8) the photometric scatter is 46mmag. This is somewhat higher than the value of 17mmag that can be expected by evaluation of the CCD equation.
After verification of the photometric precision the camera has been used to observe low-mass eclipsing binary candidates. The objects were chosen from the Northern Sky Variability Survey that are lacking follow-up observations to refine and constrain their orbital parameters and thus determining the physical properties of these systems. Candidates have been chosen by the following criteria: short periods that allow multiple occasions for observations to allow for bad weather losses, dense stellar fields to have multiple reference stars in the small field of view of the detector (size: 169"*135"), objects that will have altitudes of more than 40° at Hamburg for extended periods of time and deep transits to allow high S/N. First results of this newly started observing campaign will be presented.

Poster General

# The eROSITA Near Real Time Analysis

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We present an overview of the Near Real Time Analysis (NRTA) software of the X-ray telescope eROSITA. The two main purposes of the NRTA are to provide a quick scientific analysis and to perform health checks of the incoming data as early as possible to ensure the scientific quality of the data and to identify possible problems.
As a first step, the NRTA pipeline will decode the telemetry stream and write the event and housekeeping information to separate FITS files. Secondly, the health checks will be performed and resulting detector and housekeeping graphs will be displayed. The third step is to run the eROSITA standard SASS pipeline to obtain sky images and source lists.
To study the capabilities of the instrument and to assess the requirements for the NRTA, we have developed a generic X-ray instrument simulator. Based on a Monte Carlo approach, the code generates photons for sources in an X-ray source catalogue such as the ROSAT all sky survey. The simulator then models the imaging and detection process based on calibration files (e.g., point spread functions). The resulting event lists can then be either analyzed using standard software or packaged as telemetry stream to test the NRTA. Due to its modular concept, the simulator is also used for the future missions.

Poster General

# The BeXRB outburst zoo: outburst catalog and properties

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We present an almost complete catalog of X-ray outbursts of 16 different Be X-ray binaries (BeXRBs) as observed by INTEGRAL-ISGRI and -JEM-X, CGRO-BATSE, RXTE-ASM, Swift-BAT, and MAXI. Such a catalog does not exist yet up to our knowledge. However, it is considered to be of particular importance when studying Be X-ray binary (BeXRBs) quantitatively. Furthermore, it allows to quickly find and reference particular outbursts for future work. Apart from the outburst dates we have included some basic properties for each outburst. Those results were obtained by a fit of every single outburst to a phenomenological model describing the outburst's long-term flux evolution. We find that a large fraction of all cataloged outbursts can be described well with this model. Some of the resulting parameters, such as the outburst length and the peakflux, correlate for a particular source. These correlations, however, differ between the various BeXRBs, and are therefore specific properties of a system. What causes these properties and how they depend on other quantities of the binary, e.g. the orbital period or the neutron star's magnetic field, will improve our understanding of BeXRBs in the future.

Poster General

# The X-ray emission in Water Maser and Non-Maser Galaxies

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Water maser galaxies are a rare subclass of Active Galactic Nuclei (AGN). They play a key role in modern cosmology, since they provide a significant improvement for measuring geometrical distances with high precision. Therefore, they allow a determination of $H_0$ with accuracy of better than 3%, providing powerful constraints on the equation of state of dark energy (Braatz 2008, ASPC, 395, 103B). Measurements for every single object are independent, the uncertainty consequently decreases with increasing detections of suitable water masers. We have studied the X-ray properties of a unique and homogeneous sample of Type 2 AGN with water-maser activity observed by *XMM-Newton* to investigate the properties of AGN hosting mega-masers compared to a control sample of non-maser AGN, both analysed in a uniform way. A comparison of the spectral shape of water-maser and non-maser AGN indicates that water-maser X-ray spectra tend to be more complex than non-maser spectra. This suggests that also the physical processes in maser sources are more complex. Here we present a unique, systematically-analyzed sample of maser and non-maser AGN that have been observed by *XMM-Newton*.

Poster General

# Determination of $H_0$ with Megamaser Galaxies

E. Litzinger[1,2], J. Braatz[3], M. Kadler[1], J. Wilms[2] on behalf of the *Megamaser Cosmology Project*

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The Megamaser Cosmology Project (MCP) is an NRAO Key Science Project to measure the Hubble Constant, $H_0$, by determining geometric distances to circumnuclear 22 GHz $H_2O$ megamasers in galaxies well into the Hubble flow. In combination with the recent, exquisite observations of the Cosmic Microwave Background (CMB) by WMAP and Planck, these measurements provide a direct test of the standard cosmological model and constrain the equation of state of dark energy. The MCP has determined $H_0 = 68.6 \pm 3.8\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$ (Braatz et al. 2013; Gao et al., in prep), a 5.5% result. Our measurement is intermediate between the Planck prediction of $H_0$ in the context of the standard cosmological model ($H_0 = 67.3 \pm 1.2\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$) and recent measurements based on standard candles ($H_0 = 74 \pm 2.5\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$).
The second goal of the MCP is to measure “gold standard” masses of supermassive black holes (SMBH) by tracing the Keplerian rotation curves of megamaser disks only tenths of a pc from the nuclei and well within the SMBH "sphere of influence". To date we have measured 17 SMBH masses, most with $< 10\%$ uncertainties (Kuo et al. 2011; Zhao et al., in prep). These measurements demonstrate a breakdown of the M-$\sigma$ relation at the low-mass end, implying that any feedback that controls the apparent co-evolution of SMBHs and their elliptical host galaxies has not yet taken hold in spiral galaxies (Greene et al. 2010).

Poster General

# A High Resolution Solar Atlas observed with a Fourier-Transform-Infrared Spectrometer

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The Institut für Astrophysik at the Georg-August-Universität Göttingen is owner of a ground based 50 cm Vacuum-Vertical-Telescope which is embedded in the physics department building. In the history of the institute, solar spectroscopy has always been an important topic that allows fundamental research on the basic physical processes that are happening in stars. Since two years the institute holds a Fourier-Transform-Spectrograph of type IFS 125 HR from Bruker that makes high precession solar measurements possible. A new solar atlas, that covers a spectral range from 400 nm up to 2.3 $\mu$m with a spectral resolving power $R = \frac{\lambda}{\Delta\lambda} = 1\,000\,000$, was prepared with this instruments. Integrated sun as well as center disk spectra were measured with an accuracy in line position of $\approx 30\ \frac{\mathrm{m}}{\mathrm{s}}$ and a signal to noise ratio SNR up to $\approx 5000$. Line identifications are taken from different databases and are provided for solar as well as for telluric lines. The spectra were all measured between February and July 2014 after the maximum of the 24th solar cycle.

Poster General

# ALMA: The Atacama Large Millimeter/Submillimeter Array

S. Mühle[1], for the German ARC node[1,2]

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The Atacama Millimeter/Submillimeter Array (ALMA) is a revolutionary interferometer that complements world-leading optical/IR telescopes and premium radio interferometers. When fully completed, ALMA will offer an increase in sensitivity and angular resolution of up to two orders of magnitude over all previously existing mm/submm interferometers. This poster summarizes its capabilities and the current status of Early Science observations. A more comprehensive introduction to ALMA and a review of its current status will be presented in a talk at the ALMA Users' Meeting.

Poster General

ALMA Users Meeting

## Support for (prospective) ALMA users: The European ALMA Regional Centre

S. Mühle[1], for the German ARC node[1,2]

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The European ALMA Regional Centre (ARC) is the interface between the Atacama Large Millimeter/Submillimeter Array (ALMA) and the European user community. It consists of a network of regional support nodes, with a central node located at ESO in Garching bei München. This poster summarizes the ALMA support available to European astronomers and briefly introduces the German ARC node. A more comprehensive discussion of the support structure, including the many ways in which the German ARC node supports (prospective) ALMA users in Germany, Austria and Switzerland, will be presented in a talk at the ALMA Users' Meeting.

Poster General

# The stellar population among the XMM-Newton slew transients

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We study X-ray transients from the XMM-Newton slew catalog with focus on the identification of flare stars. We have selected 119 variable X-ray sources from the XMM-Newton slew catalog Delta-3 on the basis of at least 70-fold enhanced count rate with respect to ROSAT. Our characterization of the counterparts includes a systematic cross-match with optical and infrared photometric catalogs. The photometry was used to identify candidate stars for spectroscopic follow-up. Optical low-resolution spectra were obtained for 34 of those objects with OSIRIS@GranTeCan, most of them without any previous spectroscopic data. Among these objects we find many M-type stars, some giant stars and a small number of extragalactic sources. We present here the X-ray, optical and near-infrared properties of all slew transients from our sample.

Poster General

# Vertical shear instability in accretion discs with radiation transport

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The origin of turbulence in accretion discs is still not fully understood. While the magneto-rotational instability is considered to operate in sufficiently ionized discs, its role in the poorly ionized protoplanetary disc is questionable. Recently, the vertical shear instability (VSI) has been suggested as a possible alternative. We have studied the characteristics of this instability and the efficiency of angular momentum transport, in extended discs, under the influence of radiative transport and irradiation from the central star. In agreement with previous studies we find for the isothermal disc a sustained unstable state with a weak positive angular momentum transport of the order of $\alpha \approx 10^{-4}$. Under the inclusion of radiative transport the disc cools off and the turbulence terminates. For discs irradiated from the central star we find again a persistent instability with a similar $\alpha$ value as for the isothermal case.

# Alphabetic List of Participants

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