

3rd generation IMPRS Scientific Workshop

Scientific Programme – Overview

Lecturers: Dr. Christian Fendt, Dr. Andreas Just

W e d n e s d a y , 1 1 M a r c h

12:25 *Arrival*
13:30 *Lunch*
15:00 **Session 1: Extragalactic Astronomy**
16:30 *Coffee break*
17:00 **Session 2: Stellar Astrophysics**
18:30 *End of talks*
19:30 *Dinner*

T h u r s d a y , 1 2 M a r c h

09:00 **Session 3: Extrasolar Planets**
10:30 *Coffee break*
11:00 **Session 5: Extragalactic Astronomy**
12:30 *Lunch + free time*
14:00 **Session 4: High-Energy Astrophysics**
14:30 **Invited Talk: Dr. Martin Zwaan (ESO Garching): Career opportunities at ESO**
17:00 *Coffee break*
17:30 **Session 6: Stellar Astrophysics**
18:30 *End of talks, dinner*
20:00 **Invited Talk: Dr. Sascha Quanz (McKinsey Inc.): Astronomers outside astronomy**

F r i d a y , 1 3 M a r c h

09:00 **Session 7: High-Energy Astrophysics**
10:30 *Coffee Break*
11:00 **Session 8: Extragalactic Astronomy / Cosmology**
12:00 *Closing Remarks, Lunch*
14:36 **Departure**

Wednesday, 11 March, 15:00

Session 1: Extragalactic Astronomy

15:00

Hsiang-Hsu Wang: The First Step of Evolving 3D Galactic Disks

Initial condition is the first and crucial step for evolving a galactic disk. Recently, more and more attention has been drawing on simulating a 3D isolated galaxy. However, in literature, there is no systematic way to immerse a well-balanced disk in the very beginning of simulation. I will discuss and propose solutions for this problem. With the well-controlled beginning, we are able to investigate, the ongoing work, star formation along the grand-designed spiral shock.

15:30

Christine Ruhland: Understanding the assembly of disk galaxies

The diffuse outer stellar envelope of galaxies (their stellar halos) are a gold-mine of information about the assembly of galaxies owing to their long dynamical times and the relative absence of in-situ star formation. My thesis project is to study the populations, kinematics and (sub-)structure of the stellar halo of the Milky Way and other galaxies using the SDSS and PanSTARRS-1.

16:00

Denija Crnojevic: Evolution of dwarf galaxies in the Centaurus A group

The study of (dwarf) galaxies in nearby groups is a powerful tool to investigate galaxy evolution, chemical enrichment and environmental effects on these objects. We consider archival HST/ACS data to constrain star formation histories of dwarf galaxies in the Centaurus A complex. For dwarf spheroidal galaxies with predominantly old stellar populations we derive the red giant metallicity distribution function. The resulting mean metallicities are low, and there is always the presence of a wide metallicity spread. Moreover, for the dwarf spheroidals there does not seem to be any evidence for radial population gradients. On the other side, in dwarf irregulars with a pronounced contribution from younger stars we find different spatial distributions for populations of different ages including the presence of recent, localized bursts of star formation. We derive star formation histories for these galaxies via synthetic color-magnitude diagrams and investigate how they are related to the position of the galaxy within the group.



Wednesday, 11 March, 17:00

Session 2: Stellar Astrophysics

17:00

Christoph Federrath: The statistics of interstellar turbulence and its role in star formation

The statistics of supersonic turbulence is an important ingredient for analytical theories of star formation trying to explain the observed core and stellar initial mass functions and measured scaling relations in the ISM. I will show results of numerical simulations of supersonic turbulence aiming at comparing the statistics obtained in these numerical experiments to the observational evidence.

17:30

Nicola Da Rio: Understanding Pre-Main-Sequence Evolution: A Ground-based Multi-color Optical Survey of the Orion Nebula Cluster

I present new results of UBV broad band and 620nm medium band of the Orion Nebula Cluster (ONC) obtained from ground based photometry, as part of the HST Orion Treasury Program on the ONC. We use color-color diagrams to compare our photometry with synthetic photometry on grids of modelled atmospheres and Pre-Main-Sequence evolutionary tracks. This allows us to constrain the stellar parameters and derive a homogeneous set of reference models which we use to derive the intrinsic colors and bolometric corrections in our instrumental photometric system. We introduce a

new method to self-consistently derive the stellar reddening, bolometric and accretion luminosities, obtaining a new, unbiased HR diagram of the population, as well as the Initial Mass Function, and we discuss the mass-age relation derived. Our analysis shows how such results in reddening limited PMS population are sensitive to the choice of intrinsic stellar quantities and theoretical evolutionary models, and how a multi-band observational approach reduces noticeably the common biases.

18:00

Ronny Geisler: What can Interferometry tell us about the Late Stages of Evolved Stars?

We observed the dusty circumstellar environments of Asymptotic Giant Branch (AGB) stars with MIDI, a Mid-Infrared ($\sim 10 \mu\text{m}$) interferometer with a spectral resolution between 30 and 230. In principle, such observations will allow us to fit for the stellar diameter and structure of the dense stellar winds, in particular the location of the dust formation layer and its dependence on pulsation cycle, mass loss rate, and chemistry. I give a short introduction to interferometry, the meaning of visibilities, and the data-reduction process. I then fit our V Hya data to a preliminary model, composed of a uniform disk and circular ring. Thus far, these data are insufficient to study the dependence on pulsation phase or model an asymmetric dust shell but give very reasonable results for the size of the dust layer. With upcoming model improvements and new data this will lead to a better understanding of the late stage of evolved stars.

Thursday, 12 March, 09:00

Session 3: Extrasolar Planets

09:00

Andras Zsom: Circumstellar disk and dust aggregates: the biggest billiard table with the smallest balls

A conclusive bottom-up model on the formation of pre-planetary bodies has so far only been established for the very first fractal growth regime. The major reason for this drawback is that, after the restructuring and compaction of the dust aggregates, laboratory experiments show diverse results in the collisional outcomes (e.g. cratering, erosion, bouncing, etc.) which proved to be difficult to incorporate into dust collision models. In this talk I introduce the first model which, due to its Monte Carlo nature, can handle the full complexity of aggregate collisions. The model was developed with the help of Juergen Blum and his group in Braunschweig. We categorize dust aggregate collisions into eight regimes based on the porosity of the collision partners and their relative masses. In these regimes, aggregate masses, porosities and collision velocities determine the outcome. From experimental observations we distinguish nine classes of outcomes: 4 types of sticking, 2 types of bouncing and 3 types of fragmentation. Although experiments are not available for all possible collisions, we are able to cover the whole parameter space by plausible extrapolations. Based on this recipe we ran a growth simulation in a disk model introduced by Brauer et al. (2008) and found that bouncing slows down the initial growth of particles. When, however, the aggregate masses reach a critical value, new ways of growth become available (e.g. growth by penetration). After a sudden transition in the mass distribution function, the compacted aggregates do nothing but bounce without further growth or fragmentation. The maximum mass of the particles is two orders of magnitude lower compared to previous dust models, such as Brauer et al. (2008) and Zsom & Dullemond (2008).

09:30

Maximiliano Moyano: Transit detection algorithms

The Pan-Planets survey (Afonso & Henning 2007), a massive search for Hot Jupiters is expected to begin spring 2009. The survey will be performed with the 1.8m Pan-STARRS telescope in Haleakala, Hawaii, and its camera with 7 square degrees field of view. False positives are a major concern for transit searches. However, the combination of several transit detection algorithms allows to identify false detections other than background or grazing eclipsing binaries, as was pointed out by Moutou et al. (2005). I have implemented a transit detection pipeline with three different algorithms that will be used in the Pan-Planets survey: the Box-fitting algorithm (Kovacs et al. 2002), the Fast-Hybrid Algorithm (Collier-Cameron et al. 2006) and the TRUFAS algorithm (Regulo et al. 2007). The algorithms are described and the results are presented.

10:00

Nikolay Nikolov: Identification of the False-positives in the Pan-planets Data

A transiting extrasolar planet can be observed when the planetary orbit lies nearly in the plane of the observer's line of sight. Then once per orbital period the planet passes in front of the stellar disk, causing a temporary drop in the brightness of the exoplanet host star. Planetary transits may yield many properties - radius and orbital distance of the planet and inclination angle. In my talk I will discuss the main points of my PhD, dedicated to data analysis from the Pan-STARRS and LAIWO surveys. The objectives are put on discovery and characterization of new transiting extrasolar planets.

Thursday, 12 March, 11:00

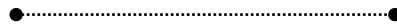
Session 4: High-Energy Astrophysics

11:00

Olaf Schulz: Vetoing Atmospheric Neutrinos in a High Energy Neutrino Telescope

The basic strategy for neutrino telescopes up to today has been to suppress the background of atmospheric muons by restricting the field of view to the hemisphere below the detector. The main remaining background is then built by atmospheric neutrinos and is irreducible. The new generation of km-scale neutrino telescopes, such as IceCube or the planned km³Net project, offer the new opportunity to use a large part of the detector as an active veto to suppress atmospheric muons, thereby

opening the field of view to the above hemisphere. We discuss the possibility to suppress downward atmospheric neutrinos in high energy neutrino telescopes. This can be achieved if the muon, which is produced by the same parent meson decay in the atmosphere, can be vetoed. In principle, atmospheric neutrinos with energies $E > 10$ TeV and zenith angle up to 60° can be vetoed with an efficiency of $> 99\%$. Practical realization will depend on the depth of the neutrino telescope, on the muon veto efficiency and on the ability to identify downward moving neutrinos with a good energy estimation.



Thursday, 12 March, 15:30

Session 5: Extragalactic Astronomy

15:30

Sophia Lianou: Early-type dwarf galaxies in the M81 group

The M81 group is a highly interacting group consisting of a few large galaxies and about 40 dwarfs of both early and late type. This group is an important nearby laboratory to study environmental effects and the role of interactions in the formation and evolution of dwarf galaxies. We will show results on the metallicity distribution functions and on the potential presence of population gradients for the whole early-type dwarf galaxy population for which HST/ACS data are available.

16:00

Giovanni Natale: Dust emission from the Intergalactic Medium of Stephan's Quintet

In this talk I will present the results of the analysis of Spitzer MIPS 70 and 160 micron maps of Stephan's Quintet compact group of galaxies. The data shows clear evidence of FIR emission outside galaxies. Comparing FIR maps with multiwavelength data, I will discuss the nature of this emission and its implications for hot gas

cooling and star formation in the Intergalactic medium of interacting groups.

16:30

Leonard Burtscher: First convincing evidence for a torus in a "face-on" Active Galaxy

The paradigm for the dichotomy seen in the emission line broadness of Active Galactic Nuclei (AGNs) is well-established: The central engine, i.e. a supermassive black hole with an accretion disk, is embedded in a dusty torus that blocks our line of sight towards the center in some cases. Interferometric observations in the mid-infrared made studies of this dusty torus possible and proved its existence in a number of nearby "type 2" AGNs (where the torus blocks our line of sight). For the first time we have now seen convincing evidence of such a dusty torus in the closest and brightest "type 1" galaxy NGC 4151, where the AGN is seen face-on. The size of the torus fits well to what has been seen in "type 2" objects. The weak if at all existent silicate emission feature gives strong constraints for the modelling of this source.

Thursday, 12 March, 17:30

Session 6: Stellar Astrophysics

17:30

Baybars Külebi: A Recent Update on Magnetic White Dwarfs

We have calculated optical spectra of hydrogen-rich (DA) white dwarfs with magnetic field strengths between 1 MG and 1000 MG for temperatures between 7000 K and 50000 K. Through a least-squares minimization scheme with an evolutionary algorithm, we have analyzed the spectra of 140 magnetic DAs from the SDSS (96 previously published plus 39 newly discovered within SDSS, and five discovered by SEGUE). Since we were limited to a single spectrum for each object we used only centered magnetic dipoles or dipoles which were shifted along the magnetic dipole axis. We also statistically investigated the distribution of magnetic-field strengths and geometries of our sample.

18:00

Tatiana Vasyunina: Investigation of the early evolution of high-mass stars.

The actual formation of high-mass stars happens in the heavily obscured densest regions of molecular cloud complexes, and can only be studied using long-wavelength (far-IR to radio) techniques. However, as soon as a massive star begins to emit UV photons and develops a stellar wind, it starts to clear the environment and there is a chance to detect the star in the near-IR, where extinction is low and thermal emission from molecular cloud dust is not important. Thus, with the new Spectrograph for INtegral Field Observations in the Near Infrared (SINFONI), it is now possible to obtain a full spectral inventory of the youngest massive stellar populations in star forming regions currently accessible. In my talk I would like to speak about the SINFONI Program devoted to the investigation of the early evolution of young high-mass stars. In more detail I'll dwell on the stellar content and cluster surroundings for the more evolved region IRAS 08546-4254 and IRAS 06058+2138, where the presence of outflows and other activities can indicate a younger cluster.



Friday, 13 March, 09:00

Session 7: High-Energy Astrophysics

09:00

Christoph Deil: Gamma-ray emission from pulsars and their nebulae

A few years ago almost nothing was known on the Galactic populations of gamma-ray sources. An all-sky survey of the satellite-based instrument EGRET in the 1990s at energies of ~ 100 MeV to 10 GeV detected ~ 100 Galactic sources. Due to poor angular resolution, only 7 bright pulsars, among them the Crab, Vela and Geminga, could be identified. In the last years the High Energy Stereoscopic System (H.E.S.S.) has surveyed the inner part of the Galaxy at energies 100 GeV to 10 TeV with high sensitivity and detected ~ 50 sources. Many seem to be pulsar wind nebulae, such as the well-known Crab nebula, although in many cases the association is not certain. In February 2009 the Fermi Gamma-ray Space Telescope will publish a catalog of bright sources at energies 30 MeV to 300 GeV with much improved sensitivity and angular resolution compared to EGRET. In this talk a population study comparing the known radio pulsar sample, the Fermi bright sources catalog and the H.E.S.S. Galactic plane survey will be presented.

09:30

Olga Zacharopoulou: Modification of high energy γ -ray spectrum of blazars due to internal and intergalactic absorption

Blazars are known TeV sources. The emitted γ -rays undergo absorption before they reach our telescopes, due to the intergalactic radiation fields. Corrections on the observed spectra must be applied. This can result to unusual hard spectra. Considering a non-negligible internal absorption, a hard spectrum can be produced by the interaction of the γ -rays with a dense narrow band radiation field present at the vicinity of the γ -rays' production area.

10:00

Ioanna Arka: Particle acceleration and radiation in strong electromagnetic waves and its relevance in astrophysics.

Strong electromagnetic waves are of relevance in the laboratory, where they are expected to be produced in the next generation high-intensity laser facilities. In astrophysics, the possibility of strong wave emission by pulsars has led to the investigation of their interaction with electrons (e.g. Gunn & Ostriker 1971). We investigate the trajectories and radiation of particles in single and counterpropagating vacuum waves, and the relevance of this acceleration and radiation mechanism in astrophysical environments.

Friday, 13 March, 11:00

Session 8: Extragalactic Astronomy / Cosmology

11:00

Kelly Foyle: Determining the Mean Rate of Secular Evolution among Present Day Spiral Galaxies

Non-axisymmetric features like bars and spiral arms exert gravitational torques on the stellar distribution of spiral galaxies. The question remains as to whether such effects will reshape galaxies on a small enough timescale to be significant. Using a sample of low-redshift, relatively face-on galaxies, I'll examine the significance of gravitational torques. Accurate mass maps are generated for the sample and are used to determine the instantaneous rate of change of angular momentum in a set of annuli throughout the disk. Simulations of disk galaxies are used to verify that the torques exerted by the stellar spiral arms and bar exceed those of the gas and halo. A timescale is derived for the long-term secular

evolution of angular momentum in observed galaxies. This is done (after scaling with disk scale length), by stacking the radial profiles of the mean torque for each galaxy.

11:30

Massimo Viola: Determination of halo density slope

One of the prediction of the CDM paradigm is the density profile of dark matter. Numerical simulation has shown in particular that the profile can be characterized by an outer slope -3 and a free inner slope α . I will present a method based on optimal linear filters that can be used to infer the value of α from weak lensing data and I will discuss which are the observational requirements to apply it successfully.



Logistics

Bring along

- towels
- house shoes
- games (indoor / outdoor), football, ...

Transportation

Arrival: Departure Heidelberg: 8:48 (track 8, S3), change in Karlsruhe (10:10, track 7, RE 4707), change in St. Georgen (12:13, Bus 7266) to Brigach Hirzwald / St. Georgen (arrival at 12:25) -- from there it's ~ 100m by foot to the Naturkolleghaus (turn left at restaurant, then its to our right near the forest)

Departure: Departure Brigach Hirzwald / St. Georgen: 14:36 (Bus 7266), change in St. Georgen (15:03, IRE 4714), change in Karlsruhe (17:03, track 7, S3) to Heidelberg (arrival at 17:45); alternatively: departure to Zürich

Address

Naturfreundehaus
Naturkolleg Hirzwald
Hausleiterin: Karin Griesau
im Hirzwald 5
78112 St. Georgen
Tel: +49-7724-6471
Fax: +49-7724-9486703
E-Mail: naturkolleg.hirzwald@web.de