IMPRS workshop retreat Stiftsberg 2012
6th generation students

Deprature: 9:00 at Crowne Plaza Hotel (close to LH bus stop); 230 km, 2.5 hours till D-54655 Kyllburg

Transportation:

a) LSW bus: Heidt + Cologna, Henke, Kalovidouris, Konstandin, Merkel, Pinilla, Windmark
b) MPIA car 1: Henning + Lippok
c) MPIA car 2: Hennawi + Dittrich, Kannan, Maier
d) priv. car 1: Laesker + Ramkumar, Rorai
e) priv. car 2: Colombo + Prosekhin, Nikolic, Trifonov
f) priv. car 3: Mohler + Albertsson, Chang, Kalinova

Food: 1 vegetarian (accepting chicken & turkey), 1 vegetarian (accepting fish, egg, milk).

Time schedule:

	Monday	Tuesday	Wednesday
8.30 - 9.00		**Breakfast**	**Breakfast**
9.00 – 9.25		Rahul Kannan (JHi)	Sladjana Nikolic (JHt)
9.25 – 9.50	Departure Crowne Plaza	Nils Lippok (JHt)	Stepahn Henke (JHi)
9.50 – 10.15		Maren Mohler (THg)	Trifon Trifonov (JHt)
10.15 – 10.40		Ronald Laesker (JHi)	Alberto Rorai (JHi)
10.40 – 11.10	**Student talks:**	**Coffee break**	**Coffee break**
11.10 – 11.35	20min+5 discussion	Philipp Merkel (JHt)	Bala Ramkumar (JHt)
11.35 - 12.00		Paola Pinilla (THg)	Feedback session
12.00 – 12.25		Gabriele Maier (JHi)	
12.30 - 13.30	**Lunch, Introduction**	**Lunch**	**Lunch**
13.30 – 13.55	Tobias Albertsson (THg)	Anton Prosekin (THg)	Departure to Heidelberg
13.55 – 14.20	Yu-Yen Chang (JHi)	Feedback session	
14.20 – 14.45	Gabriele Cologna (JHt)		
14.45 – 15.05	**Coffee break**	Jochen Heidt:	
15.05 - 15.30	Dario Colombo (JHt)	Evaluation of proposals	
15.30 – 15.55	Vesselina Kalinova (JHi)	**Bitburg brewery**	THg: feedback Henning
15.55 – 16.20	Karsten Dittrich (Thg)		THi: feedback Hennawi
16.20 – 16.40	**Coffee break**		THg: feedback Heidt
16.40 – 17.05	Fredrik Windmark (THg)		
17.05 – 17.30	Lukas Konstandin (JHt)		
17.30 – 17.55	Angelos Kaloviduris (JHi)		
18.00 – 19.00	**Dinner**	**Dinner (BBQ)**	
19.00 – 19.45	Feedback session	Free evening	
20.00 – 21.00	Thomas Henning, Joe Hennawi		
	Discussion: Job opportunities		

Abstracts:

1) Tobias Albertsson

Modeling deuterium fractionation in cold and warm molecular environments with large chemical networks

Observations of deuterated species have long proven essential to probe properties and thermal history of various astrophysical environments. With new observations of Herschel and ALMA we will be able to probe new environments and reveal multitudes of new molecules, including multi-deuterated species. We present an elaborated chemical network that includes tens of thousands of reactions with multi-deuterated species, both gas-phase and surface, in which the most recent information on deuterium chemistry is implemented. A detailed study of the chemical evolution under wide range of temperatures and densities typical of cold molecular cores, warm protostellar envelopes, and hot cores/corinos is performed. We consider two cases of initial abundances, with 1) mainly atomic composition and all deuterium locked in HD, and 2) molecular abundances accumulated at 1 Myr of the evolution of a cold prestellar core. Our model successfully explains observed D/H ratios of many single, double, and triple-deuterated molecules, including water, methanol, ammonia, and hydrocarbons in a variety of environments (cold cores, hot protostellar envelopes and hot cores/corinos). We indicate deuterated species that are particularly sensitive to temperature gradients and initial chemical composition. Many multiply-deuterated species produced at 10 K by exothermic ion-molecule chemistry retain large abundances even when the temperature rises above 100 K, and can only be destroyed by dissociation. We list the most abundant observable deuterated species predicted by our model in different environments of low- and high-mass star-formation regions, as well as key formation and destruction pathways for DCO+, DCN and isotopologues of H2O, H3+ and CH3OH.

2) Yu-Yen Chang

Internal Structure of the z~2 Galaxy Population

We use high-resolution VLT/HAWK-I and HST/WFC3 imaging to study the structural evolution of early-type galaxies since z~2. Mass-selected samples are drawn from pre-existing photometric redshift surveys, which are then separated into actively star-forming and passive galaxies. The (projected) axis-ratio distributions are compared with those of lower redshift samples, and we reconstruct intrinsic axis-ratio distributions by assuming that galaxies are simple, axi-symmetric systems. We find that at all redshifts z<~2 more massive galaxies are rounder. That is, at all epochs stars are predominantly formed in disk-like systems, whereas early-type galaxies are more bulge dominated, especially at higher masses.

3) Dario Colombo

The PAWS project: Giant Molecular Clouds in M51

Comprehend the true nature of Giant Molecular Clouds (GMCs) is the keystone to unravel the puzzle of star formation in the galaxies. Using the data from the PdBI Arcsecond Whirlpool Survey, a large IRAM program that mapped the 12CO (1-0) emission of the central M51 8 kpc at an unprecedented resolution of 45 pc (1.1") and sensibility of 10^5 Msun, we have been able to generate the biggest GMC catalog ever made, collecting more than 1500 objects. In order to compare our result with the GMC population of Local Group galaxies, we used a robust identification algorithm (CPROPS) that minimizes the bias between the available data. Our GMC have been studied in the different environments offer by spiral arm, inter-arm and central regions of M51, in order to test the universality of these objects with properties (in)dependents by the conditions they live and evolve in. We also examined the true nature of Giant Molecular Associations: are they a separate class of objects, or a simply superposition of GMCs?

4) Gabriele Cologna

VHE emission from AGN and constrains on the Extragalactic Magnetic Field - The case of 1ES 0229+200

TeV gamma-ray astronomy is quite a new branch in astrophysics. Only with the advent of the current generation of TeV telescopes such as H.E.S.S. (High Energy Stereoscopic System), sufficient sensitivity was achieved to allow for surveys of significant fractions of the sky. H.E.S.S. is an array of four Imaging Atmospheric Cerenkov Telescopes (IACT) located in Namibia in the Khomas Highlands and is designed to detect very high energy (VHE > 100 GeV) gamma-rays in the energy range up to 100 TeV by looking at the Cherenkov light emitted in the air shower. The H.E.S.S. array is fully operational from late 2003 and since then it has observed and detected numerous galactic as well as extragalactic sources, not all clearly identified with known counterparts yet.
The high-frequency peaked BL Lac Object (HBL) 1ES 0229+200 is a well know Active Galactic Nucleus (AGN) with a redshift of ~0.14. It was first detected at VHE by H.E.S.S. in 2006 [Aharonian et al.(2007)]. Due to its relative high distance (for the VHE range) and its spectral characterics (hard spectrum and constant flux), it has been used to derive constraints on the Extragalactic Background Light (EBL) [Aharonian et al.(2007)] and on the Intergalactic Magnetic Field (IGMF) [Tavecchio et al.(2010), Dermer et al.(2011)]. New observations at VHE (Benbow 2011) and X-rays (Kaufmann, in preparation) show however signs of monthly flux variability. This will affect the derivation of the constraints on both EBL and IGMF.

5) Karsten Dittrich

Planetesimal Formation in Zonal Flows

Recent simulations show long lived sub- and super-Keplerian flows in protoplanetary disks. These so-called zonal flows are found in local as well as global simulations of magnetorotational instable disks. I investigated the strength and life time of the resulting long lived gas over- and under-densities while altering the azimuthal and radial size of the local shearing box. Changes in the azimuthal extent do not affect the zonal flow features. However, strength and life time of zonal flows increase with increasing radial box sizes. For the first time, the reaction of dust particles in boxes with zonal flows are studied. I will show that objects of planetesimal mass can be formed without any self-gravitating forces acting on the point masses.

6) Stephan Henke

Testing the onion shell model for chondritic parent bodies

Chondritic meteorites are assumed to stem from asteroids that have not melted. H-chondrites are assumed origin in the same parent body (6-Hebe). A numerical model of this parent body is fitted to data of H-chondrites by a genetical algorithm to test the onion shell model and to appropriate initial conditions for the thermal evolution of this parent body.

7) Vesselina Kalinova

The mass distribution of galaxies in one and two dimensional stellar kinematics

We present the mass distribution of a sample of 18 Sb-Sd galaxies, using one and two-dimensional stellar kinematics obtained with the integral-field spectrograph SAURON (Ganda et al. 2006). The observed second order velocity moments of these galaxies are fitted with solutions of the axisymmetric Jeans equations. The accurate errors of the velocity moments (obtained by Monte Carlo simulations) and best fit tests of the dynamical model, give us a precise estimation of the dark matter content in the galaxies. We compare the mass distribution of the galaxies in one and two dimensional stellar kinematics. The results show the accuracy of the dynamical model for the late-type spiral galaxies.

8) Angelos Kaloviduris

Extreme value statistics of the weak lensing convergence

I shall discuss Extreme Value Statistics of the weak lensing convergence. My intrest in the maximum values relates to the question of how often strong convergences arrise as extremes of the weak convergence probability distribution. On the other hand, heuristic lognormal models of the weak lensing probability distribution feature the empty beam convergence k_min. This is a minimum value never obtained in praxe. The search for realistic minimum values, leads to the extreme value statistics of minima. The dependence of these answers on cosmology, smoothing scale and filter function is investigated.

9) Rahul Kannan

A Recipe for Bulge Formation Due to Mergers

We try to come up with a recipe for how the bulge fraction of galaxies change according to mergers. Present models are very crude and mainly over predict the formation of bulges. We use high resolution hydro-dynamical simulations to study the effect of minor mergers, major mergers and flybys on bulge formation of galaxies

10) Lukas Konstandin

Statistical properties of supersonic turbulence

Knowledge of the statistical characteristics of turbulence is a key prerequisite for understanding turbulent flows on all scales. While common terrestrial flows are incompressible, astrophysical flows are supersonic and compressible. As turbulence is a process characterised by a chaotic fluctuating velocity field, there is a scale-dependent spatial and temporal correlation of fluid quantities. While large improvements were made in the understanding of incompressible turbulence in the last years, there are still open questions in our understanding of compressible turbulence. The non-local, inter-scale processes of compressible turbulence arising in shock fronts change the Richardson-Kolmogorov picture of the energy cascade of incompressible turbulence, where scale-locality is crucial for the existence of universal statistics. We therefore analyse high resolution hydrodynamical grid simulations and study the statistical properties of supersonic turbulence under different conditions.

11) Ronald Laesker

Black Hole Scaling Relations: from improved photometry to dynamical models

We investigate scaling relations linking Supermassive Black Hole (BH) masses with properties of their host galaxy. Better definition and understanding of these correlations is required to ascertain and compare their significance from both an observational and astrophysical point of view. Starting from existing BH mass measurements, we seek to find the global physical parameter, or a combination thereof, that is most suitable to: a) predict BH masses, e.g. used in BH demographic studies, and b) constrain BH-galaxy co-evolution models, which aim to explain BH origin, growth mechanisms, and links with their host galaxy.
We obtained and analyzed new near-infrared (NIR) photometric data for galaxies with measured central BH mass, allowing us to refine and expand on existing MBH-LK relations. Likewise, we observed the same targets in near-ultraviolet (NUV) and optical bands, and plan to utilize the results to make a transition from luminosity measurements to reliable stellar mass distributions. Finally, we began to combine these measurements with spectroscopic integral-field unit (IFU) data to model the corresponding distributions of dynamical mass, including dark matter (DM) contributions, in order to relate those to BH masses as well.

12) Nils Lippok

Freeze-out study of star-less cores

Low–mass molecular cloud cores are the birthplaces of solar–type stars. Nearby, small and isolated clouds, like Bok globules, are ideal laboratories for studying the physical and chemical properties of such star–forming cores because they are relatively simply structured. We have observed 12 Bok globules as part of the Herschel Guaranteed Time Key Project EPOS (Earliest Stages of Star Formation) containing cores of different evolutionary stages (from starless to Class 1). Our continuum observations obtained with the PACS and SPIRE bolometers (ranging from 100 to 500 mu) together with ground-based (sub)mm observations allow us to derive spatially resolved dust temperature and density maps of the globules. Based on these maps and molecular line observations we study molecular freezeout. Ultimatively we aim at establishing a connection between molecular freezeout and a change of the dust properties in these regions.

13) Gabriele Maier

The transverse proximity effect in close quasar pairs

Proximity Effect denotes the ionization of hydrogen by quasar radiation close by. SDSS-III's Baryon Oscillation Spectroscopic Survey (BOSS) should provide a statistically large enough dataset of quasar spectra to study this.

14) Philipp Merkel

Ellipticity alignments of galaxies and weak gravitational lensing

A powerful model for the acquisition of the angular momentum of galaxies is given by the so-called tidal torque theory. This theory allows for the prediction of the correlations between the angular momenta of neighbouring galaxies. An important consequence of correlated angular momenta is that they also induce correlations in the apparent shapes of the galaxies. Accordingly, these intrinsic galaxy ellipticity correlations are a severe contaminant in weak lensing measurements because this is where correlations in the galaxy shapes are (solely) related to the gravitational light deflection caused by the intervening large scale structure. I will present some of my results concerning (analytical) predictions of angular momentum correlations and their connection to intrinsic ellipticity correlations, focusing on their interplay with higher order weak lensing statistics.

15) Maren Mohler

Radial velocity search for planets around very young stars

Over recent years the effort to find extrasolar planetary systems steadily increased and still does. Planets form in circumstellar disks around newly born stars. The timescales of planet formation and migration remain poorly constrained and are a matter of ongoing debate. I try to find planets in the age range of 1 to 100 Myrs with the radial velocity method. The age of an existing planet gives the possibility to test the predicted time scales needed to form planets described in the current theories. In the same manner, non-detections of planets around stars of a certain age range are very important. Therefore, I aim on giving observational constraints on ages of existing planets, which can be used to test theories of planet formation and migration.

16) Sladjana Nikolic

3D spatial-spectral mapping of fast Balmer-dominated shocks in the SNR 1006

We present three-dimensional spatial-spectral mapping of the fast (2000-3000 km/s), Balmer-dominated shocks surrounding the northwestern rim of the remnant of supernova (SN) 1006. Unlike in previous studies, mostly utilizing long-slit spectroscopy, we are able to combine high spatial and spectral resolution to show that the physical characteristics of the shocks exhibit a strong spatial variation across 135 locations. Using models which do not take cosmic ray physics into account, we convert the observed broad Halpha line widths and the ratio of narrow to broad Halpha line intensities into shock velocities and electron-to-proton temperature ratios. More than 70% of our observed data are not matched with model solutions. Additionally, we are able to detect non-Gaussianity in the broad Halpha lines. Taken together, our results point to the presence of a population of non-thermal protons associated with the Balmer-dominated shocks, which we identify as low-energy (10-100 keV) hadronic cosmic rays.

17) Paola Pinilla

Trapping dust particles in the outer regions of protoplanetary disks

The growth of sub-micron sized particles to pebbles is the most critical stage of planet formation which contains different physical challenges. One of the essential mysteries is to understand how large grains can survive in the outer regions of the disk as it is observed at sub-mm and mm wavelengths. While theoretically, pebbles may not grow due to destructive collisions and radial drift due to their interaction with the gas. Different efforts have been aimed to explain how these two phenomena can be prevented, without a conclusive answer. We introduce how the presence of long-lived pressure bumps, with certain characteristics, moderate the rapid inward drift using a coagulation/fragmentation disk model. These pressure inhomogeneities allow the retainment of large dust particles on million years time scales and a better agreement between observations and theory. Future ALMA observations can give us a deeper comprehension of the physics of dust growth and help us to resolve an old puzzle in planet formation field.

18) Anton Prosekin

Contribution of UHE cosmic rays to the extragalactic diffuse gamma-ray background

Extragalactic diffuse gamma-ray background (EGRB) has a relatively featureless energy spectrum that complicates the identification of sources which contribute to the overall intensity. The recent measurements made by Fermi LAT and subsequent studies shows that the contribution of known sources can explain from 40 to 70 % of the EGRB intensity depending on energy. The lack of the intensity occurs especially at energies greater 10 GeV. The hardening of this part of spectrum as compared with the low energies is not reproduced in the model spectra. It leads to the rapid decrease of the ratio of the modeled intensity to the observed one. We suggest that the hardening could be explained by the contribution of the electromagnetic cascades initiated by cosmic rays. The cosmic rays produced at AGN could initiate cascades at the distances closer to the Earth than gamma rays of intrinsic spectrum of AGN that results in more energetic spectrum of detected gamma rays. We consider cosmic rays with energies ~ 10^17 eV which have a large interaction length to initiate the cascade close to the Earth and weak extragalactic magnetic field of the order 10^-15 G which does not deflect cosmic rays considerably during their propagation.

19) Balasubramanian Ramkumar

K selected Near Infrared catalog of Extended Chandra Deep Field South from VLT HAWKI

We present K selected Near Infrared photometric catalog of Extended Chandra Deep Field South (ECDFS) to the astronomical community. The VLT HAWK-I image of J and K for complete 1/2 x 1/2 Sq.Deg of ECDFS has a 5 sigma limit of K(AB) 24.3 and J(AB) 24.4 magnitudes. The empirical completeness for 22.3 < K < 23.53 is > 90%. The quality of images have been verified thoroughly using both internal consistency checks as well as external comparisons with other catalogs such as MUSYC. At present, HAWK-I catalog is the deepest in ECDFS

for J and K bands, and so,the color magnitude plot which is used in selection of high-z galaxies provide high redshift galaxies much deeper than MUSYC and other previous catalogs. The properties of massive galaxies between 1 < z < 2.5 has been proposed for further studies in the near future using this catalog.

20) Alberto Rorai

Studying the intergalactic medium with quasar pairs

This project aims to understand the eect of pressure on the intergalactic medium at small scales (< 1 Mpc), to set constrains on the the Jeans filtering length measuring coherence of close quasar pairs, eventually studying implications on the global thermal history of the Universe. The employed model is based on dark matter only simulations, and makes use of analytical prescriptions to recover the lyman alpha forest. This method has enough flexibility to allow a parameter study of the relevant thermal parameters.

21) Trifon Trifonov

Testing the Planet hypothesis around K giants with High-precision Visual and IR echelle spectrographs and N-body simulation techniques

As the number of planets detected with high-precision Radial Velocity measurements around K giants is constantly growing, it rise the natural question "Are all these planets indeed real?". Decades before the first discovery of exoplanets, it had been known that some K giants show radial velocity variations with periods of several hundred days and semi-amplitudes with several hundred m/s, but the interpretation was not clear. In particular, pulsations or rotational modulation of surface features could not be excluded. My work is to test the planet hypothesis around a sample of around 400 K giants which our science group have been observing at Lick Observatory with the Hamilton Echelle Spectrograph since 1999. A fraction of 20 K giants shows periodic pattern in the RV's obtained in the visible wavelength regime which is clear evidence of planet/substellar companion/companions. However the possibility these RV shifts to be caused by surface features like pulsations or rotational modulation is still high. This ambiguity requires to measure infrared radial velocities with the CRIRES spectograph (VLT) for these 20 K giants. This test is critical, and will provide a very important argument in favor of or against the companion hypothesis. After the extraction of the CRISER IR spectra and derive the RV's we can make a conclusion about the nature of the RV's shifts of these stars. More over a dynamical test is done for some of the K giants which are showing an evidence of more than one companion. I am simulating the dynamical stability of these candidate systems with the N-body integrator MERCURY. In case of a stable long term solution for a given system we can claim that this system can shelter a planets, in the other hand if there is no stable solution in all possible sets of orbital elements simulations, it will be clear that this RV signals are due to stellar activity.

22) Fredrik Windmark

Planetesimal formation by sweep-up: How the bouncing barrier can aid growth

The formation of planetesimals is often accredited to collisional sticking of dust grains. The exact process is however unknown, as collisions between larger aggregates tend to lead to fragmentation or bouncing rather than sticking. To study this, we have created a new dust collision model based on the latest laboratory experiments, and have used it together with a dust-size evolution code capable of resolving all grain interactions in the protoplanetary disk. We find that for the general dust population, bouncing collisions prevent the growth above millimeter-sizes. However, if a small number of cm-sized particles are introduced, they can act as a catalyst and start to sweep up the smaller particles. At a distance of 3 AU, 100-meter-sized bodies are formed on a timescale of 1 Myr. The bouncing barrier is here even beneficial, as it prevents the growth of too many large particles that would otherwise only fragment among each other, and creates a reservoir of small particles that can be swept up by larger bodies. However, for this process to work, a few seeds of cm-size or larger have to be introduced.