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A 01

The Tautenburg Radial-velocity Survey for Extrasolar Planets

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Throughout the world there are nowerdays quite a number programs for detecting extra-solar planets indirectly by means of precision radial-velocity measurements of stars. Most of these surveys however are strongly biased towards solar-like stars. From the currently available data it is thus quite difficult to deduce which properties of the stars influences the formation the planets. One and a half years ago, we have started a radial-velocity survey using the 2 m Alfred-Jensch telescope in Tautenburg. The Tautenburg-survey differs from others by choosing classes of stars that are normally not covered. On class of stars surveyd are short-period binaries. In principle it is possible that short-period binaries have planets that are orbiting both components but do such systems actually exist? Up to now, there seems to be tendency that metal-rich stars have more planets than metal poor ones. We thus also survey a sample of super metal rich stars in order to find out, if the formation of planets depends on the metallicity of the parent stars. It has now been excepted that migration is important for the evolution of the orbits of planets. Since the most dramatic effects are expected when the stars are sill young, we also study a sample of young stars.

A 02

A Planetary Companion to the Binary Star γ Cephei

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Gamma Cephei is a sub-giant in a long-period (P> 40 yrs) binary system. Walker et al. (1992) reported short-term periodic radial velocity (RV) variations in the residuals after subtracting the velocity contribution due to the stellar companion. These residual variations had a period of 2.52 yr period and were consistent with a Jupiter-mass companion in orbit at approximately 2 AU from the primary. Walker et al. dismissed this hypothesis because they detected weak variations in the Ca II 8662 A emission line index with the same period as "planet". We present precise stellar radial velocity variations for γ Cep taken at McDonald Observatory that extend the time base of observations to more than 20 years. The combined dataset shows that the planet period has been present and coherent over the past 20 years. The long lived nature of the residual RV variations make it unlikely that they are due to stellar rotation. We also present Ca II S-index measurements that show no periodic variations with the 2.5 yr period. Furthermore, no appropriate period is found in (contemporaneous) Hipparcos photometry. We conclude that a planet with a projected mass of 1.25 $M_{Jupiter}$ in orbit 1.8 AU from the primary star is the most likely explanation for the residual RV variations in γ Cep. This planet is in a binary star system with the shortest binary period found so far and should provide an interesting case study for understanding how binary stars influence the planet formation process.

A 03

Spectral Types of Planetary Host Star Candidates: New Transiting Planets?

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Recently, 46 low-luminosity object transits were reported from the Optical Gravitational Lensing Experiment. Our follow-up spectroscopy of the 16 most promising candidates provides a spectral classification of the primary. Together with the radius ratio from the transit measurements, we derived the radii of the low-luminosity companions. This allows to examine the possible sub-stellar nature of these objects. Fourteen of them can be clearly identified as low-mass stars. Two objects, OGLE-TR-03 and OGLE-TR-10 have companions with radii of $0.15\,R_\odot$ which is very similar to the radius of the transiting planet HD 209458 B. The planetary nature of these two objects will therefore be confirmed by dynamical mass determinations.

A 04

Direct Imaging of Extra-solar Planets Around Young Nearby Stars – a Progress Report

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We will report about recent developments in our direct imaging search for giant extra-solar planets around young (most of them up to 100 Myrs) nearby (within 100 pc) stars, which we perform in the IR with normal imaging, speckle, and AO using HST, Gemini, Keck, VLT, NTT, and the Calar Alto 3.5 m. So far, we have observed most of the stars in our sample of 200 young nearby stars and have found four brown dwarf companions. Several more sub-stellar companion candidates were found, some of which will be presented here together with 2nd epoch imaging and/or spectroscopy.

A 05

A Direct Imaging Search for Wide (Sub-)stellar Companions to Radial Velocity Planet Candidate Host Stars – First Results

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We will give an introduction to our project "Search for wide stellar and substellar companions around radial velocity planet host stars". Although it is generally believed that planets are formed in a circumstellar disk and therefore revolve on almost circular orbits around their host star, many of the recently found extra-solar planets are in highly eccentric orbits. One possible explanation is that there is a brown dwarf or stellar companion which disturbs the orbit. The idea of this project is to search for these hidden companions. We do our project in the IR with direct imaging techniques, using the ESO 3.5 m NTT and the 2.2 m telescope on Calar Alto. The 2Mass Survey serves as reference database. The first step in our project is the measurement of the proper motion of the observed objects, to find out which of them are moving with the host stars. Up to now about half the stars have been observed, covering several years after most of the 2Mass observations.

A 06

The Star Formation Process in the Upper Scorpius OB Association and Implications for Planet Formation

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We have performed a detailed investigation of the stellar population and star formation history of the Upper Scorpius OB association, the most nearby region of recent massive star formation. Our HR-diagram for 364 high- and low-mass members showed that the whole stellar population is well characterized by a very narrow age distribution around 5 Myr, suggesting that the star formation process in Upper Sco was triggered, most likely by a supernova shock-wave. We estimated individual masses for all members and found that the empirical mass function in the $0.1\,M_\odot$ to $20\,M_\odot$ range is consistent with recent determinations of the field initial mass function. Our result confirms earlier suggestions that most stars in our galaxy form in OB associations, i. e. close to massive stars. This implies that most planetary systems form in an environment where they are exposed to stellar winds, ionizing radiation, and supernova shock-waves from massive stars, which should significantly affect their evolution.

A 07

Searching for Terrestrial Planets in the Habitable Zone of M Dwarfs with the VLT+UVES

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We present a status report of our precision RV survey of M dwarfs carried out at the VLT+UVES. We demonstrate that our achievable RV precision of ≈ 2 m s^{-1} is sufficient to search for terrestrial planets in the habitable zone of late-M dwarf stars; i.e. planets of a few Earth masses for stellar masses of ≈ 0.2 $M_\odot$ or less. First results on the variability of selected objects are shown.

A 08

A Groundbased Search for Transits of Jupiter-sized Exoplanets

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Radial velocity observations of nearby sun-like stars have been used to detect over 100 Jupiter-sized planets orbiting more than 85 stars. Of these detected giant exoplanets 17 have been classisfied as 'hot jupiters', including the first discovered exoplanet around the sun-like star 51 Peg. Short orbital periods up to 11 days and small orbital radii (< 0.1 AU) charaterize these 'hot jupiters'. For one of these stars, HD 209458, a planet causes a temporarily decrease of the brightness of star. This transit event can only be observed when the orbital plane is approximatly aligned with the line of sight. Even small groundbased telescopes are able to detect such events, caused by Jupiter-sized planets. To improve the detection probabilty of transit events a large number of stars has to be observed simultaneously with high photometric precision. To achieve this goal, we use a flat-field camera coupled with a CCD of 2048×2048 pixels, enabling us to observe a field of view of 3.1×3.1 degree with more than 30 000 detectable stars in typical fields centered in the galactic plane. First results of observations of selected target fields will be presented.

A 09

Giant Planet Formation: A First Classification of Isothermal Protoplanetary Equilibria

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The work aims to clarify an important concept of giant planet formation, namely the so-called critical mass, necessary to permanently attract gas of the protoplanetary nebula to a terrestrial-planet-like, heavy element core. We approximate the protoplanet as a spherically symmetric, isothermal, self-gravitating classical ideal gas envelope in equilibrium around a rigid body of given mass and density, with the gaseous envelope required to fill the Hill Sphere. Equilibria are calculated without apriori determination of total protoplanet mass or nebula density, starting only with core of given mass, and an envelope gas density at the core surface. Our model predicts two types of envelope equilibria: 'uniform', with density of envelope gas dropping weakly with increase in radial distance, and 'compact', having a small, but very dense gas layer wrapped around the core, and very low gas density further out. Critical core masses for orbits of Earth, Jupiter, and Neptune are found to be 0.1524, 0.0948, and 0.0335 Earth Masses, respectively. Furthermore, our solutions show a wide range of possible envelopes. This variety is a consequence of the envelope's self-gravity. We show that multiple planetary equilibria exist for given nebula conditions. Not all of these can be reached along a hydrostatic sequence of models. For a given core, multiple solutions exist, that fit into the same nebula, and some of them also have equal envelope mass. Above the critical mass only 'compact' solutions exist. We also disscuss how these simple protoplanetary models relate to the planets of the Sun and other stars.

A 10

Planets versus Brown Dwarfs – The First 20 Million Years

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The formation and early evolution of a giant planet and a brown dwarf are compared. The giant planet is formed as the consequence of the accretion of a solid core and the subsequent capture of nebula gas, the brown dwarf results from the collapse of a Jeans-unstable Bonnor-Ebert sphere.

For both models the grey equations of radiation fluid dynamics are solved in Eddington-approximation, with spherical symmetry and including a time-dependent convection model. Detailed non-ideal equations of state and opacities (including dust and molecules) are used.

The planet's peak luminosity is attained during the rapid contraction phase that follows after the critical mass is reached. The respective maximum of the brown dwarf occurs early in its brief accretion phase. The luminosity maxima are separated by the time needed to grow the planets critical core resulting in different ages at corresponding contraction states.

Both the planet and the brown dwarf do have partially radiative interiors at the beginning of their hydrostatic evolution. The planet becomes almost fully convective during the rapid contraction after the critical mass. The Bonnor-Ebert collapse produces an $0.05\,M_\odot$ young brown dwarf with a radiative interior, that extends to 2/3 of the radius, from beginning of its hydrostatic contraction phase to an age of 5 Ma.

The onset of Deuterium burning makes the brown dwarf essentially fully convective. Deuterium energy production is sufficient to fully balance the surface energy losses and the brown dwarf is in thermal equilibrium for a few Ma (in the stellar structure sence). Hence there is the possibility of a Deuterium main-sequence. After about 10 Ma the global properties of the brown dwarf correspond to those of standard evolutionary models that do not account for the formation process.

A 11

The Interaction of the Solar System with Dense Interstellar Clouds

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Several consequences of the passage of the Sun through dense interstellar molecular clouds are discussed. These clouds, dense (more than 100 cm^{-3}), cold (10–100 K) and extended (larger than 1 pc), are characterized by gas to dust mass ratio about 100, power grain size spectrum (grain radii are within the range 0.01–3 micron) and average grain number density about 10^{-12} of the overall density of H nuclei. Frequently they contain small-scale (10–100 AU) condensations with gas concentrations up to 10^5 cm^{-3} and population of larger dust particles (1 micron and more).

It is shown, that close to the Sun, at 1 AU, the cloud's matter is predominantly neutral and should interact with the solar wind by charge exchange processes. Dust particles of the cloud serve as source of neutrals generated by solar UV irradiation of dust grains via different pathways, followed by strong influences on the solar wind plasma flow. The location, shape and size of the interaction region are investigated on the base of a 2D-hydrodynamic approach to model the interaction processes. Because of a reduction of the heliosphere's dimension down to 1 AU containing the Earth, direct input of the cloud's matter to the terrestrial enviromnent and atmosphere could be envisaged.

A 12

The Early Evolution and Eonic Variation of the Primordial Heliosphere

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Soon after the mass-accreting protosolar core has reached its T-Tauri phase, it developes a strong solar wind which first interacts with the ambient material of the early solar system. Outside of the protoplanetary accretion disk this wind will, however, soon be able to expand to large solar distances where it eventually dynamically interacts with the counterflowing ambient interstellar material by adapting to the outer flow establishing a heliopause boundary surface. We shall study the evolution of this wind-dominated early heliosphere taking into account both the time-evolution of the protosolar wind and the varying outer interstellar gas conditions at the passage of the early solar system through the interstellar space. While the heliosphere stops ongoing accretion of interstellar material to the early solar system, it is filled up by an intensive high-energy particle radiation, called "anomalous cosmic rays" which may isotopically process meteoritic material of the early solar system and so detune meteoritic clocks.

A 13

The First Substellar Companion to a K Giant Star

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We report on the first detection of a substellar companion to a K giant star by means of precise radial velocities. About 70 individual radial velocities for iota Draconis were gathered at Lick Observatory over the past two years using the Hamilton High Resolution Spectrograph in conjunction with an Iodine Cell.

The data are well fitted by a Keplerian with a period of about 533 days and an eccentricity of 0.7. Assuming a primary mass for iota Draconis of 1.05 solar masses, our fit implies a minimum companion mass m2*sin(i) of 9.0 Jupiter masses, making it a planet candidate. The non-detection of the orbit by Hipparcos allows to place an upper limit of 45 Jupiter masses on the companion mass, which establishes the substellar nature of the object. We estimate that transits in this system could occur already for inclinations as low as 81.5 degrees, due the large diameter of the giant star.

A 14

The Formation of Brown Dwarfs: Constraints from a Survey in Southern Star Forming Regions

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The results of a recent survey for brown dwarfs in Chamaeleon and Lupus with the WFI mosaic camera at the ESO/MPG 2.2 m telescope are presented within the context of brown dwarf formation. It is still unclear whether these objects form like planets, in circumstellar disks around young stars, or like the stars themselves, from the gravitational collapse of a molecular cloud. We analyse the properties of the found objects and discuss the implications for several proposed formation scenarios. While in Chamaeleon I and Lupus 3 brown dwarfs appear to be as numerous as very low-mass stars, in Chamaeleon II we find a drop in the number of objects towards lower masses. We interprete these results as a consequence of the different environmental conditions. In all cases, the spatial distribution of the brown dwarfs resembles very much that of the low-mass stars; it seems thus unlikely that they have been ejected from their parental systems. Moreover, since most of our objects are found in isolation, it is improbable that they formed in circumstellar disks. With help of published infrared photometry, we also show that a remarkable amount of the brown dwarfs in Chamaeleon I must be surrounded by accretion disks. We conclude that brown dwarfs seem to be a natural extension of stars below the hydrogen burning limit.

A 15

Rotation and Accretion of Brown Dwarfs in the σ Ori Cluster

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We present the results of photometric monitoring campaigns of very young Brown Dwarfs (BDs) and Very Low Mass Stars (VLMS) in the σOri cluster. The target objects were identified with multi-filter photometry in R, I, J, H, K and are located in a $17' \times 17'$ field north of σOri. This field was observed in two time series campaigns with the TLS Schmidt telescope (January 2001) and with the 1.23 m telescope on Calar Alto (December 2001). Each run covered at least four nights within one week.

From our 93 photometric candidates, 8 VLMS and 6 BDs show periodic variability in the Calar Alto time series with amplitudes between 0.01 and 0.08 mag. These variabilities are most likely caused by periodic modulation of the emitted flux through cool magnetically induced spots. Four of these periods are significant in the TLS data as well. The implied rotation periods range from 3 hours up to 4 days.

Surprisingly, 8 objects, among them 5 BDs, show photometric variability with no unambiguous periodicity and amplitudes larger than 0.15 mag, in some cases up to 0.6 mag. Four of these extremely high amplitudes are confirmed through the TLS time series. The characteristics of the lightcurves exclude eclipse phenomena, frequent flaring, and cool spots as an explanation for the large amplitudes. The most probable interpretation is the existence of hot spots caused by infalling material from an accretion disk onto the objects. This supports a star-like formation mechanism for objects down to $0.02\,M_{\odot}$.

A 16

Dust in the Atmospheres of Ultra Cool Dwarfs

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Equilibrium thermodynamics shows that dust particles form in the atmospheres of ultra cool M, L and T dwarfs. This has been confirmed in many cases from the modelling of the optical and near infrared spectral energy distributions of low mass stars and brown dwarfs. The canonical model (as far as there is one) suggests that, as the effective temperature drops below about 2500 K, the photosphere becomes increasingly dusty due to increased gas condensation, whereas at even lower temperatures the dust opacity is reduced due to gravitational settling of the dust below the photosphere.

However, such models assume static and uniform horizontal distributions of this dust, whereas observational work over the past few years has shown many ultra cool dwarfs to be photometrically variable, with variable dust-related clouds a possible origin.

In this talk, I will briefly review the observational evidence for time-dependent phenomena in ultra cool dwarfs, including the results of both photometric and spectroscopic monitoring programs. This evidence will be critically analysed in terms of both dust-related models and other causes of variability, such as magnetically-induced spots. Turbulent convection arrising from rapid rotation may be responsible for cloud dynamics, yet the detection of Hα flaring as well as X-ray and radio emission from some ultra cool dwarfs indicates active chromospheric or coronal-like structures which may be relevant to the optical and infrared variability. The implications of time-variable phenomena on the study of low mass stars and brown dwarfs as well as the search for planetary companions about these objects will be discussed.

A 17

Time-dependent Dust Scenario in the Atmospheres of Brown Dwarfs

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The temporal evolution of Brown Dwarf atmospheres is affected by different interacting physical and chemical processes. The outer parts of these substellar objects, for one example, are strongly influenced by stellar convection and thus ultimately linked with the interior parts. The optical appearance reveal the presence of large quantities of solid dust grains. Their existence is justified by the thermodynamical conditions present in these cool and dense atmospheres.

We present the first results of time dependent calculations (1D) including convective radiation hydrodynamics (cf. Wuchterl & Feuchtinger, A&A 340, 419, 1998; Feuchtinger A&AS 136, 217, 1999) and the description of heterogeneous dust processing for a typical Brown Dwarf atmosphere on evolutionary time scales. The effects of depletion and reinjection of heavier chemical elements due to rain-out and convective mixing is explicitly taken into account in the model. In order to describe the sedimentation process numerically an adaptive bin-method has been developed.

Within this theoretical framework the scenario of an uprising mass element being injected into the atmosphere is simulated. The results of these calculations reveal the development of short-term variations in the atmosphere. The time scales of these changes correspond to those being actually observed in Brown Dwarf atmospheres (see e. g. Bailer-Jones & R. Mundt, A&A 367, 218, 2001).

A 18

Evolution of Dust in Protoplanetary Discs

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The dust component in protoplanetary accretion discs is subject to a number of processes which modify the structure, chemical composition, and properties of the dust particles. In the outer disc regions the dust mixture is dominated by dust from the parent molecular cloud: amorphous, dirty dust with strongly non-equilibrium composition. In the inner disc regions the dust is crystalline and the dust mixture corresponds to chemical equilibrium. Large scale transport processes mix both components throughout the planetary formation region. The signatures of such processes are found in the chemical composition and mineralogical properties of dust in matrix material of meteorites and cometary nuclei. The basic processes of dust metamorphosis and their implications for the composition of the raw material, from which planetesimals and their successors are formed, are discussed.

A 19

KH 15D: Detection of Significant Structure in the Circumstellar Disk of a Pre-Main Sequence Star

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Photometric and spectroscopic data are presented of KH 15D, a unique, eclipsing pre-main sequence star located in the young (2–4 Myr) cluster NGC 2264. A coordinated international observing campaign took place during the eclipse period from 1–21 December 2001, and involved the following observatories from around the world: Van Vleck, Calar Alto, Maidanak, KPNO, USNO, Wise, UHH, Gemini South, OVRO Millimeter-Wavelength Array, IRTF, and the VLT. This international campaign has allowed us to probe in detail the structure of a disk surrounding a pre-main sequence star for the first time. Preliminary results from these observations indicate that when the object is in eclipse, it appears to be variable at the 0.2 mag level over the course of hours. There is little evidence, however, for variability outside eclipse beyond the 0.03 mag level. No real evidence for a systematic color change between when the object is bright and when it is in eclipse has been observed, indicating that the eclipse must be caused by particles larger than interstellar dust grains. It appears that the favorable geometry in this case is giving us the opportunity to study structure in a disk which has evolved at least part way to the formation of planetesimals. A more complete picture of this object based our multi-wavelength, international campaign is presented.

A 20

Tenuous Disks Around Young Solar-type Stars

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Young solar-type stars show more chromospheric activity than our present Sun. Hence these stars still have a strong ultraviolet (UV) radiation field even though accretion is no longer its dominant source. By using an observationally derived scaling law, the far UV field of a T Tauri star can be reconstructed from the present solar observations. The complete radiation field is then composed of the far UV data, IUE observations and a Kurucz model atmosphere.

We present here results for the temperature in these disks as well as for the chemical composition in the presence of the strong chromospheric radiation field.

A 21

Ultra-high-resolution Spectroscopy of Circumstellar Disks around A-type Stars

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IRAS observations have shown that about 20 % of all A stars are surrounded by dust. Detailed abundance studies of IRAS sources revealed A stars with narrow absorption features in the Ca II K line which are attributed to the presence of circumstellar gas. This is of particular interest in the framework of the formation of planetary systems. In the case of the prototype with circumstellar material – β Pictoris – these narrow absorption features are a well-studied phenomenon. Their variability on short timescales corresponds with the scenario of falling evaporating bodies (FEB) approaching the star. Information on the variability of prominent narrow absorptions in Ca II K of other A stars is scarce. Investigation of spectral variations using ultra-high-resolution spectroscopy provides an excellent tool to tackle the question whether these features are of circumstellar or rather interstellar origin. Furthermore, it allows to both investigate the FEB scenario and the dynamics of the circumstellar gas. We present results from Ca II K observations carried out with the ESO 3.6-m telescope equipped with the CES at a resolution of 200 000.

A 22

New Observational Constraints for the Unified Model of Class 0 Objects and their Associated Outflows

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Building up a unified picture of the evolution of protostars and their associated molecular outflows is a major step in the understanding of the star formation process as a whole. FIR observations with ISOPHOT provide new constraints in order to refine these models.

Using ISOPHOT photometry (60, 100, 160 and 200 μm), we determined T_{bol}, the sub-mm slope of the SED and the sizes of the protostellar envelopes, as well as L_{bol} and L_{fir} of six objects (Cep E, RNO 15 FIR, HH 211-MM, L 1157, L 1211 and IC 1396 W). All are verified by their L_{fir}/L_{bol} ratios as Class 0 sources. We find that these objects represent a sample of cold and luminous protostars. Using evolutionary tracks based on the unification scheme of Smith (2002) we determined the ages, final and current masses of the objects, as well as the masses of the protostellar envelopes. Furthermore, we investigated correlations between outflow luminosity and source properties. The luminosity in the 1−0 S(1) line of H_2 at 2.122 μm was measured for outflows of 15 verified Class 0 sources in NIR images. No statistically significant correlation between $L_{1-0\,S(1)}$ and one of the source properties (T_{bol}, L_{bol}, M_{env}) was found. A constant value for $L_{1-0\,S(1)}$ is also excluded by a Kolmogorow-Smirnow test. This non-correlation is confirmed by the unification scheme, which shows that $L_{1-0\,S(1)}$ depends on the combination of mass and age of the protostar. Such relationships are also partially disguised by the local properties of the surrounding material, the extinction and short-term flux variability.

A 23

Looking at the Earliest Stages of the Formation of Stars: SCUBA Observations of Deeply Embedded Sources

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Deriving physical parameters of deeply embedded outflow sources at the earliest stage of star formation from observations is of key importance for testing models of their structure. Here, we present new continuum images of deeply embedded sources in the Orion and Perseus star forming regions taken at 450 and 850 μm with SCUBA at the JCMT and report on results of these new observations. We focus on the following regions: HH211-MM, NGC 1333, RNO15 FIR, L1448, L1634, NGC 1333 and L1641N. The maps show the detailed structure of the regions which contain the sources themselves, other compact sources and extended emission features which have not been detected in any previous data set.

Photometry and physical parameters of the brightest sources, like the spectral index $\alpha_{450/850}$, masses (gas and dust), and sizes are derived. Radial profiles were obtained to determinate the diameters. The results reveal that the new sources have a mass of a few times that of the sun. Comparisons with near-infrared images and combinations with far-infrared data confirm the Class 0 nature of some of our sources. Two of the clumps in RNO15 FIR appear amorphous in shape at 450 μm and are probably of prestellar nature. The mean value of the spectral index for all sources is 2.9 $\pm$ 0.2. Sizes of the extended envelopes span a range of ~1500–6000 AU (450 μm) and ~4000–9000 AU (850 μm), except for a bigger compact source in L1634 and for RNO15 FIR (850 μm).

A 24

HST/STIS Observations of the Bipolar Jet from RW Aurigae

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We have observed the bipolar jet of RW Aur A with the STIS spectrograph on board the HST. A set of seven spectra was taken, keeping the slit parallel to the outflow axis, but moving it transversely across the jet in steps of 0.″07. This datacube allows the construction of high angular resolution images of the jet in different radial velocity intervals.

After continuum subtraction, morphological and kinematic properties of this outflow can be traced to within 0.″1 from the source in forbidden emission lines. The jet appears well collimated, with typical FWHMs of 20 to 30 AU in the first 2″ and surprisingly does not show a separate low-velocity component in contrast to earlier observations. The systemic radial outflow velocity of the blueshifted lobe is typically 50 % larger than that of the redshifted one with a velocity difference of about 65 $\mathrm{km\,s^{-1}}$. Although such asymmetries have been seen before on larger scales, our high spatial resolution observations suggest that they are intrinsic to the "central engine" rather than effects of the star's immediate environment. Temporal variations of the bipolar jet's outflow velocities appear to occur on timescales of a few years, suggesting that the emission knots of the RW Aur jet are internal working surfaces. These variations have combined to produce a 55 % increase in the velocity asymmetry between the two lobes over the past decade. In the red lobe estimated mass flux $\dot{M}_j$ and momentum flux $\dot{P}_j$ values are around one half and one third of those for the blue lobe, respectively. The mass outflow to mass accretion rate is 0.05, the former being measured at a distance of 0.″35 from the source.

A 25

Direct Detection of the 0.15 $M_\odot$ Companion to χ^1 Orionis

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We will report on the direct detection of the low mass companion to χ^1 Orionis, a star slightly more massive than the sun. Therefore we present an H-band image of the companion of χ^1 Orionis taken with the Keck NIRC2 adaptive optic system and camera equipped with a coronographic mask of 300 μm. We will present the exceptional advantages of a semi-transparent coronographic mask in combination with a 10 m-class telescope and an adaptive optics system for the search for low-mass companions around nearby bright solar-type stars.

The direct detection of this companion star enables us to calculate dynamical masses using only Kepler's laws ($M_A = 1.01 \pm 0.13 M_\odot$, $M_B = 0.15 \pm 0.02 M_\odot$) independent of stellar models. This can result in a quantitative study of stellar evolutionary models at a wide spread of masses. Assuming the models are correct, with the low mass companion there is an independent way of estimating ages for stellar clusters. For example, the application of Baraffe et al. (1998) pre-main-sequence models to the secondary implies an age of 110–150 Myrs. This is in conflict to the age of the primary, a confirmed member of the Ursa Major Cluster with a canonical age of 300 Myrs. As a consequence, either the models at low masses underestimate the age of such stars or the Ursa Major Cluster is considerably younger than assumed or the truth is somewhat in-between.

A 26

Stellar Rotation in Young Open Clusters: The Case of NGC 2264

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We have carried out I band observations of the young (2–4 Myr) open cluster NGC 2264 (d = 770 pc) on 44 nights over a total time interval of two months using the Wide Field Imager (WFI) on the MPG/ESO 2.2 m telescope at La Silla, Chile. All of the 11 000 stars in the field ($32' \times 34'$) with magnitudes between I = 9 mag and I = 21 mag have been checked for both periodic and irregular variability. Altogether we found about 1200 irregular variable and 653 periodic variables stars. The latter are thought to be rotating, spotted T Tauri stars. The measured rotational periods are typically between 0.5 and 15 days. The period distribution is magnitude dependent and for stars with $19 \leq I \leq 15.5$ mag (which corresponds roughly to $M \gtrsim 0.3 M_{\odot}$) it is bimodal with peaks at about 1 and 4 days. For stars with $I \geq 15.5$ mag (which probably extends into the substellar regime) we find an unimodal distribution with a peak at about 1 day. The bimodality of the period distribution of the higher mass stars can be explained within a disk-locking scenario: The slow rotators have been magnetically locked to their circumstellar disks which prevented them from spinning up. When we compare our results for NGC 2264 with the younger Orion Nebular Cluster (ONC, age: 1 Myr), we find that in NGC 2264 the peaks in both the bimodal distribution of the higher mass stars and in the unimodal distribution of the lower mass stars are at about half of the values measured for the ONC. If one assumes that most stars in NGC 2264 are no longer magnetically locked to their disks (i. e. their angular momentum is conserved) their much higher rotational speed can simply be interpreted as a result of their larger age and a correspondingly smaller stellar radius.

Splinter Meeting B

Recent Developments in Research and Legislature on Light Pollution

Contributed Talks: B 01 ... 4

Chairmen:

Thomas Posch, Wien
Josef Hron, Wien
Günther Wuchterl, Garching

Related posters: P 03 ... 05

B 01

The Situation of Light Pollution in Germany

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Some nations or regions have laws that regulate the amount of light emitted in the direction of the sky to reduce sky pollution. In Germany the situation is very complicated because there exist several laws that may be applied for the different light sources and their use. There exist norms for street lighting, a light immission regulation and environmental laws that however do not mention light explicitly. Further instructions are given in the building regulations. The problem is that detailed technical regulations lack, mainly because reliable scientific data are scarce or even do not exist. Some of these problematic areas will be discussed.

B 02

Radio Pollution and RFI: Regulation and Recent Developments

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Due to their commercial use, mainly, and unlike optical wavelengths, the radio spectrum is regulated and reglemented. The International Telecommunication Union, ITU, produces these rules, which are then applied nationally. Radio astronomy is a recognised radio service and co-operates with the other radiocommunication services to update and improve the ITU rules, continuously. Recently consideration of rules for optical links as planned or used between satellites has been proposed within ITU-R, the radio sector of ITU. We are still far from regulating the commercially used optical spectrum, but in the studies, which may start soon, astronomers are invited to provide their protection requirements. A discussion about such requirements should start now, within the optical astronomy community.

B 03

How many stars do we still see?

A nationwide public experiment to determine the visual limiting magnitude in Austria

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During the Austrian Science Week, May 11–20th 2001,a week devoted to the presentation of science to the general public, the *Vienna Institute for Astronomy* and the *Verein Kuffner-Sternwarte* organised an observational campaign to estimate the light pollution nationwide. The experiment was based on determining the naked-eye visibility of stars in the little dipper. Participants supplied the time and location of their observation together with an identifier for the image that fitted their UMi observation best. A total of more than 1700 observations have been reported. We present the method, the public outreach material, the overall results and possible extensions to the tropics and southern hemisphere based on the Orion-belt stars. Of key importance were the simplicity of the observational method, easy means of observation-reporting (call-center, telephone robot, internet-page), and the distribution of instructions and 'finding charts' via mass media. Reaching 100 000 persons would typically result in 100 observations during the two following days. Based on the total media-range we estimate that more than two Mio people received our calls for observations. The participation of amateur astronomers and public observatories was important to establish a network of information-points and to contact the public locally. We estimate that a total of 5000 observation are needed to cover the less populated parts of Austria. Observations are still collected and results are shown at: http://www.astro.univie.ac.at/~scw

B 04

The Brightness of the Night Sky in Urban Areas

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In large cities, it has become usual to permanently measure many parameters that characterize the environmental pollution: e. g. the concentrations of CO_2, SO_2, nitrogen oxides, dust and soot in the atmosphere and so on. By contrast, light pollution is currently not being monitored in urban areas, even though the public awareness of this problem is increasing not only among astronomers.

The present contribution aims at summarizing the basic set of quantities and units characterizing light pollution. We discuss the relation between the presently valid limits of illuminace caused by artificial lights on the one hand and illuminances due to natural (astronomical) radiation sources on the other hand. One of the key questions in this context is whether illuminances amounting to 500 times that of the full moon can be considered as tolerable for public street lighting.

Facts and figures are presented that show the dramatic amount of artificial sky brightness in Vienna (depending on weather, time, zenith distance etc.).

We promote the idea of standardizing light pollution measurements in a way that they can be included into urban environmental pollution control.

Splinter Meeting C

Interferometric Insights into the Cycle of Matter

Contributed Talks: C 01 ... 02

Chairpeople:

Katharina Schreyer, Jena
Jürgen Steinacker, Jena

Related posters: P 36 ... 37

C 01

A Multiplicity Survey of the ρ Oph Molecular Cloud – Preliminary Results

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Muliplicity surveys among young T Tauri stars in various star forming regions and young clusters have revealed that formation of binary stars is the dominant mode of low mass star formation (Leinert et al., A&A, 278, 129, 1993). In Taurus the multiplicity is higher by a factor of 1.93 ± 0.26 (Köhler et al., A&A, 331, 977, 1998) and in Scorpius-Centaurus by a factor of 1.59 ± 0.34 (Köhler et al., A&A, 356, 541, 2000) compared to solar-type main-sequence stars (Duquennoy and Mayor, A&A, 248, 485, 1991).

Motivated by these results we selected 159 ($m_K \leq 11$ mag) young stellar objects located in the center and the periphery of the molecular clouds L1688, L1689 and L1709 around ρ Oph. We observed these sources wih speckle interferometry at the ESO New Technology Telescope on La Silla, Chile, in June 2000 and June/July 2001. The instrument used was SHARP I (MPE) with a field of view of 12.8×12.8 arsec. All observations were performed in the K-band.

The software package developed by our group for reducing and analysing speckle images enables us to detect companions with projected separations down to the diffraction limit of the telescope (≈ 0.13 arcsec). At the distance of the Ophiuchus clouds (125 ± 25 pc, de Geus et al., A&A, 216, 44, 1989), this corresponds to separations ≥ 15 AU or (on average) to periods ≥ 100 yr.

We present the first preliminary statistical results and compare them to those of other star forming regions.

C 02

Bispectrum Speckle Interferometry of Young Jet- and Outflow-sources

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The mechanisms by which the jets and outflows from young stellar objects are generated, accelerated, and collimated are still not well understood. For a better understanding of the underlying physical processes it is important to look as close as possible to the disk/star boundary, where the jets and outflows are thought to be launched. Therefore, high-spatial resolution observations are of crucial importance for further progress in this field.

In this contribution we will present recent results from our near-infrared bispectrum speckle interferometry observations of outflow sources, including S140 IRS, R Mon, and Mon R2 IRS 3. With a spatial resolution of up to $0.055''$, our data represent the highest resolution images obtained so far for these objects and exhibit previously unseen complex structures. In the case of S140, our results provide evidence for the existence of two distinct bipolar outflow systems originating simultaneously from the protostar IRS 1 and a remarkable precessing jet from IRS 3. We will also discuss our results for the other targets and the relation of the observed circumstellar structures to the jets and outflows from the young stellar objects.

Splinter Meeting D

AGB Stars, Winds, and Nucleosynthesis

Contributed Talks: D 01 ... 12

Chairmen:

Detlef Schoenberner, Potsdam
Matthias Steffen, Potsdam
Falk Herwig, Victoria

Related posters: P 53 ... 59

D 01

Laboratory Studies on Presolar Grains from AGB Stars

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Primitive meteorites contain small quantities of presolar dust grains that are characterized by highly anomalous isotopic compositions. These grains formed in the winds of evolved stars or in the ejecta of stellar explosions and they thus represent a sample of stardust that can be studied in the laboratory [1, 2].

The most abundant presolar minerals identified to date are diamond, silicon carbide (SiC), graphite, and corundum (Al_2O_3). Among the proposed stellar sources of those grains are RGB and AGB stars, supernovae, novae, and Wolf-Rayet stars. The majority of the SiC grains is believed to have formed in AGB stars as indicated by enrichments in ^{13}C (1–3 × solar), ^{14}N (2–70 × solar), and s-process elements, and high inferred $^{26}Al/^{27}Al$ ratios. A small fraction of presolar SiC grains has $^{12}C/^{13}C$ ratios as low as 2–10 and considerable enrichments in ^{15}N (up to 5 × solar) and J-type carbon stars and born-again AGB stars have been proposed as potential stellar sources. AGB stars have also been considered as a source for many corundum grains. These grains are characterized by enrichments in 17O (typically by up to 5 × solar), depletions in 18O (typically by up to a factor of 2 relative to solar), and the presence of radiogenic ^{26}Mg.

References:
[1] Zinner E. 1998, Annu. Rev. Earth Planet. Sci., 26, 147
[2] Hoppe P. and Zinner E. 2000, JGR, 105, 10371

D 02

Fe II and [Fe II] Emission Lines as a Diagnostic Tool to Probe the Shocked Atmospheres of M-type Miras

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Our time-resolved high resolution observations of cool, shock penetrated, expanding atmospheres of M-type Mira variables (cf. Richter & Wood 2001, A&A 369, 1027) have suggested that the Fe II and [Fe II] emission lines are an excellent diagnostic tool to study the physical conditions in the shocked regions close to the photosphere of these stars. These lines must be generated in the vicinity of the stars at $\sim 1.5 - 3\,R_*$, as estimated according to the phases of their appearance. Since dust formation takes place in about the same regions, a detailed analysis of these lines provides the possibility to determine the physical conditions of the inner dust formation zone of M-type Miras.

In order to reveal the hydro- and thermodynamical conditions which lead to the formation of the Fe II and [Fe II] emission lines, we carried out detailed NLTE radiative transfer calculations which have been performed on a series of radial, thermodynamical structures of periodic shock waves. These basic parameter studies indicate that the lines of ionised iron originate right from the hot post-shock regions and that they are in fact emitted close to the photosphere. In combination with observational constraints on the line fluxes, we demonstrate that only a certain parameter range of the pre-shock density and velocity amplitude of the shock leads to the formation of the corresponding observed line fluxes. We therewith can draw specific conclusions on the *real* hydrodynamical conditions existing in the inner zones of M-type Mira atmospheres.

D 03

Long Term Modelling of Mass Loss on the Late AGB

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We present self-consistent calculations of the envelope of a star on the late AGB. These calculations cover the last few thermal pulse cycles. We apply two-fluid flow, semi-analytical radiative transfer, gas equilibrium chemistry and the nucleation, growth and evaporation of grains are calculated within the numerical code. The evolution of the stellar temperature and luminosity are applied as an inner boundary condition.

D 04

The Role of AGB Stars in Galactic Chemical Evolution

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I will explore some recent advancements in the understanding the role of AGB stars in Galactic chemical evolution. The chemical enrichment of the Galaxy has been followed in the framework of a detailed evolutionary model. I will discuss the astrophysical origin of the *s*-process nuclei with atomic mass number $A > 90$. I will focus on the fact that *s*-process has not a unique nature, the abundance distribution in the Solar System being the outcome of all previous generations of AGB stars of different masses and metallicities. Among others, one very interesting point that I will discuss is the *s*-process contribution by the Galactic chemical evolution to Lead, comparing theoretical predictions with recent spectroscopic observations in very low-metallicity stars.

Finally, the AGB contribution to Galactic evolution of light elements, in particular Carbon, will be also briefly discussed and perspectives and aims for future researches will be resumed.

D 05

Nucleosynthesis and Massive Stars in the Orion Region

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Massive stars produce ^{26}Al as radioactive by-product of their nucleosynthesis activity in their interior and in the terminal supernova. Gamma-ray emission from this isotope with its one-million year decay time integrates over many sources and events ejecting such enriched material, and also reflects the morphology of the surrounding interstellar medium. In the Orion region, subgroups of the Orion OB1 association are probably responsible for the formation of the Eridanus cavity which extends from the Orion molecular clouds towards the Sun. Also, ^{26}Al radioactivity is ejected by subgroups of ages above about 3 My. The gamma-ray observations show radioactivity displaced from the location of the massive stars towards this cavity, which is interpreted as support of our understanding of this role of massive stars in nucleosynthesis and in shaping of the ISM.

D 06

The Shapes of Gamma-Ray Lines from Radioactives – Prospects for INTEGRAL

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Gamma rays are emitted by freshly synthesized radioactive isotopes ejected into the interstellar medium in stellar winds or during explosions such as supernovae.

Gamma-ray lines are intrinsically very sharp, but will become Doppler-broadened due to the velocities involved in the ejection of the material containing the isotopes and the subsequent dispersal and interaction with the surrounding interstellar medium. The resulting intensity distribution and line shape hold information about the distribution of matter in geometrical space and in velocity space.

The ESA gamma-ray observatory INTEGRAL will be launched in October 2002. Its spectrometer SPI will have high spectral resolution, sufficient to measure these line shapes.

We model the spatial and spectral gamma-ray emission characteristics of interesting radioactive sources such as individual supernova remnants and bubbles forming around groups of massive stars.

D 07

Dynamical Atmospheres and Winds of AGB Stars

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Atmospheres of pulsating Asymptotic Giant Branch stars present a major challenge for realistic, self-consistent modelling: Propagating shock waves caused by stellar pulsation modify the structure of the atmosphere on local and global scales, causing strong deviations from hydrostatic stratification. The radiative field is dominated by molecular opacities or even by dust grains forming in the cool outer layers of the atmospheres. Important microphysical processes like chemistry and dust formation may be severely out of equilibrium.

Our latest generation of model atmospheres for AGB stars combines time-dependent dynamics and frequency-dependent radiative transfer. This allows us to take both the effects of pulsation and the complex influence of molecular opacities into account. In the case of C-rich stars, the models also include a self-consistent time-dependent description of dust formation. We compare our new models to existing grey dynamical models as well as to classical hydrostatic model atmospheres. We stress the importance of non-grey radiative transfer for obtaining realistic background structures even in highly dynamical models, discussing both the resulting observable properties and the wind characteristics. We study the influence of the microphysical properties of dust grains on the mass loss rate, the wind velocity and the degree of condensation. Presenting synthetic spectra, we argue that the current dynamical models represent an important step in a process leading from a qualitative to a quantitative description of atmospheres and winds of pulsating AGB stars.

D 08

Tracing AGB s-process Nucleosynthesis by the Analysis of Post-AGB Stars

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In this contribution we will focus on the new results of the analysis of high-resolution high signal-to-noise UVES spectra of strongly s-process enriched post-AGB objects.

During their AGB phase, the photosphere of these objects became enriched in Carbon and trans-iron elements synthesized by neutron capture. We show that some post-AGB objects are the most s-process enriched objects known and are ideally suited to constrain the AGB nucleosynthetic and mixing models. Moreover, the intrinsically enriched objects cover a spread in initial metallicity making them very useful to study the impact of the reduced metallicity on the production characteristics of the neutron-capture elements. Finally we confront these findings with literature results on the s-process element enrichment of AGB stars and of extrinsically enriched object.

D 09

Nuclear Astrophysiscs in AGB Stars

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AGB stars are an important ingredient in the cosmic recycling of matter. They are, for example, a major nuclear production site for the trans-iron elements (s-process) as well as for nitrogen and carbon. Accurate models for the nuclear production in AGB stars depend on the reliability of mixing models. Today a wide spectrum of constraints are available to probe different mixing processes in AGB stars. These include spectroscopic observations of AGB and post-AGB stars, s-process branching points as stellar thermometer and detailed cosmo-chemistry data from pre-solar meteoritic inclusions.

Specifically it is shown that oxygen dredge-up in AGB stars is suggested by recent models of H-deficient pre-white dwarfs and central stars of planetary nebulae. This oxygen dredge-up can not be excluded on the basis of elemental oxygen and carbon abundance observations in giant stars. However, existing oxygen dredge-up models based on hydrodynamic convective overshooting are possibly in contradiction with well determined s-process branchings, for example $^{96}Zr/^{94}Zr$. Furthermore, with respect to the extra mixing processes responsible for the s-process we present new quantitative models which suggest that a combination of rotationally induced mixing and some additional mixing process during the third-dredge up phase (for example hydrodynamical overshooting) can in principle account for observational properties of the s-process as evident from both spectroscopic stellar and pre-solar meteoritic data. Finally we discuss the implication of oxygen dredge-up, for example on the nitrogen yields in zero- and low metallicity AGB stars.

D 10

Microphysical Aspects of Dust Formation in the Winds of AGB Stars

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During the late stages of their evolution, low and intermediate mass stars on the asymptotic giant branch (AGB) experience substantial mass loss and extended circumstellar envelopes of gas and dust are formed, returning this material into the ISM. A complex interplay between different physical and chemical processes with different characteristic time scales takes place. In particular, grain formation has a significant effect on the thermal, hydrodynamical, and chemical structure of the outflows.

The transition from a gas to solid particles takes place via the formation and growth of small clusters in the gas. The required kinetic and thermodynamic data of such microphysical processes are often rarely available. Therefore, the nature and physical properties of clusters possibly involved in dust condensation processes from the gas phase have been studied theoretically employing computational electronic structure techniques. The properties, thus obtained, are necessary prerequisites for the study of such phase transitions in astrophysical environments. Consequences regarding the formation of dust particles in the outflows of AGB stars are discussed.

D 11

Three-component Modeling of AGB Star Winds

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The winds of AGB stars are complex systems of radiation field, gas and dust interaction processes, all of which an accurate wind model has to describe properly.

Our atmospheric wind model is based on time-dependent radiation hydrodynamics combined with a carbon dust component represented by moment equations; the relevant interaction terms between the three components have in addition been described. The model makes it possible to study the properties of the stellar wind when the dust component is allowed to drift with respect to the gas component. We present current results of our three-component calculations, and discuss the consequences for atmospheric structure and mass loss.

D 12

The Surface Composition of Hydrogen-deficient Post-AGB Stars

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Most Central Stars of Planetary Nebulae exhibit a spectrum of a hydrogen-rich hot star with little or no stellar wind. About 20 % of the CSPN, however, show entirely different spectra dominated by bright and broad emission lines of carbon, oxygen and helium, resembling the so-called Wolf-Rayet (WR) spectral class originally established for massive, Pop. I stars. These spectra indicate a hydrogen-deficient surface composition and, at the same time, strong mass-loss.

As the WR spectra are formed entirely in a dense stellar wind, their spectral analysis requires adequate modelling. Corresponding Non-LTE model atmospheres have been developed in the last decade and became more and more sophisticated. They have been applied yet for analyzing almost all available WR-type CSPN spectra, establishing the stellar parameters.

The obtained surface abundances are not understandable in terms of "classical" evolutionary calculations, but agree in principle with the advanced models for AGB evolution which account consistently for diffusive mixing and nuclear burning. The underabundance of iron, which we established in a recent study of a WC-type central star (LMC–SMP 61), gives indirect evidence that neutron-capture synthesis has converted Fe into s-process elements.

Splinter Meeting E

Active Black Holes

Contributed Talks: E 01 ... 11

Chairpeople:

Heino Falcke and Anton Zensus, Bonn
Stefanie Komossa, Garching
Stefan Wagner, Heidelberg
Matthias Dietrich, Florida
Karl Mannheim, Würzburg

Related posters: P 72 ... 79

E 01

Long-Term Variability of Galactic Black Holes

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We present the results of several year-long monitoring campaigns of the galactic black holes Cyg X-1, GX 339−4, and LMC X-3 with the Rossi X-ray Timing Explorer, focusing on the correlated changes of the spectral and temporal properties of these sources.

The study of the changes in the X-ray spectrum during state transitions between the canonical hard and soft states using several Comptonization models reveals the presence of a hysteretic region where the source spectrum is different depending on its previous history. During the hard state itself, a possible anticorrelation between the covering factor of cold material and the compactness of the putative Compton corona is observed.

During state transitions, the timing behavior of the sources changes dramatically. While the power spectral density during the hard state can be well described as the sum of four broad Lorentzian components, two of these components dominate during the spectral transitions. Increased time lags in the frequency band of these Lorentzians are indicative of an increase of the size of the region producing the observed radiation. Since state changes are also associated with ejection events observed in the radio, we speculate on a possible relationship between the mechanisms responsible for the production of the X-rays and the radio emission.

E 02

X-ray/optical Correlations in the Transient Black Hole System KV UMa (XTE J1118+48)

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From January to August 2000 the bright X-ray transient XTE J1118+48 (=KV UMa), a binary system containing a 6 solar mass black hole, provided a unique opportunity for simultaneous X-ray and optical observations. The MPE fast timing optical photometer OPTIMA was used on July 4–7, 2000 at the 1.3 m telescope of Skinakas observatory, Crete for observations of KV UMa simultaneous with RXTE. A total common exposure of 2.5 hours with accurate single photon timing (few μs) was accumulated. X-ray and optical variations were found to be strongly correlated, with the optical emission rising very fast ($\sim 30ms$) after an increase in X-ray brightness. The maximum of the optical response lags the X-ray peaks by typically 500 ms. A curious dimming of the optical light is also apparent 2–5 s before the X-ray outbursts. Although this delayed optical emission is suggestive of a reprocessing scenario (light echo), the autocorrelation of the X-ray and optical time series shows that the latter has intrinsically a much faster timing structure. This argues strongly against reprocessing. A possible scenario to explain this result invokes a slow (∼0.1 c) magnetically controlled outflow from the black hole. The optical light is generated as cyclosynchrotron emission in a region about 20 000 km from the center. The optical response is then explained as the propagation delay of an accretion

E 03

Time Lags of Black Hole Candidates

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Most black hole candidate X-ray binaries show time lags between softer and harder X-rays. The hard photons seem to arrive up to a few ms after the soft ones for a given Fourier frequency of the perturbation. The energy dependence of the time lags is roughly logarithmic. Up to now most theories fail to explain the observed magnitude of the lags or the observed cross/auto-correlation function.

One recent suggestion has been that the hard X-ray emission in XRBs (as in some AGN) is due to synchrotron radiation from a jet. Inspired by this, we show that the time lags can arise from a simple pivoting power law model, which creates the logarithmic dependence on the photon energy at once. For small variations of the power law index the lags can be derived analytical. They show the qualitative correct behavior of the dependence of the time lag on Fourier frequency. If one assumes variations of the power law index from –1.3 to –1.7 as observed for blazars the model can account for the observed magnitude of the time lags. As a second test we calculated the cross- and auto-correlation functions for our model which show qualitatively the observed behavior. The autocorrelation functions for higher energy have a narrower peak than the lower energy and the cross-correlation function is asymmetric but peaks nearly at zero.

We conclude the pivoting power law model can reproduce many statistical properties of black hole candidate XRBs and may be applicable to AGN.

E 04

Jet-Domination in Sub-Eddington Black Holes

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With better sensitivity in radio and X-rays more and more detailed observations of sub-Eddington black holes are possible. This is especially important for Low-Luminosity AGN and X-ray binaries in the low/hard-state. Fitting the spectral energy distribution of these sources with a combined jet and disk model (either standard thin disks or ADAFs) we find that the contribution from jets become relatively stronger compared to the emission from the accretion disk at most wavelengths. This may be an important input for unified schemes and can, for example, explain the absence of any thermal disk spectrum in BL Lacs or FR I radio galaxies. If sub-Eddington black holes are indeed largely dominated by non-thermal spectra from jets, one can explain a range of phenomena, like, for example, the intriguing radio-X-ray correlation in some X-ray binaries and the unusual spectral energy distributions of some famous LLAGN, such as Sgr A* and NGC 4258.

E 05

A 3 mm Polarization Survey of Active Galactic Nuclei

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We describe the commissioning of and first results obtained with a versatile polarimeter operating at the intermediate frequency (150 GHz) of the IRAM 30 m telescope. This versatile instrument allows continuum as well as spectral line observations in all millimeter atmospheric windows accessible with the 30 m telescope.

After discussing the performance of the new polarimeter and its limitations, we present results from the first large scale polarization survey at 3 mm wavelength, started in 1999. About 100 Active Galactic Nuclei with flux densities stronger than ~ 0.8 Jy were observed, many of them repeatedly. Linear polarization larger than 10 percent is found in several sources at several epochs. Weak circular polarization is detected, probably for the first time at this wavelength in several sources. We see the clearest yet statistical evidence that the magnetic field is preferentially perpendicular to the jet axis in the subset of BL Lac objects.

E 06

Tentativ Evidence for an Intrinsic Multi-TeV Turnover in the Spectra of Mkn501 and Mkn421

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Using our newly developed model for the metagalactic radiation field (MRF) due to optical and infrared emitting galaxies, we investigate the effect of cosmological pair attenuation on the gamma-ray spectra of blazars. The analysis is based on all available datasets for Mkn501 and Mkn421 in their high states. We find best-fit solutions for the de-absorbed spectra which indicate an intrinsic turnover.

E 07

Compact Symmetric Objects: The Youngest Radio Galaxies

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Compact Symmetric Objects (CSOs) are powerful radio sources with symmetric radio emission around the centre of activity in the form of mini-lobes which contain hotspots and/or jets extending up to 1 kpc. Their morphology is analogous to the large kpc and Mpc-scale double radio galaxies. The hotspots can be considered as the working surface of the jet as they propagate through the ISM and not just the location of a simple shock propagating in the jet. We discuss recent measurements of proper motions of the hotspots of Compact Symmetric Objects. Source expansion has been detected in ten CSOs so far and all these objects are very young ($< 3 \times 10^3$ years). For a few sources in which ages have also been estimated from energy supply and spectral ageing arguments we show that these estimates are comparable. We also use proper motion studies to constrain hotspot accelerations, side-to-side motions and differences in hotspot advance speeds between the two hotspots within sources. Although most CSOs are young sources their evolution is unclear. It appears that many of them are the precursors of the large double radio galaxies. There is also increasing evidence that in some objects the CSO structure represents a new phase of activity within a recurrent source. We also discuss recent detections of atomic (H I) and molecular (CO and excited OH) gas in CSOs which we tentatively identify as lying in a disk or torus with a plane normal to the axis of the radio source, consistent with the hypothesis of the Unified Schemes.

E 08

The Inner Broad Line Region Structure in Mrk110

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We present new spectroscopic results of the highly variable narrow-line Seyfert 1 galaxy Mrk110. The data of this variability campaign have been obtained with the 9.2 m HET Telescope at McDonald Observatory. Delays of the integrated He II, He I, and Balmer line fluxes with respect to the variable continuum verify an ionization structure in the BLR of Mrk110. Furthermore, we studied in detail the variability pattern of the resolved emission line profiles to determine the geometry and kinematics of the Broad Line Region. Only an accretion disk wind model matches our observations. In addition, we derive the central black hole mass in this AGN from the integrated line variations as well as from velocity delay maps (Kollatschny and Bischoff, Astron. Astrophys. Lett. 386, L19 (2002); Kollatschny in prep. (2002)).

E 09

Size of Quasar Emission-Line Regions

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We present a Hubble Space Telescope (HST) emission-line imaging survey of the seven brightest radio-quiet PG quasars with $z < 0.5$. Images in the [O III] λ5007 line were obtained using linear-ramp filters and the Wide Field Planetary Camera 2 with a pixel resolution of 0.0455 to 0.1 arcsec. Two quasars exhibit compact filamentary structure like that seen for Seyferts and may be related to radio outflows. The latter is also reminiscent of the situation in many Seyfert galaxies, where radio outflows are morphologically related to the NLR. All narrow-line regions (NLRs) are very compact with typical extents of 2-4 arcsec. Generally, the structure is relatively symmetric, in agreement with the unified scheme, that predicts a view into the ionization cones of these type 1 objects. The NLR in quasars seems to be consistent with being a scaled-up version of the NLR in Seyferts when including a sample of Seyfert galaxies observed with HST. Most interestingly, the size of the NLR of Seyferts and quasars seems to scale roughly with the square root of the [O III]. This relationship is comparable to the scaling found for the size of the broad-line region (measured from reverberation mapping) with continuum luminosity. It can been interpreted in terms of a constant photoionization parameter. These data provide the first direct evidence that quasar and Seyfert NLR are related and possibly evolve along a common luminosity-size track determined by photoionization.

E 10

Optical Emission Line Properties of Seyfert 1 Type AGN from ROSAT All Sky Survey

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We have studied the optical emission line properties of a sample of 155 low-redshift bright X-ray selected ROSAT Seyfert 1 type AGN for which adequate signal-to-noise ratio spectroscopic observations are available. We measured emission line properties by performing multi-component fits to emission line profiles, covering the effect of blended iron emission. We also obtain continuum parameters, including 250 eV X-ray luminosities derived from the ROSAT database. Here we will discuss the correlation analysis and possible origins of some peculiar trends.

E 11

Galaxy Clusters around Quasars?

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Studies of fields around QSOs from host galaxy to cluster scales have been established to explore the possible connection between AGN activity and its environment and to search for differences of environments as function of Quasar type and redshift.

Motivated by contradicting results from the literature regarding the galaxy clustering strength around Quasars, we have performed a deep and large imaging survey of fields around QSOs from low to intermediate z including recent VLT observations. We i) observed 130 QSOs, ii) considered radio-loud (RLQs) *and* radio-quiet (RQQs) Quasars, iii) focussed on intermediate redshift (where data are scarce), and, in particular iv) performed, explored and compared a variety of clustering analysis methods. These survey properties are in contrast to most previous studies.

One important aspect of our presentation will be the discussion of different clustering measurement methods and their impact on the obtained results. Altogether, we found that RQQs and RLQs reside mainly within comparable galaxy environments. Although the scatter in clustering strenght around the QSOs is large they seem to reside predominantly within compact groups of galaxies. Even QSOs within field galaxy environments show an excess of close companion candidates and in some cases clear evidence for tidal interactions with such galaxies.

Splinter Meeting F

X-ray Astronomy from the Solar System to the High Redshift Universe

Contributed Talks: F 01 ... 18

Chairpeople:

Stefanie Komossa, Garching
Vadim Burwitz, Garching
Norbert Schartel, Villafranca
Günther Hasinger, Garching

Related posters: P 80 ... 86

F 01

XMM-Newton: Mission Status and Science Archive

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The X-ray Multi-mirror Mission (XMM-Newton) is the second cornerstone of the European Space Agency's Horizon 2000 Science Programme, providing an observatory-class X-ray facility. The observatory provides simultaneous non-dispersive spectroscopic imaging (European Photon Imaging Camera; EPIC), medium resolution dispersive spectroscopy (Reflection Grating Spectrometer; RGS) and optical/UV imaging and timing from a co-aligned telescope (Optical Monitor; OM).

In combination the three cameras of EPIC offer a large effective area over the energy range from 150 eV to 15 keV, up to 2500 cm^2 at 1.5 keV and ~1800 cm^2 at 5 keV. Each of the two modules of the RGS cover the energy range from 0.35 keV to 2.5 keV with an effective area of up to 60 cm^2 at 15 Å. Thus, XMM-Newton offers a unique opportunity for a wide variety of sensitive X-ray observations accompanied by simultaneous optical/UV measurements.

The talk will give an overview of the status of the XMM-Newton mission. Based on this an outlook of activities planned for the near future will be provided.

The Science Archive of XMM-Newton is available to the scientific community since April 2002. The talk intents to provide a first introduction: "How to work with the Science Archive of XMM-Newton".

F 02

Introduction to the *Chandra* X-ray Observatory

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The *Chandra* X-ray observatory was launched in July 1999 into 64 hour highly elliptical orbit around earth. *Chandra*'s mirrors were designed so that X-ray images could be obtained in the 0.1 keV to 10 keV band with a sub-arcsecond spatial resolution similar to that achieved in visible light from ground-based telescopes. Thanks to the advanced CCD imaging spectrometer (ACIS) arrays it is also possible to obtain the spectral information for these images. Apart from the CCD imaging (ACIS-I) and spectroscopic (ACIS-S) arrays there are high resolution camera (HRC) micro-channel-plate detectors for imaging (HRC-I) and for detecting (HRC-S) the high resolution spectra. On-board Chandra there are two transmission gratings spectrographs which are brought into the convergent beam of X-ray. These are low energy transmission grating (LETG) and the combined high and medium energy transmission gratings (HETG).

With these instruments on-board *Chandra* many new exiting discoveries have been made. I will present some of these results here to help illustrate the capability of this satellite with its instruments. Already lots of the observations are now in the public archive. The access to the archive is pretty straight-forward and easy to use. The software and the threads to follow for analysing the data are all well documented.

For details of the intruments, their usage, data analysis and working with the data archive check the *Chandra* X-ray Center (CXC) web page: http://cxc.harvard.edu.

F 03

Discovery of X-rays from Mars with *Chandra*

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On 4 July 2001, X-rays from Mars were detected for the first time. The observation was performed with the ACIS-I detector onboard Chandra. Mars is clearly seen as an almost fully illuminated disk, with an indication of limb brightening at the sunward side, accompanied by some fading on the opposite side. The X-ray morphology and luminosity are fully consistent with fluorescent scattering of solar X-rays in the upper Mars atmosphere. The X-ray spectrum is dominated by a single narrow emission line, which is most likely caused by O-K_α fluorescence. No evidence for temporal variability is found. This is in agreement with the solar X-ray flux, which was almost constant during the observation. In addition to the X-ray fluorescence, there is evidence for an additional source of X-ray emission, indicated by a faint X-ray halo which can be traced to about three Mars radii, and by an additional component in the X-ray spectrum of Mars, which has a similar spectral shape as the halo. Within the available limited statistics, the spectrum of this component can be characterized by 0.2 keV thermal bremsstrahlung emission. This is indicative of charge exchange interactions between highly charged heavy ions in the solar wind and exospheric hydrogen and oxygen around Mars. Although the observation was performed at the onset of a global dust storm, no evidence for dust-related X-ray emission was found.

F 04

Investigation of Stellar Coronae with *Chandra* and XMM-Newton

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The traditional view of the solar corona has always been restricted to the very short times of solar eclipses, because the optical corona is too faint and is outshined by the solar photosphere. From optical observations it has been found out that the corona consists of a very hot, tenuous plasma with temperatures over 10^6 K and densities between 10^8 and 10^{12} cm^{-3}. These kinds of plasma can ideally be investigated in the X-ray range, since no X-ray light is emitted by the photosphere. With the gratings onboard Chandra and XMM-Newton the sensitivity and resolution are provided in order to do X-ray spectroscopy and the X-ray spectra of **stellar** coronae can be analysed. These spectra show continuum emission consistent with a bremsstrahlung spectrum and a wealth of emission lines which can be used in order to determine plasma temperatures and densities.

I will present an overview over what is known about stellar coronae from previous measurements and from comparison with the Sun. Further I will introduce into what can be learnt from the data provided by the new instruments. I will focus on density measurements with He-like triplets and present results obtained with Chandra and XMM measurements.

F 05

High-resolution X-ray Spectra of Young Stars

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We present the X-ray spectrum of three young stars obtained with the Reflection Grating Spectrometer onboard *XMM-Newton*. The high spectral resolution of this instrument allows to measure the flux of emission lines in the soft X-ray range ($\sim 6 - 35$ Å). Ratios between line fluxes are used for plasma diagnostics. In particular we use the Helium-like triplet of oxygen to estimate and compare the density in the corona of the two nearby young stars YY Gem, Gl 182, and TW Hya.

For the eclipsing spectroscopic binary YY Gem we obtained simultaneous observations with both large X-ray observatories, *XMM-Newton* and *Chandra* providing an excellent opportunity to compare the performance of these two instruments.

F 06

Chandra Spectroscopy of an Extremely Hot Bare Stellar C/O Core

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H1504+65 is an extremely hot ($T_{\rm eff}$ = 180 000 K) and unique pre-white dwarf. Its atmosphere is devoid of hydrogen and helium. It is mainly composed of carbon and oxygen by equal amounts. Trace amounts of neon were detected on hand of an EUVE spectrum (Werner & Wolff 1999). It appears that H1504+65 is the naked stellar C/O core of a former red giant, but it is completely unknown how this object was formed.

Chandra spectroscopy of H1504+65 reveals a wealth of absorption lines in the 60–160 Å range. The soft X-ray spectrum is dominated by lines from highly ionized O, Ne and Mg and many other, hitherto unidentified features. Hence H1504+65 might have been one of the "heavyweight" intermediate-mass stars ($8\,M_\odot \leq M \leq 10\,M_\odot$) which form white dwarfs with electron-degenerate O-Ne-Mg cores resulting from carbon burning.

F 07

Blobby Accretion in the Polar V1309 Ori

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We present the first full-orbit X-ray light curve of the remarkable eclipsing magnetic cataclysmic variable V1309 Ori obtained with XMM-Newton. Unlike in most other synchronized magnetic CVs the accretion flow is completely segmented into individual blobs of material. The blobs have livetimes of $\sim$ 30 sec and reach peak count rates with the EPIC PN detector of 25 cts/sec. Their emission can be entirely modelled by a black body spectrum with no additional hard bremstrahlung component required, confirming that all accreted matter is thermalized below the surface of the white dwarf. Additionally, a faint hard X-ray emission component is observed throughout the orbit whose eclipse properties suggest an orgin from the accretion stream. In conjunction with earlier ROSAT observations we will discuss the accretion geometry of the primary accretion region.

F 08

The Cyclotron Line in GX 301−2

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We present observations of the High Mass X-ray Binary GX 301−2 taken in 2000 November with the Rossi X-ray Timing Explorer. The optical companion of GX 301−2 is the B1 Ia+ hyper giant Wray 977 with a luminosity of $1.3 \times 10^6\,L_\odot$ and a mass of $\sim 48\,M_\odot$. The neutron star orbits its companion in a wide eccentric 41.5 day orbit. During periastron passage the neutron star passes through the outer atmosphere in a height of $\sim 0.1\,R_\star$ above Wray 977 resulting in strong X-ray flaring activity.

We observed the system during the periastron passage of the neutron star for ∼200 ksec. The derived X-ray light curves show a strong variability with luminosity changes up to a factor of five in one hour.

Phase resolved spectra show a strong phase dependence of the spectrum: especially the energy and the depth of the cyclotron resonant scattering feature varies strongly with pulse phase. The line is deepest in the rise of the secondary pulse, while it is almost negligible in the center of the main pulse and outside the pulses. The energy varies by more than 20 % from ∼29 keV to ∼36 keV.

F 09

Do we live in a Local Chimney?

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The successful launch of *XMM-Newton* and the excellent performance of the EPIC X-ray cameras onboard have yielded a wealth of new observations of and new results on the interstellar medium. In particular, the increased spectral resolution and effective area compared to the *ROSAT* PSPC and *Chandra* give more significant information on the spectral composition of the diffuse galactic X-ray emission (hot gas in the Local Bubble and the Galactic Halo).

We have detected the first X-ray shadow with *XMM-Newton* in a 15 ks observation of the Ophiuchus Molecular Cloud at a distance of 150 pc. Detailed analysis of the spectrum of this cloud and also of the medium-latitude molecular cloud MBM 12, located most likely inside the Local Bubble, give clear evidence of the existence of diagnostic lines of O VII (0.57 keV) and O VIII (0.66 keV). These results pose strong constraints on the state of the local plasma and hence on the origin and evolution. In particular, the standard local hot bubble model (million degree plasma in collisional ionisation equilibrium and solar abundances) is in contradiction with the spectral results.

Additionally, galactic halo targets (the molecular clouds G133–69, North Galactic Pole Rift) have been observed, allowing us to disentangle diffuse foreground emission from the Local Bubble and the Galactic Halo. Again, O VII and O VIII lines serve as diagnostic lines. The spectral similarity between the Local Bubble and the Galactic Halo will be discussed in the view of a local chimney model.

F 10

The Bright Halo of GX 13+1 Observed by XMM

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We present XMM preliminary results of the bright diffuse X-ray scattering halo which surrounds the X-ray binary **GX 13+1**. The measured halo contribution is ∼30 % at ∼1.7 keV, consistent to what previously found by ROSAT. In addition, thanks to the broader energy band of XMM, the energy dependence of the halo brightness could be determined. We discuss the validity of the classical scattering model, based on the Raleigh-Gans theory in comparison also with the Chandra results on the same source.

The study of the halo shape and intensity depends crucially on the determination of the PSF. The fine tuning needed to study extended and relatively weak emission around bright pointlike sources in presence of pileup, as the case of scattering haloes, is also described.

F 11

The XMM-NEWTON View of the LMC Superbubble N51D

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N51D (= DEM L 192) appears at first as a near circular, 120 pc diameter bubble of ionized gas around the LMC OB association LH 54. Deep Hα imaging reveals a complex web of filaments. Dynamical studies showed a non-spherical expansion pattern. To investigate the detailed interaction of the massive star with the interstellar medium we observed the region of N51D with a deep XMM-NEWTON X-ray pointing. We find that diffuse, soft X-ray emitting gas fills the superbubble as defined by the Hα filaments. Contrary to recent findings for galactic winds, the correlation between Hα and X-ray surface brightness is not very good. The X-ray spectrum of this diffuse gas is soft (kT $<$ 0.3 keV) and cannot be fitted with a MeKaL model spectra with Galactic or LMC abundance patterns. An acceptable fit requires LMC abundance plus an overabundance of at least oxygen and neon, consistent with recent enrichment from supernovae type II. Some indications for enhanced mixing at the brightest region of the Hα shell and for a beginning outflow of the hot gas were also detected.

F 12

X-ray SNRs in Nearby Galaxies and CR Source Distribution

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In the shock waves of supernova remnants (SNRs), particles can obtain relativistic energies due to diffusive shock acceleration. Considering global energy requirements, SNRs are thought to be the primary sources of Galactic cosmic rays (CRs). Although the distribution of SNRs in the Milky Way is an important basis for modeling the distribution of the CRs and their γ-ray spectrum, only the surface density distribution of *radio* SNRs in the Milky Way was studied in detail so far. Since in this flux limited sample, older and more distant remnants are missed systematically, we started a study of the SNR distribution in nearby galaxies in order to obtain important complementary information.

We analyzed the radial surface density of *X-ray* and *radio* SNRs in the Large Magellanic Cloud (LMC) and M33. Both in X-rays and in radio, the surface densities of the SNRs are in excellent agreement in both galaxies, showing an exponential decay in radius. The results were compared to the SNR distribution in the spiral galaxies M31 and NGC 6946 as well. The radial scalelength of the distribution is $\frac{1}{4} - \frac{1}{3}$ of the radius of the galaxies, fully consistent with values derived for the Milky Way, the LMC, and M33.

According to theoretical models for CR propagation which is based on a CR source distribution similar to that of the radio SNRs in the Milky Way, the observed γ-ray continuum is reproduced very well if a self-consistent advection of CRs is assumed. Our analysis of nearby galaxies shows that their SNR distribution is similar to that of the Milky Way, and that not only the radio SNRs, but also the X-ray detected SNR sample is representative for the CR sources within a galaxy.

F 13

The Hamburg/RASS Catalogue of Optical Identifications of ROSAT BSC X-ray Sources

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We used the digitized Schmidt plates taken for the northern hemisphere Hamburg Quasar Survey (HQS) to obtain optical identifications for all high galactic latitude X-ray sources at $|b| \geq 30°$ and DEC $\geq 0°$ in the ROSAT Bright Source Catalogue (RASS-BSC, revision 1RXS). In this part of the sky the RASS-BSC contains 5341 X-ray sources. For the identification of a RASS-BSC source we first searched on digitized direct plates for all possible counterparts in the X-ray error circle, then extracted spectra from the digitized spectral plates at the positions of these objects, and finally classified interactively the counterparts. The most likely identification of the RASS-BSC source was entered into the *Hamburg/RASS Catalogue of Optical Identifications, version 3.0* which meanwhile contains identifications for all 5341 1RXS sources in the selected 10 000 sq. deg. of the sky. For 82 % of the selected RASS-BSC sources an optical counterpart was found. With 42 % AGN represent the largest group of X-ray emitters, 31 % have a stellar counterpart, whereas galaxies and cluster of galaxies comprise only 4 % and 5 %, respectively. In 3 % of the RASS-BSC sources no object was visible on our blue direct plates (limiting magnitude $B \approx 20$) within 40 arcsec around the X-ray source position. For 15 % no identification could be given. The catalogue will be available on http://www.hs.uni-hamburg.de/hrc.html.

F 14

X-ray Variability in the ROSAT All-Sky Survey

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We present a systematic search for variability for the ROSAT All-Sky Survey X-ray sources with ecliptic latitude $\beta > |60|°$. We generated lightcurves for 8208 X-ray point sources sufficiently above background (Maximum Likelihood > 15). For the variability search different algorithms were developed in order to find flares, periods and trends, respectively.

Out of 8208 point sources studied, 366 sources show significant variability. Out of 366 variable sources, 204 show flares, 86 periodic variability and 90 trends; note that some sources show more than one type of variability.

The variable sources were identified with optical counterparts from the SIMBAD database and the USNO-A2.0 catalog. This provides the possibility of statistical analyses of the variable sources. 10 % of the variable sources are found to be AGNs, 60 % are stars (mostly of type K and M) and 30 % of the variable sources cannot be identified with an object known at other wavelength.

We present examples for the various variable source classes and focus on a discussion of the energetics of strong flares on stars with known parallaxes.

F 15

NGC 6240, Local Key Representative and Pathfinder to the High-redshift Universe of ULIRGs: the *Chandra* High-resolution View

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Ultraluminous infrared galaxies (ULIRGs) are outstanding due to their huge luminosity output in the infrared, predominantly powered by superstarbursts and/or hidden AGN. Many distant *SCUBA* sources, massive and dusty galaxies, are believed to be ULIRG equivalents at high redshift. Local ULIRGs, of which NGC 6240 is a key representative, are therefore important laboratories to study the physics of superwinds driven by the nuclear starbursts, the processes of IGM enrichment, to search for the presence of hidden AGN, and to study the physics of galaxy formation (many ULIRGs are mergers).

NGC 6240 is one of the nearest members of the class of ULIRGs and exhibits exceptional X-ray properties. Here, we report about the first high-resolution imaging spectroscopy of NGC 6240, carried out with ACIS-S aboard the *Chandra* X-ray observatory. The observations revealed a surprise.

F 16

Wide-Angle X-ray Cluster Surveys and their Impact on Cosmology

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During the last few years samples with several hundreds of galaxy clusters, namely REFLEX and NORAS, have been constructed based on the ROSAT All-Sky Survey. The detailed understanding of selection effects in conjunction with the high statistical completeness which has been achieved in recent times permits to derive cosmological parameters with a precision that is competitive to other popular methods such as those based on the analyses of cosmic microwave background anisotropies or high-redshift samples of SN Ia.

Two very important parameters in the context of cosmological structure formation, the total matter density, Ω_0, and the amplitude of mass fluctuations, σ_8, can be already estimated from the redshift distribution of galaxy clusters. The spatial clustering which is usually quantified by the power spectrum of fluctuations provides an independent test for the paradigm of large-scale structure formation driven by gravitational instability and it further tightens the permitted range of cosmological parameters.

F 17

XMM-Newton Discovery of an Ionized Fe-K Edge in the $z = 3.91$ BAL Quasar APM 08279+5255

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Recent *XMM-Newton* observations of the high-redshift lensed broad absorption line (BAL) quasar APM 08279+5255, one of the most luminous objects in the universe, allowed the detailed X-ray diagnostic of a BAL QSO with unprecedented precision. The high redshift and high luminosity of this object, combined with the superb sensitivity of the *XMM-Newton* instruments shows that the underlying QSO continuum is consistent with a simple power law with photon index $\Gamma = 2$ up to restframe energies of 60 keV. We detected a high column density absorber ($N_H > 10^{23}\ cm^{-2}$) in the form of an absorption edge of significantly ionised Fe-Kα and corresponding ionised lower-energy absorption. Our findings confirm a basic prediction of phenomenological geometry models for the BAL outflow and can constrain the size of the absorbing region. The Fe/O abundance of the absorbing material is significantly higher than solar (Fe/O = 2–5), giving interesting constraints on the gas enrichment history in the early universe.

F 18

The Population of High-redshift Type-2 Quasars Found in Deep *Chandra* and XMM-Newton Surveys

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Previous Deep X-ray surveys have shown that the cosmic X-ray background, discovered by Riccardo Giacconi and colleagues in 1962, is largely due to the accretion onto supermassive black holes, integrated over the cosmic time. The *ROSAT* satellite has resolved about 70–80 % of the soft X-ray background into discrete sources, which are mainly X-ray and optically unobscured AGN (type-1, e. g., Quasars and Seyfert galaxies).

The charateristic hard spectrum of the XRB can be explained if most of the AGN are heavily absorbed (type-2). Deep surveys with *Chandra* and *XMM-Newton* in the Hubble Deep Field-North, in the *Chandra* Deep Field-South and the Lockman Hole field have resolved most of the hard X-ray background into discrete sources.

The new *Chandra* and *XMM-Newton* sources are fainter and typically harder than the *ROSAT* sources. The majority of these optically faint sources are intrinsically absorbed type-2 AGN, which are predicted by the population synthesis models for the X-ray background, based on the unified AGN schemes. Interestingly, a significant number of the long-sought class of high-luminosity, heavily obscured AGN (type-2 Quasars) at high redshift have been detected in deep *Chandra* and *XMM-Newton* fields. We present their optical/near-infrared and X-ray properties and discuss possible implications on the X-ray background models and on the space density of quasars.

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Bodo Ziegler, Göttingen

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G 01

No Intrinsic Stellar Population in Compact High-Velocity Clouds?

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Compact High-Velocity Clouds (CHVCs) have been considered as the building blocks of larger galaxies in the Local Group of Galaxies. We tested the hypothesis that CHVCs represent the very low mass end of galaxy formation by searching for an embedded stellar population. Deep V and I band imaging with FORS1 at the VLT was performed towards five CHVC down to I = 24. The optical analysis was supplemented by a study of the 2MASS public data, including all stars down to K = 16 within a radius of one degree. Data for several dwarf galaxies served for numerical tests to establishe upper bounds of stellar populations which can be still detected with these data. While the 2MASS data test an old population through the RGB out to distance moduli of about 20, the VLT data are limited to distance moduli of about 27. In none of the tested locations, we found a stellar population intrinsic to the HVCs.

G 02

Exploring the Resolved Stellar Contents of E/S0 Galaxies

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Formation paradigms for massive galaxies have long centered round two antipodal hypotheses – the monolithic collapse and the accretion model. Empirical data on the stellar contents are crucial in order to develop galaxy formation and assembly scenarios which have their root in observations. Large ground-based telescopes and Hubble Space Telescope have enabled us to study directly individual stars in the nearby E/S0 galaxies Cen A, NGC 3115, NGC 5102, and NGC 404. We here present and compare single-star photometry in multiple fields. Using color-magnitude diagrams and stellar luminosity functions, we gauge the galaxies' distances and assess their stellar contents. We compare the color distributions of red giant stars with stellar isochrones and derive metallicity distribution functions. The stellar metallicity distributions are in turn used to constrain chemical enrichment scenarios, a step towards unravelling the evolution of E/S0 galaxies.

G 03

Circuit of Matter in 3D Chemo-Dynamics

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The interstellar medium (ISM) plays an important rôle for the evolution of galaxies, e. g. for the transport of matter towards the center or for the self-regulation of star formation. So far in 3d-models of galaxies the ISM is mostly described either as a diffuse phase with smoothed particle hydrodynamics (SPH) (e. g. Hernquist & Katz, 1989, ApJS, 70, 419) or as a clumpy phase with sticky particles (e. g. Theis & Hensler, 1993, A&A, 280, 85). Alternatively in so called chemo-dynamical models a multi-phase ISM is used, but these models are usually restricted to spherical or axisymmetric systems (e. g. Samland et al., 1997, ApJ, 476, 544).

In order to extend the chemo-dynamical models to three dimensions both aspects of the ISM, i. e. the diffuse and the clumpy nature, are combined in a new particle based code. The warm diffuse gas phase is described by a SPH formalism, whereas the cold molecular clouds are represented by a sticky particle scheme. The coupling between the two gas phases is achieved by the following processes: 1) clouds can condensate or evaporate, 2) a drag is exerted by ram pressure and 3) cooling can lead to cloud formation due to thermal instabilities. Finally the cycle of matter is closed by star formation. In first simulations of isolated disc galaxies the rôle of gas-gas interactions is investigated in detail. Especially the resulting mass spectra of the clouds and their influence on star formation are discussed.

G 04

Population Membership of White Dwarfs from the SPY Project

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The percentage of the total mass of the Galaxy contained in the thick disk and halo still being uncertain it is interesting to probe the population membership of white dwarfs. We present results of kinematics of a sample of 107 DA white dwarfs from the SPY project(ESO SN Ia Progenitor surveY (Napiwotzki et al., 2001, AN 322, 411)) and discuss kinematic criteria for a distinction of thin, thick disk, and halo populations. This is the first homogeneous sample of white dwarfs for which 3D space motions are determined.

Radial velocities with unprecedented precision obtained from high resolution UVES VLT spectra combined with our measurements of proper motions and spectroscopic distances are used as an input for a numerical code. With this code we calculate galactic orbits and kinematic parameters like velocity components U,V,W, total energy, z-component of angular momentum (J_z) and eccentricity.

The calibration of our kinematic criteria is done with a sample of 137 F and G main-sequence stars for which the separation of thin disk, thick disk, and halo can be done by chemical criteria found in the literature.

By plotting both the calibration stars and the white dwarfs in the U–V velocity diagram we get 14 possible halo and thick disk white dwarf candidates. To decide on population membership we use more sophisticated analysis tools like the position in the J_z-eccentricity diagram and the shape of the orbit. We find 4 halo and 7 bona fide thick disk white dwarfs.

G 05

The Influence of a Cold Dust Component on the Nuclear Disk Structure

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Recent hight resolution optical and sub-mm observations have unveiled a variety of mini-structures with a size of about a few hundred pc in the circumnuclear regions of galaxies. Because these regions lie well inside the inner Linblad resonance, stellar density waves cannot produce these features. Several mechanisms have been invoked for the creating of these mini-spirals. Though, these models can explain several mini-spirals, they do not work for all nuclear spirals observed so far. Here we are investigating an alternative model assuming that the coupling between gas and the dynamically cold dust leads to an instability. Therefore, we study the behavior of a two-fluid system, composed of dust and gas, coupled by gravity and friction by means of hydrodynamical simulations of 2D-disks.

Based on observational data of the kinematics and photometry of NGC 4321 and NGC 5248 we study the influence of the strength of the coupling and the dust-to-gas ratio on the stability of the inner disk.

G 06

Insight into Galaxy Evolution from a Near-infrared Survey Project

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In recent years, near-infrared surveys have gained considerable attention due to the availability of new detectors with reasonable size. Amongst other things, those surveys are ideally suited for the study of the evolution of massive field galaxies.

During the last five years we have carried out such a project called the Munich Near-Infrared Cluster Survey (MUNICS). MUNICS is a wide-field, medium deep survey in the near-infrared K and J bands covering a large area of 1 square degree, with additional optical imaging in the I, R, V, and B bands for 0.35 square degrees. The limiting magnitudes are 19.5 mag in K, and 24.5 in R (50 % completeness limit for point sources).

Redshifts for the extragalactic objects are derived from their photometric colours, relying on a spectroscopic catalogue of now roughly 500 objects for calibration of the photometric redshift estimator.

While the survey was initially designed to detect clusters of galaxies out to redshifts around unity by tracing their population of early-type galaxies, it also offers the fantastic possibility to study the evolution of field galaxies in a similar redshift range. This evolution is analysed in terms of changes of statistical quantities like the near-infrared luminosity function and the stellar mass function, with the latter being derived from a conversion of K-band light to mass. We find only little evolution in the characteristic luminosity in the K band, but a significant change in the integrated stellar mass function in the sense that the number density of more massive galaxies decreases with increasing redshift.

G 07

Galaxy-Galaxy Lensing in the COMBO-17 Survey

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Galaxy-galaxy lensing provides an unique tool to measure the mass of galactic halos out to large radii. However, the lensing effect of typical galaxies is too weak to be measured directly. Therefore one has to stack lenses and can thus derive only averaged mass profiles of these galaxies. If available, classification into different galaxy types can simplify the interpretation.

The COMBO-17 survey is a deep multicolor survey that is particularly well suited for lensing studies: it has observed 1 square degree total area in four fields down to $\mathrm{R} = 25.5$ at good seeing conditions ($\approx 0.8''$). Observations in five broad band filters (UBVRI) and twelve medium band filters give redshift estimates and spectral classification into galaxy types for objects brighter than $\mathrm{R} = 24$.

Using redshifts and spectral classification we study the mass profiles of galaxies of different type and its evolution with redshift. The field selection of COMBO-17 also allows us to study galaxies in different environments, ranging from emtpy fields to clusters and even a supercluster.

G 08

UV Spectral Properties and Line Indices of Active Early-Type Galaxies

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A dataset of UV spectra of 22 early-type galaxies with signatures of nuclear activity is produced using spectra from the on-line archive of the International Ultraviolet Observer (IUE) satellite mission. We present both line flux measurements and index-color-diagrams in order to discuss the impact of observational UV properties on galaxy evolution.

The comparsion of the mid-UV colors and absorption line strengths of the different galaxies exhibit that these objects are systems of similar averaged temperatures. According to expectations in respect of a galaxy age-metallicity relation the bluer systems have more metal-rich stellar populations–similar to that seen in local galactic disk stars.

We also present emission line flux measurements which indicate that optically defined activity classes reflect their different behaviours in the UV-range, too.

G 09

The Fundamental Plane of Spirals at Intermediate Redshift

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The three fundamental parameters of disk galaxies – luminosity L, maximum rotation velocity $V_{\rm max}$ and scale length $r_{\rm d}$ – are correlated via a plane in three-dimensional parameter space that is similar to the well-known fundamental plane (FP) of elliptical galaxies. Although the FP of spirals has been studied in an increasing number of theoretical publications in the last few years, it has so far rarely been used in observational approaches to the field of galaxy evolution, and only at low redshifts. Nevertheless, the late-type FP and its projections are powerful tools to simultaneously test the hierarchical structure formation scenario and stellar population models, especially when applied to a sample that covers a significant fraction of the Hubble time.

Using the Very Large Telescope, we have observed a purely magnitude-selected sample of ~ 80 field spirals in the FORS Deep Field (Appenzeller et al., The Messenger 100, p. 44, 2000), covering the redshift range $0.1 < z < 1.0$ and spanning all Hubble types from Sa to Sm/Irr. Maximum rotation velocities were derived by generating synthetic velocity fields that consider all observational effects from slit misalignment to optical beam smearing. The $V_{\rm max}$–L (Tully-Fisher) relation shows evidence for a mass-dependant luminosity evolution, possibly combined with the existence of a population of small, blue galaxies that is underrepresented in the local universe. While the high-mass galaxies have absolute magnitudes comparable to their local counterparts, the low-mass objects are brighter by 1–2 mag in the rest frame B-band. Another projection of the FP of our sample, the $V_{\rm max}$–$r_{\rm d}$ rotation velocity-size relation, favours a non-zero cosmological constant, when compared to the predictions of numerical simulations.

G 10

A New Galaxy Template Library for Multi-color Classification based on PEGASE-spectra

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In multi-color surveys like COMBO-17 (Wolf et al. 2001) there is a need for galaxy template libraries that deliver good redshift estimations. Measured spectra of nearby galaxies showed good suitabilities for that purpose. For example, in the COMBO-17 survey the UV-optical spectra measured by Kinney et al. (1996) are used to classify the galaxies in a 17-dimensional color-space. That yield accurate redshifts ($\sigma_z \leq 0.02$) down to R = 24 mag.

However, we have done a new approach to obtain good redshifts using synthetic galaxy spectra derived with a stellar population synthesis model. We created a spectra library by using the PEGASE code (Fioc & Rocca-Volmerange 1997) that challenges the redshift accuracy of the old library based on the Kinney et al. (1996) spectra.

The obvious advantage of the synthetic spectra is the potential of their astrophysical parameters: The known mass-to-light ratio will allow us to establish a stellar mass estimation for approximately 50 000 galaxies in our survey. Additionally the known star formation history will enable further investigations of galaxy evolution.

G 11

Dynamical Friction in Inhomogeneous Systems

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The standard formula for dynamical friction from Chandrasekhar is based on some local approximations based on the assumption of an infinte sea of homogeneously distributed perturbing particles. In most cases and for many aspects the resulting formula works surprisingly well. But there are some questions open, where the orbit evolution cannot be fitted by using the standard formula.

We are interested in the evolution of satellite galaxies moving in the Dark Matter halo of galaxies. The circularisation and the precession of the orbits are not well understood. On the other hand especially the motion near the pericenter is very important for mass loss and the lifetime of the satellites. Binney (1977, MNRAS 181, 735) derived a generalisation of the standard formula firstly to anisotroic systems and secondly to local density gradients. To include the latter effect, he took into account the 1. order Taylor expansion of the local density. For the application to clusters of galaxies, he showed that this 1. order effect is negligible compared to the 0. order standard term.

For the parameters of satellite galaxies in Dark Matter halos this is not the case. For a satellite with $M = 4 \cdot 10^9\ M_\odot$ and a pericenter at 20 kpc, the 1. order force is about 0.2 times the 0. order force. Since the direction of the 1. order force is not parallel to the motion of the satellite, the effect on the orbit is very different from the standard case. We analyse the results from N-body particle-mesh models with semianalytical computations in order to show that the asymmetry of the gravitational wake due to the 1. order dynamical friction gives a better understanding of the orbit evolution.

G 12

Early-type Galaxies in the Cluster Abell 2390 at $z = 0.23$

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A key question of early-type galaxy evolution is when and within what timescales their stellar populations have been formed. In monolithic collapse models a burst of star formation at high redshift ($z_{\rm form} \geq 2$) is followed by a passive evolution of the stellar populations, whereas in the hierachical galaxy formation scenario the assembly timescales for more massive galaxies are longer, resulting in somewhat younger mean ages.

To investigate the environmental dependence of this question we obtained high-quality spectra of 51 elliptical and lenticular galaxies in the rich cluster A2390 at $z = 0.23$ with MOSCA at the 3.5 m telescope on Calar Alto Observatory. Our investigation spans a wider range in luminosity ($M_B^* + 1$) than previous spectroscopic studies at intermediate redshift, which were limited to a small number of the more luminous galaxies (apart from the study of Ziegler et al. 2001 MNRAS, 325, 1571 of the cluster A2218 at $z = 0.18$). The evolution of galaxies in age, metallicity and abundance ratios is explored by analysing absorption line strengths, such as Hβ, Mg$_b$, Fe5270 and Fe5335, in comparison with stellar population models. Velocity dispersions (σ) are determined to study the slope, scatter and zeropoint of the Faber-Jackson and Mg$-\sigma$ relations. For a subsample of 14 galaxies where morphological and structural parameters are available from HST observations, we also investigate the evolution of the Fundamental Plane. With our large sample it is possible to look for variations in early-type galaxy evolution as a function of distance from the cluster center as well as for different sub-populations like S0 or Balmer-line enhanced galaxies in a statistically significant way.

G 13

The H I Distribution and Kinematics in the Post-Starburst Dwarf Galaxy NGC 1569

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Dwarf galaxies are considered to be ideal targets for studies of star formation processes and their impact on the ISM in (dwarf) galaxies. There is much evidence that NGC 1569, a nearby dwarf irregular galaxy, has recently experienced a very strong starburst episode and is now in a post-starburst phase: The star formation history suggests star formation rates of $0.5 \ldots 3$ M$_\odot$/yr until a few million years ago and a kink in the synchrotron spectrum indicates an end of the starburst about 5 million years ago. The strong impact of this starburst on the ISM is clearly visible in numerous Hα filaments along the minor axis of NGC 1569, extended X-ray emission and a metal-rich wind.

Here, we present new observations of the H I gas obtained with the Effelsberg telescope and show the influence of the Galactic foreground emission on the data analysis. Using yet unpublished high-resolution H I observations of the VLA (B-, C- and D-array), we thoroughly discuss the distribution and kinematics of the neutral atomic hydrogen and compare them with the Hα morphology and Hα velocity features. Finally, we report our first results on the complex halo structure that we have detected around NGC 1569 in a very deep H I map.

G 14

The Global Structure of Galactic Stellar Disks at $z \sim 1$

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Radial and vertical profiles are determined for a sample of 34 edge-on disk galaxies in the HDFs, selected for their apparent diameter larger than 1.3″ and their unperturbed morphology. The thickness of their disks is determined and discussed with regard to evolution with redshift.

We find that sub-L^* spiral galaxies with $z \sim 1$ have relative thickness or flatness (characterized by h_z/h the scaleheight to scalelength ratio) globally similar to those in the local Universe. A slight trend is however apparent, with the h_z/h flatness ratio larger by a factor of ~ 1.5 in distant galaxies if compared to local samples.

In absolute value, the disks are smaller than in present-day galaxies. About half of $z \sim 1$ spiral disks show non-exponential surface brightness distribution.

G 15

Probing the Internal Kinematics of Spirals in Distant Clusters

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Many cluster spirals show a disturbed appearance, a deficiency in H I gas or even a displacement between stellar disk and H I disk (e. g. Bravo-Alfaro et al. 2000, AJ 119, 580). Furthermore, strong evolutionary effects in the cluster galaxy population have been observed (e. g. the rapid decline in the fraction of S0 galaxies from the dominant population in local clusters to about 10–20 % in z = 0.5 clusters (Dressler 1997, ApJ 490, 577)). This may be explained by a scenario of infalling field spirals into a cluster which gradually get transformed into S0 galaxies. But it remains unclear whether the dark matter (DM) halo of an infalling galaxy gets stripped off or whether it can be retained by the galaxy. Since the DM halo is thought to be responsible for the flat rotation curves of spirals, a key question is whether such galaxy transformations can affect the Tully-Fisher Relation (Tully & Fisher 1977, A&A 54, 661). In the local universe this relation between luminosity and maximum rotation velocity is valid for both field and cluster spiral samples.

To further investigate this problem, we have conducted a large campaign (5 nights with FORS1&2 at the VLT) to gain spectra of spiral galaxies within seven distant clusters ($0.3<z<0.6$) to analyse the spatially resolved [O II]- or even Hβ- and [O III]-emission lines. Besides our own wide-field ground-based imaging, HST/WFPC2 images of the cluster cores can be analysed for morphological disturbances of the galaxies. Here we will present first results of this study.

G 16

The Saha Estimator Applied to the Age of Globular Clusters

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The age of Globular Clusters (GCs) has been recognized as being of key importance for deriving a lower limit to the age of the Universe. Here we present a statistical method for determining the age of GCs that allow us to estimate the age derived from the Colour-Magnitude Diagram (CMD) more accurarely than conventional methods of isochrone fitting. We do this by measuring the likelihood between the observed cluster sequences in the CMD and the synthetic cluster sequences computed from stellar evolutionary models. The likelihood is calculated by using a particular statistical estimator (the Saha W, Saha 1998) and the goodness of the fit is estimated from the χ^2 statistics (Press et al. 1986).

We apply this method to a set of three different evolutionary models presented by three different authors. Each of these sets consists again of many different models of various chemical abundances, ages, input physic and there alike. As as example, we subsequently derive the age of the GCs NGC 6397, M92 and M3. With a confidence level of 99 %, we find that the best estimate of the age is 14.0 Gyrs in the range of 13.8 and 14.4 Gyrs for NGC 6397, 14.75 Gyrs between 14.50 and 15.40 Gyrs for M92, and 16.0 Gyrs between 15.9 and 16.3 Gyrs for M3.

G 17

Dark Matter in a Sample of Spiral Galaxies

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Combined H I and Hα rotation curves of a sample of low luminosity spiral galaxies are used to determine the distribution of dark matter in those galaxies. These combined rotation curves have both a high resolution in the inner parts and a large spatial extent. Together with photometric data we are able to perform the mass decomposition to isolate the contribution of dark matter to the rotation curve.

The H I spectra at single points in these galaxies being mostly asymmetric, we cannot use the standard methods like the first moment analysis or the single-Gaussian fitting to derive the H I rotation curves; we thus propose a modification of the Envelope-Tracing method (Sofue & Rubin 2001), that provides very good agreement with the Hα data.

We fit our rotation curves with different models of the possible dark matter halos: core-dominated halos, cusp-dominated halos, MOND and dark matter associated with H I (H I-scaling). We obtain the best fits for the core-dominated halos, with core radii of the same order as the optical radii. Cusp-dominated halos, especially the Moore halo, provide much worse fits, in particular predicting velocities that are too high in the inner parts. MOND and the H I-scaling give reasonable fits, but not as good as the core-dominated halos.

G 18

The Gravity Scale of Halo Objects Revisited

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Final results of my PhD thesis 'Cool-star Gravities' (University of Munich, 7/02, supervised by Thomas Gehren) will be presented. A non-LTE model for the line formation of iron was developed (Gehren et al. 2001a, b) and carefully calibrated using well-studied HIPPARCOS targets (Korn & Gehren 2001).

On the Balmer profile temperature scale, gravities from Fe I/Fe II ionization equilibria are for the first time in full agreement with those derived from pressure-broadened Mg Ib lines. The latter have been shown to yield results fully consistent with the HIPPARCOS astrometry (Fuhrmann 1998). Non-LTE corrections in Fe I are small ($< +0.1$ dex in gravity) for unevolved stars, even at low metallicities. However, they become increasingly important when ascending the giant branch. Individual examples will be given.

The predicted revision of the gravity scale can be thoroughly tested by means of high-resolution spectroscopy of globular cluster giant stars. If successful, the iron ionization equilibrium will serve as a powerful tool in the homogeneous study of cool stars over the full range of metallicities encountered in the Galaxy.

Fuhrmann K. 1998, A&A 338, 161
Gehren T., Butler K., Mashonkina L., Reetz J., Shi J. 2001a, A&A 366, 981
Gehren T., Korn A.J., Shi J. 2001b, A&A 380, 645
Korn A.J. & Gehren T. 2001, *in*: Astrophysical Ages and Time Scales, von Hippel T., Simpson C, Manset N. (eds.), ASP Conf. Ser. 245, 337

G 19

Massive Population III Stars: Nuclear Reactions and Mixing on the Main Sequence

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The very first generation of stars, the still hypothetical Population III stars, are believed to have formed from gas devoid of metals since standard Big Bang nucleosynthesis predicts only negligible amounts of elements with $Z > 8$. The distinct chemical gas composition of these objects leads to peculiar evolutionary properties when compared to today's stars. A thorough understanding of Population III stars is also prerequisite to the answer of many aspects of structure formation, e. g. element synthesis and re-ionization.

I present first evolutionary model calculations of massive zero-metallicity stars putting emphasis on nuclear reactions, convective mixing and time-dependent convection during the main sequence.

G 20

The Fundamental Plane and the History of the Cosmic Star Formation

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In spiral galaxies the stellar disk dominates the inner mass distribution as it is evident from the corresponding rotation curves. The resulting mass to light ratios correlate with colors as effect of differences in the Star Formation Rates. In ellipticals we use the Fundamental Plane (FP) to obtain the distribution of the dark and luminous matter within these objects. Crucially, the "central velocity dispersion" σ_0, appearing in the FP, is linked in a complex, but predictible way to photometric, dynamical and geometrical quantities of both mass components. Therefore the very existence of FP and its remarkably small scatter strongly constraints the mass models: it implies a small DM amount within the galaxy effective radius, and it leads to stellar mass-to-light increasing with spheroid mass. The inferred DM-free mass-to-light ratios, correlate with galaxy color and metallicity yielding the "formation time" of these objects, to which a passive evolution followed. By "averaging" over the Luminosity Functions, the SFR of Spirals and the FT of ellipticals, we can build the global history of cosmic star formation.

Splinter Meeting H
Galaxy Groups

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Chairmen:
Ralf-Jürgen Dettmar, Bochum
Volker Müller, Potsdam

Related posters: P 97 ... 104

H 01

Galaxy Groups – Introductory Review

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Galaxy groups contain probably the majority of all galaxies, including our own, and possibly the majority of all the matter in the Universe. Groups are therefore important both in their own right, and as the predominant galactic environment. A significant (but still unknown) fraction of groups are X-ray bright, and in these, the hot gas provides a probe of the gravitational potential, and clues to the chemical and dynamical evolution of the system.

The velocity dispersion of galaxies within groups is comparable to the internal velocities of galaxies, leading to strong galaxy-galaxy interactions. The products of this are seen in the relationship between group and galaxy properties. In this introductory presentation, we will look at the properties of groups and the galaxies they contain, and consider how these may be interconnected.

H 02

Investigating the Evolutionary and Dynamical State of the Ultracompact Group CG J1720–67.8

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Our previous studies of the ultracompact galaxy group CG J1720–67.8 have revealed that its members are undergoing strong mutual interactions, with one of them possibly already the product of a merger, and with several tidal dwarf galaxies possibly in the process of formation. All of these properties suggest that the group is in an advanced evolutionary state. New observations in the radio and optical regimes have been obtained in order to further investigate the dynamical and evolutionary state of the group. We used the Australia Telescope Compact Array to investigate the neutral hydrogen content of the group, and 20 cm continuum emission to investigate star-formation rates. The group was not detected in the 21 cm line, giving an upper limit to the integrated H I mass of a few 10^9 $M_\odot$, which suggests that the group is H I deficient, consistent with it being in an advanced evolutionary state. Extended radio continuum emission was detected, approximately following the optical morphology of the group, and indicating an overall star-formation rate of $\sim$ 16 $M_\odot$ yr^{-1}. Integral field spectra of two $9''.8 \times 10''.5$ regions of the group have been obtained with SPIRAL at the Anglo-Australian Telescope. This allowed measurement of the velocity fields of two of the group's galaxies and one of the tidal dwarf candidates. The Hα velocity field shows a significant degree of distortion in one of the galaxies and apparently confirms that ionized material forms a bridge of matter also visible in the optical continuum.

H 03

Hot Intragroup Gas in Stephan's Quintet as a Tracer of Multiple Galaxy Collision

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We present high quality X-ray Chandra data of the compact galaxy group known as Stephan's Quintet. The major morphological features, already discovered with ROSAT HRI, are imaged in greater detail and much higher S/N. The large scale shock ($1.5'$, $\sim$ 40 kpc for a distance of 85 Mpc) is seen as a narrow North-South (NS) feature embedded in more extended diffuse emission (D$\sim 4'$). The NS feature is somewhat clumpy, more sharply bounded on the W side and relatively soft (all photons with E$<$ 1.5 keV). We will discuss a scenario that explains most of the observed features in the context of a bow shock model associated with a recent new intruder galaxy.

One member, NGC 7319, hosts a Seyfert 2 nucleus, whose X-ray spectrum is best modeled with a strongly absorbed power-law and has an intrinsic luminosity $L_X = 10^{43}$ erg/sec. The nucleus is embedded in a region of more diffuse emission with $10''$ radius extent. Several additional compact sources are detected in the member galaxies, and 3 are found in the foreground NGC 7320. These sources are all consistent with an origin from an X-ray binary population. NGC 7318a is detected at a luminosity of $\sim 10^{40}$ erg/sec, consistent with the luminosity of early type galaxies of similar optical luminosity.

H 04

The Velocity Dispersion of the X-Ray Scaling Laws

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We used a sample of 20 poor groups of galaxies to study the low mass tail of the relationship among the x-ray temperature T_x, the x-ray luminosity L_x and the velocity dispersion σ. We obtained redshifts for fainter members and deep x-ray imaging of these groups. We find that x-ray brighter groups have more members and higher velocity dispersions on average. Using the fainter group members and Monte Carlo tests, we define the number of group members required to calculate a robust velocity dispersion. There is a tendency to underestimate the group velocity dispersion for samples of fewer than 5–10 members that introduces systematic errors in the slope of the relationships among L_x, T_x, and σ. Our improved velocity dispersions thus provide better constraints on the relationship between the kinematics of the hot gas and galaxies in these common environments.

H 05

The Dwarf Galaxy Population of Hickson Compact Groups

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We present very deep, wide field, broad band B, and R CCD mosaic data of Hickson Compact Groups (HCG 16, 19, 30, 31, 42) obtained with the WFI at the ESO/MPIA 2.2 m telescope at La Silla. The environment plays a vital role in the evolution of galaxies, hence compact groups are unique laboratories. Their galaxy densities approach or even exceed those found in the centers of rich clusters.

Despite the general belief, that compact groups lack faint galaxies, a significant number of dwarf galaxies are found in some groups. The outer regions of HCGs are scarcely studied. We detected hundreds of new dwarf galaxy candidates in our studied HCGs. We explore their structural, and color properties, and their distribution with regard to the center of compact groups.

To determine the extension of the group, and the relation of the compact core to a possible extended halo, we calculated the radius of the zero velocity surface, beyond which galaxies participate in the Hubble expansion. We used the velocity information of group members to derive typical radii, which are of the order of Mpc.

H 06

Properties of Las Campanas Loose Groups

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Loose groups from the Las Campanas redshift survey encompass a significant part (37%) of the galaxies. We provide evidence for a completeness of the mass function in the range $(2-10) \times 10^{13}$ $M_{\odot}$. We get agreement with simulated group mass functions for a ΛCDM model with low normalisation, $\sigma_8 \approx 0.8$, a value also found recently from cluster studies.

We have analysed group properties in the neighbourhood of Abell, APM and X-ray clusters. The loose groups show a strong evidence of segregation measured in terms of the group richness and the group velocity dispersion: loose groups in the neighbourhood of rich clusters are typically 2.5 times more massive and 1.6 times more luminous than groups on average, and they have velocity dispersions 1.3 times larger than groups on average. This is evidence that the large-scale gravitational field causing the formation of rich clusters enhances the evolution of neighbouring poor systems. Simulations reproduce this environmental influence, with a dependence of the enhancement on the cosmological model.

H 07

From X-ray Studies of Groups to Understanding of the Galaxy Formation

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We carry out a comparison between observations and hydrodynamic simulations of entropy profiles of groups and clusters of galaxies. In particular, we concentrate on the effect of the introduction of preheating at redshift of 3, recently suggested from observations. In addition, we include cooling into the simulation to both account for a role cooling plays in forming the entropy profile as well as to use the amount of star-formation as a constraint. With reasonable assumption on total energy budget of 0.75 keV/particle, we were able to reproduce the scatter in the entropy profiles between groups and clusters as well as the gas fractions. In the simulations with preheating, the star-formation is ceased very rapidly as a result of lack of gas capable to cool. We conclude that preheating provides a viable alternative to cluster environmental effects in reproducing the evolution early-type galaxies.

H 08

The Fossil Stellar Record of Galaxies as a Tool to Probe their Satellite Accretion History

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I present results from high-resolution gas-dynamical simulations of the formation of galaxies in a hierarchical clustering universe. I demonstrate how the kinematics of stars can be used to identify individual components such as the thin disk, the thick disk and the disk-halo system. A comparison of the kinematics of each of these components with their stellar age distribution implies that

- $> 90\,\%$ of the old thin disk is a result of satellite accretion events,
- the thick disk is old,
- the (old) thick disk is not a former thin disk thickened by a minor merger but actually the debris from satellite accretion events, and
- the thin disk contains a significant number of old stars.

H 09

Galaxy Groups in DM Simulations

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Hierarchical structure formation predicts the formation of a large number of small dark matter halos in groups as well as in voids. Using high resolution DM simulations we study the formation and evolution of these objects in a cosmological environment (LCDM cosmology with $\Omega = 0.3$, $h = 0.7$).

The formation time and merging histories of halos in high and low density environment differs. The relative merger rate of group halos is high at all redshifts. Halos with different merging histories show different cluster properties which can be quantified by marked correlation functions.

After $z = 1$ the total number of groups and the fraction of galaxies in groups decreases due to merging of groups into clusters or formation of large isolated halos which are surrounded by satellites.

H 10

Orientation Flip of cD-Galaxies due to Major Mergers

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We use high resolution cosmological ΛCDM simulations (ART) to analyse the impact of a major merger on the orientation of the cD galaxy in the very center of a galaxy cluster. The merger of the two subclusters takes place at redshift $z \sim 0.7$. The merging of the cluster cores is delayed until $z \sim 0.6$. To study the temporal evolution of the system in detail we investigate a sequence of 250 successive snapshots between $z = 1$ and $z = 0$. It turns out that the orientation of the major axis of the cD galaxy before and after the merging of the cores of the two subclusters is remarkable stable, but it deviates after the merging more than 45° from the initial direction.

H 11

Towards Proper Motions in the Local Group

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Key and still largely missing parameters for measuring the mass content and distribution of the Local Group are the proper motion vectors of its member galaxies. The problem when trying to derive the gravitational potential of the Local Group is that usually only radial velocities are known, and hence statistical approaches have to be used. The expected proper motions for galaxies within the Local Group, ranging from 20 to 100 μas/yr, are detectable with VLBI using the phase-referencing technique. We present phase-referencing observations of bright masers in IC 10 and M33 with respect to background quasars. We observed the H_2O masers in IC10 three times over a period of two months to check the accuracy of the relative positions. The relative positions were obtained by modeling the interferometer phase data for the maser sources referenced to the background quasars. The model allowed for a relative position shift for the source and a single vertical atmospheric delay error in the correlator model for each antenna. The rms of the relative positions for the three observations is only 10 μas, which is approximately the expected position error due to thermal noise. Preliminary results of the second epoch already yield first indications of a proper motion. Also, we present a method to measure the geometric distance to M33. This will allow re-calibration of the extragalactic distance scale based on Cepheids. The method is to measure the relative proper motions of two H_2O maser sources on opposite sides of M33. The measured angular rotation rate, coupled with other measurements of the inclination and rotation speed of the galaxy, yields a direct distance measurement.

Colloquium I
History of Astronomy

Contributed Talks: I 01 . . . 05

Chairmen:

Klaus-Dieter Herbst, Jena
Jürgen Hamel, Berlin

I 01

New Media and the Historiography of Astronomy

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For many centuries, paper was the only long-term data/information carrier for science (and astronomy in particular). Oral information (teaching, public disputes, personal conversation, negotiations, etc.) played always an important role in the development of science, but for historiography it was available only when written on paper afterwards (in the form of protocols, reminiscences, etc.). Starting with photographic emulsions, and especially with the invention of electronic media, new information carriers became available. The long-term storage and use of these media are a problem which has not yet been solved – although the preservation of books is although a growing problem. In addition, the use of the telephone and of electronic mail made informal information even more fleeting. These developments are a challange also for historians of astronomy.

On the other hand, electronic publishing and other forms of the use of new media give powerful tools also to the historian. Full-text search and data retrieval from databases are possible only with electronic media.

This paper will discuss the use of new media in historiography of astronomy, both as sources of information and as data carriers for publishing results of historical research. It will concentrate on electronic publishing (Internet, CD-ROMs) and on the use of databases.

I02

The German Venus Transit Expedition to Persia in 1874: An Insider's View

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The German Empire organized several expeditions to observe the Venus transits of 1874 and 1882. They were organized by a *Commission for the Observation of Venus Transits*, headed by Arthur Auwers. Wilhelm Foerster, director of Berlin Observatory, was one of the commission members. The leader of the 1874 "Persian" expedition to Isfahan was Gustav Theodor Fritsch (1838–1927), anatomist, physiologist, zoologist, anthropologist, and photographer, and a cousin of Foerster. He was accompanied by astronomer Ernst Becker and two more photographers. Fritsch, a very original, independent and outspoken person, had travelled in southern Africa before, had written about his expeditions, and would afterwards investigate electrical fish, do research on three-color photography, and write books on *The Human Figure* and *Naked Beauty*. Fritsch's letters, sent to Foerster in 1874/75, deal with the preparation of the expedition, the trip, the setting up of the observing station, and the observation of the transit. They have survived partly in Foerster's written estate, partly in the files of the Venus Commission, and form a complement to Auwers' official 6-volume report of the German observations of the Venus transit, and to several popular accounts published in journals and newspapers. They provide an interesting insider's view on the work of the commission, the organization of the expedition, and they describe some travel events.
Acknowledgement: This research is based on material kept in the *Akademiearchiv* of the Berlin-Brandenburgische Akademie der Wissenschaften.

I03

Astronomical Bibliography 1755–2002 in Perspective

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I will give a short overview on the available bibliographical resources in astronomy and beyond. Starting with Weidler's 1755 Bibliographia astronomica, I will also evaluate subsequent bibliographies (Scheibel, Reuss, Lalande, and Houzeau-Lancaster's monumental Bibliographie générale de l'astronomie). I will describe the status of bibliography in the "dark age" of 1881–1898, will give a short appreciation of the Astronomischer Jahresbericht and the Astronomy & Astrophysics Abstracts, and will end with various aspects of the NASA Astrophysics Data System (ADS) service.

I will also try to elucidate the merits and shortcomings of the different bibliographical resources, and will try give an overview of internet resources which may be useful for the bibliography of astronomy.

I 04

Early German Radio Astronomy

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Astronomical radio emission had been discovered in the 1930s, but its origins were not clear. Starting in the early 1940s the Kiel astrophysicist Albrecht Unsöld (1905–1995) did important theoretical work on the origin of the radio-frequency radiation from the Milky Way. After WW II, radioastronomy developed quickly in the Allied countries thanks to radar technology and in particular to the German 7.5-m diameter "Würzburg-Riese" parabolic radar antennas which were obtained as war reparation. Such work with radar or radio was forbidden in Germany itself until the middle of the 1950s. In 1952 the Allies eased the restrictions.

Early radioastronomy was practised in four places in Germany. In Kiel in 1956 a 7.5-m parabolic antenna – the size of the "Würzburg-Riese" – was used for observing the Sun. In 1955 a 3-m parabolic reflector was used in Freiburg – mainly for the radio emission of the quiet Sun, and in 1957 a radiospectrograph was built for the observation of solar bursts. In the German Democratic Republic, solar radio observations were begun in Berlin-Adlershof in 1951, and in 1953 with antennas in Tremsdorf near Potsdam. In 1957 a 36-m transit radiotelescope began operations in Berlin-Adlershof.

The first really large radiotelescope in western Germany was erected in 1956 on the Stockert in the Eifel: a 25-m parabolic reflector for observing galactic and extragalactic radio sources. This prepared the way for Germany's large presence today in the world of radioastronomy, leading to the largest (until 2000) fully steerable radiotelescope in the world: the 100-m parabolic reflector near Effelsberg in the Eifel (MPI für Radioastronomie).

I 05

Methods and Questions in Mayaastronomy

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Two major questions are arisen since the epoch making work of Ernst Förstemann until 1906 about the calendar and astronomy of the Classic Maya. During the first half of the 20^{th} century the main focus of Maya research was the search for the correlation between the Maya calendar and the Christian calendar. The progressing decipherment of the inscriptions changed the focus to the relationship between astronomical observations and religious belief, although all topics are closely related.

Beside the questions the methods of the interdisciplinary research are getting relevant, too. Linguistic knowledge and methods of text analysis are necessary to perform present archaeoastronomical investigations, although astronomical and mathematical methods are still the most important tools.

P

Poster

Sun, Solar System, Stars,
Interstellar Matter, Galaxy,
Extragalactic Systems, Cosmology,
Instruments

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P 01

LOPES – Detecting Radio Emission from Cosmic Ray Air Showers

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High energy cosmic rays, hitting the Earth's atmosphere, produce large amounts of secondary particles in an air shower. Radio pulses from these air showers were measured during the late 1960ies in the frequency range from 2 MHz to 520 MHz. Mainly due to difficulties with radio interference these measurements ceased in the late 1970ies.

LOFAR (LOw Frequency ARray), the new digital radio interferometer under development, will work at 10–200 MHz, hence just in the range of interest for air showers. Due to its fully digital nature it will be able to store the collected radio data for a short time and form beams after a transient event like an air shower has been detected. With this ability LOFAR will be capable to detect air showers from $> 2 \cdot 10^{14}$ eV to $\sim 10^{20}$ eV.

To test this new technology and demonstrate its ability to measure air showers we are building a "LOFAR Prototype Station" (LOPES). This will operate in conjunction with an existing air shower array (KASCADE in Karlsruhe) to clarify the nature and properties of radio emission from air showers and develop the software to use LOFAR as a cosmic ray detector.

The same technology can be applied to other forthcoming digital radio telescopes like the SkA. In the long run such a digital radio telescope could in principle also form the northern part of a Pierre Auger Project.

P 02

LOPES – Theory of Radio-Emission from Cosmic Ray Air Showers

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The advent of a new generation of fully digital radio telescopes such as LOFAR will offer astronomers a wealth of new possibilities. In particular, LOFAR will be a powerful tool for the study of high-energy cosmic ray air showers through the radio pulses they are known to emit. The LOPES project aims to develop the necessary hard- and software for this application. Accompanying the experimental realisation, a thorough analysis of the mechanisms responsible for radio emission from cosmic ray air showers, which is necessary for the calibration and understanding of observational data, has to be conducted.

We calculate theoretical pulse spectra in the scheme of geo-synchrotron emission from highly relativistic $e^{\pm}$ pairs gyrating in the Earth's magnetic field, adopting a simplified air shower geometry and electron-positron energy distribution. Coherence effects arising from the low shower-thickness in relation to the observation wavelength significantly enhance the emission at frequencies < 100 MHz. For a given observational bandwidth, the corresponding pulse shape can be reconstructed from the spectral information. To assess the ability of the model to reproduce known emission features, a set of model calculations is presented and compared to empirical results and theoretical estimates.

The application of radio-techniques to the study of high-energy cosmic ray air showers not only offers a possibility to obtain crucial new information about air shower properties and evolution – their use in future cosmic ray arrays would also be a very cost-effective alternative to other approaches such as air shower fluorescence measurements.

P 03

How many Stars can we Still See? First Results of a Simple Light-pollution Experiment

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We present the results of a nationwide light-pollution awareness and observing campaign carried out during the "Science Week Austria 2001". Data were obtained by issuing a public call via print media, broadcast and internet and by distributing images of Ursa Minor for 7 different limiting magnitudes (1.5 ... 6.5).

Observers compared Ursa Minor as visible under local conditions with the reference images and supplied observing time and location together with an identifier for the image that fitted their observation best (i. e. that corresponds to their local limiting magnitude).

To access the quality of the data, we called for obervations in an interval containing a significant fraction of the nautical and astronomical twilight. Reports where collected via the Website http://www.astro.univie.ac.at/~scw.

We present the results obtained so far, yielding an empirical visual limiting magnitude map of Austria, and estimate the accuracy by the twilight dependence plus a comparison with Walker's law for the case of Vienna.

The median visual limiting magnitude of 1700 reports was 4 mag. Magnitude 6 observations typically have been reported from a distance of about 100 km from the city of Vienna (pop. 1.8 Mio) with the respective number for Linz (pop. appr. 300 000) being in the range of 40 km.

P 04

Measuring the Night Sky Brightness with Solar Panels

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We used a 56×85 mm^2 solar panel with an amplifier and an ADC converter to determine the brightness of the night sky in urban, suburban and scarcely populated areas during the summer 2002.

In the spectral range where our polycrystalline silicon detector is most sensitive (i. e. around 650 nm), we could achieve a sensitivity better than 1 millilux. An equally sensitive illuminance meter has been used for calibration.

The first results of our measurements of the night sky brightness in Vienna are encouraging with respect to the usefullness of the applied technique, but very discouraging and alarming with respect to the infered level of light pollution. At a distance of 4 km from the center of Vienna, we found that
– the clear night sky (at a zenith distance of 45° and in the direction of the city) does not get darker than it is at the end of nautical twilight (i. e. when the sun is 12° below the horizon) and
– the clouded night sky does not get significantly darker than it is at the beginning of nautical twilight (i. e. when the sun is 6° below the horizon).

We discuss the implications of these results and compare them with measurements of the twilight and night sky brightness in regions with small light pollution.

P 05

An Inventory of Skybeamers in Germany

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Mainly amateur astronomers (but also other people) complain about the increasing number of so-called skybeamers, searchlights used for commercial advertising or promoting special events. These powerful concentrated, often moving light sources contaminate the night sky over large areas and prevent visual and especially photographic astronomical observations. Therefore the DARK SKY group of the german *Vereinigung der Sternfreunde* made a call to report sights of these skybeamers. We report first results and discuss the geographic distribution in Germany.

P 06

Two-dimensional Spectroscopy of G-band Bright Structures in the Solar Photosphere

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The two-dimensional filter spectrometer TESOS at the German Vacuum Tower Telescope, Tenerife, was used to obtain spectra of an absorption line of the CH-molecule and a Fe II-line in the G-band at 430.3 nm. Observed was a region of granulation near a pore, close to disk center, showing many structures with enhanced G-band intensity. We introduce a Bright Point Index (BPI) defined by the ratio of the normalized line depressions of the Fe II and the CH-line. The BPI allows to characterize the bright structures by a quantity based on their spectroscopic signature. Bright structures, caused by significant weakening (up to 40 % less absorption) of the absorption lines of the CH-molecule, have high BPI values and are accompanied by downflows. The remaining G-band bright structures, only caused by an enhanced continuum intensity, have low BPI and are related to granules.

P 07

Annular Downflow Around a Solar Pore

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Solar pores represent the magnetic link between bright flux concentrations and dark sunspots. Thus, they play a keyrole in the understanding of sunspot formation. In particular, the study of the evolution of the magnetic field properties and the flow field within and in the immediate surrounding of the pore is likely to give new insights into the development of magnetic structures. We investigate the flow field in and around a young solar pore near disk center in two photospheric spectral lines (Fe I 557.6 nm and Fe I 569.1 nm) which correspond to different heights in the atmosphere. The measurements were made during the joint adaptive optics campaign with the NSO/Sacramento-Peak adaptive optics system installed at the VTT, Tenerife. The Doppler-velocity measurements show an annular downflow around the outer edge of the pore. This downflow is persistent during the whole observation period (90 min), which is demonstrated in time-averaged Doppler-maps and the corresponding azimuthally integrated and time-averaged radial velocity profiles. In the two spectral lines the mean downflow amounts to –400 m/s and –500 m/s respectively, with a temporal variation of +/– 200 m/s. The mean velocity of a quiet sun region was taken as a velocity reference.

P 08

Time Variation of Statistical Properties of the Solar Granulation

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Our analysis is based on time series of solar granulation spectrograms obtained with the German VTT at the Observatorio del Teide (Tenerife, Spain). For each time step, we first determine the Doppler velocity, line width, and continuum intensity along the slit. Then we calculate for these observables the statistical moments of first and second order. Finally we study the temporal variation of these statistical properties as an efficient method to probe the dynamics of the solar granulation.

We demonstrate that the temporal variation of the cross correlation between intensity and velocity along the slit reflects the varying granular dynamics.

The time variation of the standard deviation of the line of sight convective velocity shows a characteristic wave pattern. The same pattern, but with reduced amplitude, can be seen in the standard deviation of the line width. This similarity demonstrates the tight connection between enhanced line broadening and granular dynamics.

The wave pattern exhibits a characteristic period of the order of 7 min. We assert that this quasi-periodic variation is not substantially produced by seeing variations during the observation.

P 09

Merging and Splitting Phenomena in the Solar Granulation: A Spectroscopic Investigation

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The splitting and merging of granular structures has often been observed in 2D movies, which can however not distinguish between bulk and phase velocities. We avoid this difficulty by studying such phenomena *spectroscopically*. Our study is based on measurements of the line Ni I 491.20 nm, recorded at the German VTT at the Observatorio del Teide on Tenerife. From these data, we derive maps showing various observables as functions of time and of space along the spectrograph slit.

The *intensity* and *velocity* maps demonstrate the intermittent behavior of the granulation; both are characterized by specific decay times. These maps also show examples of granular splitting, mergence, and disappearance, and especially of the merging of intergranular lanes. By contrast, the *line width* map does not exhibit a well-defined characteristic time scale.

We report on a case where two regions of strongly enhanced line broadening develop at the borders of a strong downdraft region, then approach each other, and ultimately merge. Since the spectral line is nonmagnetic ($g = 0$) and thermally insensitive, the line broadening represents unresolved nonthermal motions. We presume that at least part of these motions is turbulent. We also show that the correct interpretation of such complex dynamical events requires both, 2D information from slit-jaw images, and spectral information.

P 10

A New Class of Driving Mechanisms for Solar Spicules

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Spicules are one of the phenomena that constitute the "circuit of matter" in the solar atmosphere. During spicule events, plasma columns are lifted up into the upper atmosphere at high speeds, before most of the matter falls back again rather than escaping in the solar wind. This process, along with waves and turbulence, prevents at least partially the separation of elements due to gravitational settling and thermal diffusion.

Numerous mechanisms have been suggested to drive spicules. With many of them, however, free parameters must be carefully fine-tuned before they reproduce the observed spicular properties, like velocity and height. This suggests that there might be general physical principles that control these properties. For example, the velocity might be bound to the Alfvén speed in mechanisms based on magnetic reconnection or waves. We concentrate here on an alternative, even more basic principle by showing that whenever upper chromospheric plasma is exposed to a significantly nonhydrostatic pressure gradient, it starts moving upward at the observed speeds. The plasma can reach substantial heights if it continues to receive chromospheric heating while it rises. Such a hydrodynamic mechanism might help other (possibly magnetic) drivers to control the properties of spicules.

On this basis we propose to investigate spicule driving mechanisms in which the plasma is not (or not only) accelerated by wave or magnetic forces from below, but also by the generation of a high pressure region within, or a low pressure region above the chromosphere. The latter case represents a new class of spicule driving mechanisms, for which we present possible examples.

P 11

Coherent Nonlinear Wave Interaction in the Auroral Ionosphere

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In this paper the coherent nonlinear interaction of three and four electrostatic Farley-Buneman waves in the E-region of the auroral ionosphere is considered analytically and numerically. The evolution of the nonlinear waves is described by a system of magnetohydrodynamic equations.

It is shown that the interaction of the three or four coherent waves is the main physical mechanism which leads to the saturation of the Farley-Buneman instability. By the interaction of the coherent waves nonlinear waves and nonlinear structures are generated when the waves are damped linearly and propagate perpendicularly to the electron drift velocity. This wave region corresponds to large aspect and flow angles of the small-scale waves. Further, the wave interaction causes a nonlinear stabilization of the growth of the high-frequency waves. The density modifications of the charged particles during the nonlinear stage of wave growth are estimated. It is shown that the nonlinear evolution of Farley-Buneman waves can result into states of different type, quasi-stationary states, periodic and multi-periodic behaviour, and quasi-stochastic states. The scenario of the evolution depends on the plasma parameters and on the parameters of the interacting waves.

P 12

Hydrodynamic Model of the Mars Atmosphere between Near-Surface Layers and an Altitude of about 130 km

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It is planned to investigate the structure, dynamics and chemistry of the Mars atmosphere more intensively in near future using micro wave experiments. From lower Mars orbits, limb sounders will register vertical profiles of atmospheric parameters between the near-surface layers and thermospheric altitudes. The new experiments will help to improve the understanding of the Mars atmospheric circulation and climate on both short- and long-term time scales.

Thus, in this work a first hydrodynamic model of the Mars atmosphere is presented taking into account molecular heat conduction, dynamic viscosity, vertical eddy diffusion, Rayleigh friction, and surface topography. The solved system of hydrodynamic equations consists of the continuity equation, the horizontal momentum balances, and the energy balance. As initial state, an isothermal atmosphere is given. Then, the temporal behaviour of the Mars atmospheric parameters during about three hundred Mars days is considered.

As first results, vertical and horizontal profiles of the atmospheric temperature, as well as profiles of the longitudinal and zonal winds are presented. The correlation between the physical behaviour of the different parameters is analysed. Besides, possible changes of the parameters because of dust storms and radiation transport at non-local thermodynamic equilibrium are discussed.

P 13

Berlin Exoplanet Search Telescope

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The BEST (Berlin Exoplanet Search Telescope) is a simple but robust, groundbased system designed to search for transits of Jupiter-sized exoplanets across the disc of their central star. The system consists of a 20-cm flat-field camera and is equipped with a CCD camera with 2048×2048 pixels. The field of view of the telescope is around 3.1×3.1 degrees, allowing a large number of stars ($> 30\,000$) to be observed simultaneously in a typical field centered near the galactic plane. The system is operated as a groundbased support and test facility in the framework of our scientific participation in the COROT satellite project.

After one year of regular observations (observations started in July 2001) of 3 target fields at Thüringer Landessternwarte Tautenburg, Germany, first results will be presented. Two observations of the transiting exoplanet around HD209458 demonstrate the ability of the instrument to detect transits of Jupiter-sized exoplanets around Sun-like stars.

P 14

Infrared Extrasolar Planets

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Infrared techniques are essential for the study of extrasolar planets. With large telescopes and IR detector array instruments we can now begin to observe stellar flux – heated, close-in giant planets around solar-type stars. This paper presents several techniques employed in current observational studies of 'hot Jupiters'.

P 15

An Unusual Dust Disk Around TW Hya

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We present new observational evidence for an extended, massive dust disk around the 8 Myr young, K8 dwarf TW Hya. The observations measured the dust continuum at 1.2 mm using the bolometer array SIMBA at the 15 m radio telescope SEST in Chile. The structure is asymmetric and clearly resolved in the east-west direction with a total extent of $65'' \times 45''$ (E–W × N–S). In north-south direction TW Hya is not distinguishable from a point source folded with the telescope beam. Dusty material therefore extends up to radii of ~ 1000 AU around TW Hya.

Comparisons of the observed flux distribution with a radiative transfer model for the disk show that standard disk models cannot explain the large amount of material in the outer disk region. We speculate that the big size of the dust disk results from expansion in an active, massive, accretion disk around TW Hya and could constitute material of a forming "proto-Oort cloud".

P 16

A Search for Circumstellar Dust Disks with ADONIS

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We present results of a coronographic imaging search for circumstellar dust disks with the Adaptive Optics Near Infrared System (ADONIS) at the ESO 3.6-m telescope in La Silla (Chile). 22 candidate stars, known to be orbited by a planet or to emit high infrared excess radiation, were examined for circumstellar material. In the PSF-subtracted images no clear disk was found within the detection sensitivities.

These observations require a very stable PSF, which is however limited by atmospheric speckle noise. Differential polarimetric imaging, where the unpolarized speckle patterns can be removed, will therefore be a more reliable technique for circumstellar disk searches.

P 17

Implicit 2D-Simulations of Protoplanetary Accretion Disks

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Viscous forces are taken responsible for the development of gaseous disks around pre-main sequence stars, in the course of which angular momentum is carried outward while matter is transported inward towards the star. It is widely accepted that the processes responsible for planet-formation commence during this period. The goal of our work is to consistently simulate this initial phase concentrating on transport phenomena in protoplanetary accretion disks. Due to the large range of the physical time-scales that determine the evolution of these objects and the non-linear coupling of the underlying equations, the implementation of an implicit method seems desirable. Since the computation of the fully coupled system of equations still demands unacceptably vast computer resources a semi-implicit operator splitting method is required. The mach numbers of a large part of the computational domain will be very low and acoustic waves will limit the time-step of an explicit scheme. Therefore we have implemented a method derived from incompressible techniques, that determines the pressure as a primary variable from the solution of an elliptic problem rather than from the continuity equation via the equation of state. This method is combined with a finite volume discretisation to allow for the conservation of mass and angular momentum. Preliminary results of two-dimensional flow structures in protoplanetary disks will be shown.

P 18

Molecular Lines from Self-gravitating Turbulent Clouds

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Recent simulations of compressible hydrodynamic or magnetohydrodynamic turbulence provide first realistic models for the structure formation in self-gravitating molecular clouds. For a systematic comparison between observations and turbulence simulations the radiative transfer problem has to be solved, translating the density, temperature, and velocity structure into maps of molecular line profiles. We introduce a radiative transfer code using a combination of two sophisticated approximations allowing to compute the emission from the cloud models with an accuracy comparable to the calibration uncertainties of most molecular line observations.

By studying how the properties of the turbulence simulations are reflected in the resulting molecular line maps, we give rough guidelines how to deduce the true structure of molecular clouds from molecular line observations. We find that several tracers have to be observed to provide any conclusion on the cloud structure. Single molecular transitions are never sufficient to follow the gravitational collapse. The measured structure is dominated by the critical density of the transition, not by the full density distribution of the cloud. Maps of the dust emission or extinction are a better tracer of the overall density structure than molecular lines. The information from the line profiles is, however, essential to resolve the velocity structure including infall signatures.

P 19

Testing Pre-Main Sequence Tracks

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We present a test of pre-main-sequence (PMS) evolutionary models. Due to a lack of a large sample of well determined stellar parameters for low-mass PMS stars, free parameters in the input physics of theoretical models of PMS evolution are still not completely constrained. Therefore different models predict discrepant stellar parameters, especially in the low-mass regime.

For our test we use young eclipsing double-lined spectroscopic binaries with low masses. The mass of their components can be determined dynamically. The components are expected to have the same age, as components of multiple systems are supposed to form coevally. The components are plotted into the Hertzsprung-Russell diagram and compared with theoretical mass tracks and isochrones. The masses and relative ages are used to test the predictions of the evolutionary models.

However, even with precise masses, a decisive test of the PMS tracks is complicated by the large uncertainties in the determination of the effective temperature of the stars. Temperatures are usually converted from observed spectral types, but there is no established temperature scale for T Tauri stars so far. Thus, our test adopts various temperature scales for each star.

P 20

Radial Mixing in Protoplanetary Accretion Disks

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IR-spectra of many comets show clear evidence of crystalline silicate (predominantly olivine) in notable quantities, beside the known features of amorphous silicate dust. It is likely that the matter in comets represents unaltered pristine material from the formation time of the solar nebula, which has been 'frozen in' since its integration into cometesimals. Since the dust in the interstellar medium is exclusively amorphous, the protoplanetary accretion disk must be the origin of crystalline silicate. A possible formation process is annealing of amorphous silicate in the warm inner zone of the accretion disk. Due to turbulence transport in the optically thick disk some fraction of the annealed silicate dust reaches the cooler outer region of the disk where it may be built into larger bodies, e. g. cometesimals. In the matrix of some chondrites are also indications of silicate dust, which has experienced an annealing-event under the conditions of the solar nebula.

This work investigates the diffusion and crystallisation of dust in protoplanetary disks. For this purpose the diffusion equations for the dust (including annealing) are coupled with the equations for the global evolution of an one-dimensional, time-dependent α-disk model. The results suggest that the diffusive transport spreads the dust throughout the disk, and therefore provides an explanation for crystalline silicate within the primordial bodies of the solar system.

Also the large abundance of methane in comets may be explained by this model, since CH_4 is produced by carbon dust combustion in the inner disk region and is mixed radially outwards.

P 21

Chemical Evolution of a Primordial Spherically Symmetric Gas Cloud during Protostellar Collapse

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According to Standard Big Bang scenarios, only elements up to ^{7}Li were present in the primordial gas mixture. The first generation of stars (so-called Population III stars) must therefore have formed from material lacking today's most important coolants – metals and dust – presumably leaving collisional interactions between hydrogen molecules as the main cooling agent. For this reason, the formation and evolution of Pop III stars must be different from that of contemporary stars.

We present first results of a numerical model calculation for protostellar collapse including the chemical evolution of a primordial gas cloud solving a reaction network that includes the important chemical species of H, D, He and Li.

The one dimensional spherically symmetric collapse calculations are performed using a highly accurate implicit method for solving the hydrodynamics of the system, the radiative transport equation in spherical symmetry (presently in grey approximation) and the chemical reaction network on an adaptive grid.

P 22

Formation of Magnesio-wüstite Dust

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Low and mean mass stars loose most of their initial mass in a massive stellar wind as giant stars on the AGB and develop optically very thick dust shells around them. Massive stars with initial masses of $M < 25 M_{\odot}$ also reach the RGB stage before they explode as supernova. During their evolution as supergiants on the RGB they loose a substantial fraction of their mass by a massive cool stellar wind and develop optically very thick dust shells. The element mixture in stellar winds of AGB stars is either oxygen rich (M stars) or carbon rich (C stars). For RGB stars the element mixture is always oxygen rich. Depending on the carbon to oxygen abundance ratio, the dust mixture formed in the outflows from cool giant stars is quite different. The dominating dust component in stars with an oxygen rich element mixture is an amorphous magnesium-iron silicate.

We discuss the possible formation of iron-magnesium-oxides in stellar outflows from AGB giants and RGB supergiants stars with an oxygen rich element mixture. Chemical equilibrium calculations for the non-ideal solid solution of Magnesio-wüstite with composition $Mg_xFe_{1-x-\delta}O$ show that this oxide may be formed under conditions of imperfect equilibrium condensation. A model for calculating the condensation of Magnesio-wüstite under non equilibrium conditions in stellar outflows is developed, and numerical model calculations for multi-component dust condensation including Magnesio-wüstite in oxygen rich stellar outflows from cool stars are presented.

P 23

The Lyα Emission of a Clumpy Interstellar Medium

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A three-dimensional radiative transfer code is used to calculate the escape fraction of Lyα photons from a dusty and clumpy medium. A two-phase model is employed for the description of the clumpyness and model configuration with column densities of neutral hydrogen up to 10^{16} cm^{-2} and a dust optical depth up to 30 % of the gas optical depth are investigated. The results show that the flux reduction due to dust absorption is about one order of magnitude in an ionized clumpy medium. In contrast, the effect of dust absorption is large in a neutral clumpy medium, where the flux reduction ranges over several orders of magnitude. The influence of dust absorption on the Lyα line profile and Lyα emission maps are presented.

P 24

Dust Properties of Prestellar Clouds

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We are studying dust and gas in dark, quiescent molecular clouds with embedded dense cores which may be the progenitors of future protostars (Kramer et al. 2002, submitted to A&A). Here, we present the results of a submillimeter dust continuum study of a molecular ridge in IC5146 carried out at 850 micron and 450 micron with SCUBA on the James Clerk Maxell Telescope (JCMT). The mapped region is $\sim 14' \times 2.5'$ in size ($\sim 2\,\mathrm{pc} \times \sim 0.3\,\mathrm{pc}$) and consists of at least four dense prestellar cores. To study the dust properties of the ridge, we combined the dust emission data with dust extinction data obtained by Lada et al. (1999) from the NIR colors of background giant stars. Extinctions vary between ~ 10 and 40 mag.

A map of dust temperatures, constructed from the continuum flux ratios, shows significant temperature gradients: we find temperatures of up to ~ 25 K in the outskirts and between the cores, and down to ~ 10 K in the cores themselves. All cores show an isothermal inner region. Two cores show outwardly increasing temperatures profiles, which is expected when the cores are heated only externally.

We find indications for an increase of the 850 micron dust opacity with dropping dust temperature which we interpret as signature of grain coagulation and the formation of ice mantles in the dense and cold cores. This increase of opacity is predicted by models of dust evolution in dense prestellar cores (Ossenkopf & Henning 1994). It is also qualitatively consistent with the previous detection of gas-phase depletion of CO (Kramer et al. 1999).

This work is going to be published in Kramer et al. (2002, A&A, submitted).

P 25

Detection of $^{13}C^{17}O$, and Observations of Rare CO Isotopomers towards the ρ Ophiuchi Molecular Cloud

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We report the detection of $^{13}C^{17}O$, and present observations of three additional rare CO isotopomers made towards core C of the ρ Ophiuchi molecular cloud. The data encompass single pointed observations of the $J = 1 \rightarrow 0$ and $J = 2 \rightarrow 1$ rotational transitions for $C^{18}O$, $C^{17}O$ and $^{13}C^{17}O$, and the $J = 1 \rightarrow 0$ transition for $^{13}C^{18}O$. Emission is detected for all isotopes and transitions observed. For the two ^{17}O-containing species, the interstellar spectra display a partially resolved hyperfine spectrum due to the $I = 5/2$ spin of the ^{17}O nucleus. The isotope abundance ratios derived from these measurements are $[^{12}C]/[^{13}C] = 65.0 \pm 6.3\,(\mathrm{stat.}) \pm 9.2\,(\mathrm{syst.})$ and $[^{18}O]/[^{17}O] = 4.15 \pm 0.52\,(\mathrm{stat.}) \pm 0.59\,(\mathrm{syst.})$, consistent with recent measurements for nearby molecular clouds. Thus, our measurements support the idea that both ratios are smaller in the local ISM than their terrestrial value of 89 and 5.5.

P 26

The Photon Dominated Region W3

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Photon Dominated Regions (PDR) are fractal like regions at the surfaces of molecular clouds where UV radiation from nearby stellar sources is impinging. In the submm and FIR domain the most important cooling lines of the molecular gas are the [C II] and [C I] fine structure lines and CO rotational lines. In combination with appropriate modelling (e. g. Kaufman et al. 1999, Störzer et al. 1994) these lines provide a unique diagnostic of the physical conditions in the cloud.

We study the W3 complex, which is an exemplary region of massive star formation in the Perseus arm of our galaxy. From our observations done with the *SMART* receiver at the *KOSMA* telescope we were able to map W3 in the PDR tracer [C I] in two transitions $^3P_1 \rightarrow {}^3P_0$ and $^3P_2 \rightarrow {}^3P_1$ as well as in the two CO $4 \rightarrow 3$ and $7 \rightarrow 6$ lines originating from the denser molecular gas phase.

A multiline analysis of the averaged intensity ratios is done to derive basic values which may reflect some intrinsic PDR properties for specific physical conditions like the UV field, the metallicity, the density, the temperature or the mass.

In a later stage, this analysis will help to derive a consistent picture of the Photon Dominated Regions in the vicinity of massive star formation within the Galaxy or in the galactic neighborhood. This serves also as preparatory work for future missions like *SOFIA* and *Herschel* which will e. g. provide velocity resolved [C II] data.

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Cold Dust in Cirrus Cloud Cores

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Galactic cirrus clouds are nearby objects, which are dominated on large scales by turbulence. Nevertheless they harbour several dense cores. One of these cores has been found to be under gravitational collapse, indicating low mass star-formation. To examine the frequency of star-formation in cirrus cores we have started a project to analyse their dynamical and evolutionary state.

Using MAMBO at the IRAM 30 m telescope we have observed several dense cores in galactic cirrus clouds in the dust continuum emission at 1.2 mm wavelength. The broadband continuum emission at mm and submm wavelengths provides information on the distribution of the cold dust. It gives an independent measure for the total mass surface density and the temperature, which are otherwise hard to estimate. All cores are clearly detected which indicates higher column densities than expected from the IRAS measurements.

Our investigations confirm that star formation may also take place in small molecular clouds. Supplementary observations of various molecules will provide information on the dynamical state of the cores and thus for the process of low-mass star formation.

P 28

Small-Area Molecular Structures without Shielding

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Using the IRAM 30 m telescope two molecular structures have been detected which cover very small areas, $FWHM \leq 1'$. The clouds have velocities of $v_{\rm lsr} \approx 5\,{\rm km/s}$ and linewidth of $\Delta v \approx 0.8\,{\rm km/s}$; thus they belong most likely to the Milky Way. Applying standard conversion factors and arbitrarily adopting a distance of 100 pc the masses of the clouds are less than Jupiter mass and sizes are between 2000 and 6000 AU. HI 21 cm line data towards the clouds show no prominent HI clouds. The total HI column densities for both structures are below $N({\rm HI}) \leq 2.1 \times 10^{20}\,{\rm cm^{-2}}$, corresponding to $A_V \leq 0.2\,{\rm mag}$, if one adopts a standard gas-to-dust ratio. IRAS 100 μm data show also only low emission, consistent with low extinction. Current models on formation and destruction of H_2 and CO predict that this shielding is too low for the structures to survive the interstellar radiation field for a longer time. The detection of 2 such structures in a rather limited sample of observations suggests that they could be a rather common feature in the interstellar medium, however so far not recognized as such due to the weakness of their lines and their small extent.

P 29

A Survey for Low-mass Members of the Taurus-Auriga Association

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We have imaged a $2.75\,{\rm deg^2}$ area of the L1495 cloud in the Taurus-Auriga star forming region in R and I. These observations were done with the Tautenburg 2 m-telescope in its Schmidt mode. The sensitivity limit is $R \approx 21$. The detection of objects below the deuterium burning mass limit ($M = 0.013\,M_\odot$) is thus in principle possible, assuming a distance of 140 pc and an age of 1 Myr for Taurus-Auriga.

The (I, $R - I$) colour-magnitude diagram for $\approx$ 40 000 objects resulting from these observations is strongly influenced by the presence of interstellar extinction in L1495. To take this into account, we assume an extinction coefficient $A_V = 3$ for all our objects, which is larger than the values for almost all known T Tauri stars in this region. In this way we can select 40 candidate objects that physically belong to L1495 with high probablity and fall below or close to $0.08\,M_\odot$ with respect to state-of-the-art evolutionary tracks. They may be young substellar objects or still unknown T Tauri stars, which we will check with spectroscopic follow-up observations. Most of these objects can be identified also in the 2MASS database. The resultant RIJHK photometry will be used to look for excess emission indicative of disks around these young objects. Results of this work will be presented and discussed.

P 30

Mixing in Supersonic Turbulent Flows

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Stars are born from turbulent interstellar clouds of molecular hydrogen. Hence, the location and the mass growth of young stars are intimately coupled to the dynamical cloud environment. The remarkable chemical homogeneity of many stellar clusters (as measured, e. g., in the Pleiades' G dwarfs) implies that the turbulent velocity field in star forming regions must be very efficient in mixing molecular cloud material and erasing chemical concentration gradients. This can be used to constrain theoretical models of molecular cloud turbulence, and motivates a numerical investigation of transport processes in supersonically turbulent compressible gases. We derive the effective diffusion coefficients D, and show that they follow a unique scaling relation depending on the *Mach number* $\mathcal{M}$ and on the *lengthscale* $\tilde{\ell}$ of those modes of the flow that contain most of the energy. This behavior can be understood in terms of simple mixing length arguments, extending the classical approach for incompressible subsonic turbulent flows into the compressible and supersonic regime.

P 31

Synthetic Spectra of Accretion Disks

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With our recently developed code AcDc we are able to calculate vertical structures and synthetic spectra of accretion disks, especially in cataclysmic variables.

Dividing the disk into concentric rings and treating them like independent plane-parallel radiating slabs, we calculate in a first step a gray LTE model, afterwards the NLTE model, including metal line blanketing, of each individual ring. The radiative transfer is solved consistently with the system of equations of hydrostatic and radiative equilibrium, atomic level populations and particle conservation.

To get the spectrum of the whole disk for a specific angle of inclination we finally integrate over all ring spectra.

We present results for AM CVn, a special subtype of cataclysmic variable. AM CVn stars are systems of interacting binary white dwarfs, the secondary looses mass, almost pure helium, to the primary, forming an accretion disk. We also plan to calculate accretion disk models for symbiotic stars, interacting binaries, consisting of a cool giant and a hot ionizing radiation source. Some of these systems are thought to have accretion disks around the hot component.

P 32

Interaction Between a Star and a Diffuse Interstellar Cloud

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Stars which encounter a diffuse interstellar cloud are able to accrete interstellar matter from the cloud (particle density of the order of 10 cm^{-3}). In the case of main-sequence A and F-type stars, the small interstellar dust is kept away due to radiation pressure, while the gas is accreted onto the stars. Since these stars have shallow convection zones, the accretion of interstellar gas, that is depleted in condensable elements, will change the photospheric abundances.

Possible candidates for an encounter with a diffuse cloud are the λ Bootis stars, metal-poor A and F-type stars which show an abundance pattern similar to that of the interstellar medium.

P 33

Massive Stars and their Influence on the ISM: The Impact of a 15 $M_\odot$ Star

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In our approach's framework to study the impact of massive stars on their surrounding interstellar medium by means of numerical simulations we present new results for the interaction of a 15 $M_\odot$ star with its environment. This is a continuation of radiation + wind-driven H II models around 60 $M_\odot$ and 35 $M_\odot$ stars, respectively, already in publication. The calculations consider the time-dependent photoionizing radiation of the star as well as the stellar wind while the star goes through it's various phases. A fairly sophisticated treatment of ionization, radiation transfer, heating and cooling is applied in order to study the energy transfer processes in detail. Nested grids are used to enhance the resolution near the star while the coarsest grid still covers the whole area affected by stellar radiation and stellar ejecta.

The tendency of less massive stars having less structure formation in the H II region, caused by the stellar wind shell being geometrically thicker and thus more stable due to the lower stellar wind luminosity, has been confirmed. We additionally present quantitative results of the energy transformation efficiency by which the stellar energy input is converted into kinetic and thermal energy of interstellar gas.

P 34

Absorption Features of Heterogeneous Grains in Oxygen-rich Circumstellar Environments

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Solid particles in the interstellar medium are mainly silicate dust grains. The Infrared Space Observatory (ISO) have revealed their existence in the circumstellar shells around pulsating long-period variables (e. g. Waters et al. 1996, A&A 315, L361, Molster et al. 1999, A&A 350, 163). In this work, we have investigated the 13 μm feature carrier of core-mantle grains, which are composed of corundum/silicates and rutile/silicates. Since the optical properties of core-mantle grains depend on their chemical content and internal structure, we have performed calculations of the volume-normalized absorption cross section by using the Mie theory for different data sets of silicates, e. g. magnesia-rich pyroxene, iron-rich pyroxene, olivine, enstatite, forsterite, and so called astronomical silicate in order to identify the grain composition contributing to the 13 μm band.

P 35

Searching for Bow Shocks Using All-Sky Hα Surveys

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Bow Shocks are ideal astrophysical probes, which allow us to measure densities and upper limits of temperatures of the warm ISM. Up to now, only OB runaway stars, created by binary supernovae, and therefore incorporating a neutron star, were analysed in Hα.

Based on the all-sky Hα surveys The Virginia Tech Spectral-Line Survey (VTSS) and The Southern H-Alpha Sky Survey Atlas (SHASSA) we searched for Bow Shock structures around OB runaway stars. High stellar velocities result from both binary supernovae and cluster ejection. The used sample consists of candidates detected by analysing the ISSA/IRAS archival data (van Buren et al., 1995).

Using the ISSA 60 μm and 100 μm data we created excess maps which reveal the structure and orientation of the Bow Shocks. The Hα data is used to look for typical parameters that define a Bow Shock, such as symmetry-axes and radial-distance profiles. These parameters are used to decide whether an object is a Bow Shock or not. This gives us a new sample of Bow Shock candidates as seen in Hα. It is now possible to measure typical physical conditions of the warm ISM in the vicinity of these stars.

P 36

IOTA Observation of the Circumstellar Envelope of R CrB

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We report the first long baseline interferometric observation of R CrB at maximum light. The observation was carried out at Infrared Optical Telescope Array (IOTA), using our beam combiner which enables us to record fringes simultaneously in the J-, H-, and K-bands. The circumstellar envelope of R CrB is resolved with a baseline of 21 m, and the visibility at the K-band is derived to be 0.6. The new visibility obtained with IOTA and spectral energy distribution are fitted with 2-component models consisting of the central star and an optically thin dust shell. The predicted visibilities in the K-band tend to be by $\sim 10\,\%$ smaller than the observed. However, given the simplifications adopted in our models and the complex nature of the object, this can be regarded as rough agreement. As an alternative explaination for this small discrepancy, we propose that there might be a group of newly formed dust clouds close to the central star.

P 37

Bispectrum Speckle Interferometry of IRC +10 216: The Dynamic Evolution of the Circumstellar Environment from 1995 to 2001

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We present new near-infrared (JHK) bispectrum speckle-interferometry monitoring of the carbon star IRC+10216 obtained between 1999 and 2001 with the SAO 6m telescope. The J-, H-, and K-band resolutions are 50 mas, 56 mas, and 73 mas, resp. The total sequence of K-band observations covers now 8 epochs from 1995 to 2001 and shows the dynamic evolution of the inner dust shell. Four main components within a $0.2''$ radius can be identified in the K-band images. The apparent separation of the two initially brightest components A and B increased from 191 mas in 1995 to 351 mas in 2001. Simultaneously, component B has been fading and almost disappeared in 2000 whereas the initially faint components C and D became brighter. These changes can be related to changes of the optical depth caused, e. g., by mass-loss variations or new dust condensation in the wind. Our 2D radiative transfer model suggests that the observed relative motion of A and B is not consistent with the known terminal wind velocity of 15 km/s but appears to be caused by a displacement of the dust density peak due to dust evaporation in the optically thicker and hotter environment. Our monitoring, covering more than 3 pulsation periods, shows that the structural variations are not related to the stellar pulsation cycle in a simple way. This is consistent with the predictions of hydrodynamical models that enhanced dust formation takes place on a timescale of several pulsation periods. The timescale of the fading of component B can well be explained by the formation of new dust in the

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Betelgeuse – Improved Numerical Simulations of an Entire Supergiant

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In 1975 Martin Schwarzschild attributed the visual brightness fluctuations of the red supergiant Betelgeuse to huge convection cells. Each of them covers a significant fraction of the stellar surface, so that the individual brightness changes result in a non-vanishing variation of the total luminosity. Starting in 1989, interferometric observations in the visible wavelength regime revealed the existence of large-scale spatial inhomogeneities on the surface of Betelgeuse, typically described as 0 to 3 unresolved "hot spots" on a cooler circular stellar disk, varying with time in number, intensity, and position.

To improve the theoretical understanding of the surface phenomena of Betelgeuse, a new radiation hydrodynamics code ("CO^{5}BOLD") has been written with the aim to include the entire star in the computational box. It employs special inner (for the stellar core) and outer boundary conditions appropriate for this particular geometry. Due to e. g. a relative small ratio of radiative to hydrodynamical time-scales, high Mach-number flows, stronger photospheric shocks with correspondingly larger opacity variations, and a stronger sub-photospheric jump in temperature these simulations turned out to be more demanding in terms of stability of the code and in cpu-time than simulations of "ordinary" solar granulation.

Recent results from models with improved algorithms and increased numerical resolution will be presented.

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A Stochastic Model of Large Scale Motions in the Wind of Evolved Late-type Stars and its First Application to λ Velorum

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The mechanism responsible for the strong mass outflow in late type giants and supergiants is still poorly understood. In the absence of detailed hydrodynamic models the line broadening process is commonly treated assuming chaotic motions in the microturbulent sense. To investigate the influence of large scale velocity fields on the line formation we have developed a radiative transfer scheme which accounts for velocity correlations on a stochastic basis. The velocity coupling is assumed to obey a Markov process and is described by a two point correlation function. This approach leads to a Fokker Planck equation instead of the classical equation of radiative transfer.

In our initial study we show how correlated velocity fields will affect the line formation in the stellar wind. We have calculated a series of models in order to match the UV resonance lines of λ Velorum observed with the Goddard High Resolution Spectrograph (GHRS) on board the *Hubble Space Telescope*. We compare the characteristics of our new approach with the microturbulent limit and discuss the consequences for the derived wind parameters as mass-loss rate, terminal velocity, and acceleration parameter.

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Diffraction-limited Bispectrum Speckle Interferometry of the Herbig Be Star R Mon

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We explore the structures immediately surrounding the intermediate-mass young stellar object R Mon with bispectrum speckle interferometry, conventional near-infrared imaging and by analyzing optical HST archive data. Our near-infrared speckle images with unprecedented diffraction-limited resolution of 55 mas ($\sim$ 44 AU; H-band) and 76 mas ($\sim$ 61 AU; K-band) represent the highest resolution R Mon images obtained so far and exhibit previously unseen complex structures. While the binary companion R Mon B appears as an unresolved point source in our speckle images, the image of the primary R Mon A is marginally extended in the K-band and significantly extended in the H-band. The most prominent new feature is a bright arc-shaped structure, pointing away from R Mon in north-western direction. We interpret this feature as the surface of a dense structure near the thick circumstellar disk or torus around R Mon. Our images also reveal several twisted filaments of helical shape which are similar to the twisted filaments in the outer parts of the nebula. We identify structures which probably are responsible for casting pronounced shadows in the outer regions of the NGC 2261 reflection nebula. Finally, we discuss the relation of the observed features, in particular the arc-shaped speckle feature, to the wind and outflow activity (Herbig-Haro objects and jets) of R Mon.

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Near-Infrared IOTA Interferometry of the Symbiotic Star CH Cyg

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We present near-infrared IOTA interferometry of the symbiotic star CH Cyg with the IOTA interferometer and our new JHK-band beam combiner. Spectrally dispersed Michelson interferograms were simultaneously recorded in the J-, H- and K-bands. The spectrograph of the beam combiner consists of an anamorphotic lens system and a grism. We observed CH Cyg with the baselines 17 m, 20 m, and 25 m (5, 6, 8 and 11 June 2001; V-magnitude approximately 8.8; K-magnitude approximately -0.7).

From the derived JHK visibilities the size of CH Cyg was for the first time determined in 16 different spectral channels and the observations were compared with model predictions.

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Bispectrum Speckle Interferometry of the B[e] Star MWC 349A

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We present the results of bispectrum speckle interferometry of the B[e] star MWC 349A obtained with the SAO 6 m telescope. Our diffraction-limited J-, H-, and K-band images (resolutions 43–74 mas) suggest the star to be surrounded by a circumstellar disk seen almost edge-on. The observed visibility shape is consistent with a two-component elliptical disk model, probably corresponding to the gaseous and dusty components of the disk. We show that the classification of the object as a pre-main-sequence star or a young planetary nebula meets a number of serious problems. An analysis of the uncertainties in the basic parameter determination lead us to a conclusion that MWC 349A is either a B[e] supergiant or a binary system, in which the B[e]-companion dominates the observed properties.

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Strings, Jets and Shocks in η Carinae's Ejecta

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For understanding the evolution of the most massive stars, the object η Carinae plays a key role. The star – or at least one of the two, if it is indeed a binary system – is extremely luminous and unstable. During its presently ongoing LBV phase the mass loss increased dramatically and the stars underwent a giant eruption around 1843, an energetic event in which ~ 3 $M_\odot$ were ejected. Nowadays a perfectly bipolar nebula surrounds η Carinae which consists of an inner region, the *Homunculus*, and the *outer ejecta*. The expansion velocities are as high as several thousand km/s and give rise to X-ray emission. Among the most fascinating features within the nebula are highly collimated, narrow structures known as *Strings*. I will present high-resolution HST-STIS spectra of theses Strings and discuss in detail their kinematics and physical structure. These results will be compared to the X-ray emission and global structure of the nebula.

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NLTE Modeling of CO Lines in Expanding Shells of LPVs

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The dynamics of cool, shock penetrated, expanding atmospheres of Long Period Variables (LPVs) can be well studied by the infrared molecular line profiles of the CO molecule. Because of the high abundance of CO and its stability at high temperatures, it is a dominant source of line formation in the circumstellar shells of LPVs and is therefore an excellent diagnostic tool appropriate for the overall structure of the expanding circumstellar layers.

A radiative transfer code (time-independent, spherically symmetric, co-moving frame, accelerated lambda iteration) has been developed to model atomic and molecular lines in the case of the special conditions of cool LPV atmospheres. We present some results of infrared CO line calculations based on fully self-consistent and time-dependent hydrodynamical models of LPVs.

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Spots and Flares on the Weak-line T Tauri Star V410 Tau

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In November 2001 we carried out simultaneous multi-wavelength observations of the weak-line T Tauri star V410 Tau. The campaign included photometric observations at various sites throughout the world providing complete phase coverage of the 1.87 d photometric spot cycle of the star in just 11 days of monitoring. Besides this we performed optical spectroscopy at low and high resolution, probing the chromosphere of this highly active star by studying the Balmer emission lines. Contemporaneous X-ray observations with *Chandra* were obtained to examine correlations between photometric variability induced by star spots and the structure of the corona.

Due to the intense monitoring our observations revealed a large number of optical flares. This is in contrast to previous findings. Only very few flares on V410 Tau had been identified, presumably because of poor time sampling. Our wealth of data enables us to discuss the energetics and statistics of flares on V410 Tau in comparison to flares on dMe stars.

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Resolving the Magnetosphere of T Tauri South B

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We have observed the T Tauri system at 8.4 GHz with a VLBI array comprising the VLBA, VLA and Effelsberg 100 m telescopes. We detect a compact source offset some 33 mas from the best optical position of the T Tau Sb component. This object is resolved on milliarcsecond scales. The other system components (T Tau Sa, T Tau N) were not detected. Examination of the VLA lightcurve reveals strong flaring behaviour, which together with circular polarisation and its compact nature indicate that the observed flux is most likely synchrotron emission from a magnetosphere or inner jet. One flare was observed to have almost 100 % right-hand circular polarisation, suggestive of a coherent emission process, most probably an electron cyclotron maser. With this assumption it is possible to determine the magnetic field strength in the emitting region, which is estimated at 1–2 kilogauss.

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Spectro-interferometry of the Mira Star T Cep with the IOTA Interferometer and Comparison with Models

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Our new IOTA JHK-band beam combiner allows the simultaneous recording of spectrally dispersed J-, H- and K-band Michelson interferograms. We present our IOTA observations of the Mira star T Cep with this beam combiner (observations on June 6, 9, 10 and 11, 2001). The beam combiner optics consists of an anamorphotic cylindrical lens system and a grism. From the JHK interferograms of T Cep we derive the J-, H-, and K-band visibility functions and the uniform-disk diameters of 14.0 mas, 13.7 mas and 15.0 mas, respectively. Angular stellar filter radii and Rosseland radii are derived from the measured visibilities by fitting different theoretical center-to-limb intensity variations (CLVs) of different Mira star models. The available HIPPARCOS parallax of T Cep allows us to determine linear radii. For example, from the K-band visibility we derive a Rosseland radius of 329^{+70}_{-50} solar radii if we use the CLVs of the M-models as fit functions. This radius is in good agreement with the theoretical M-model Rosseland radius of 315 solar radii.

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The Rotational Velocity of the sdOB Primary of the Eclipsing Binary System AA Dor

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AA Dor is a close binary ($P = 0.26$ d) consisting of an sdOB primary star and possibly a planet which had experienced a common envelope phase during their evolution.

A recent spectral analysis of the primary based on high-resolution ESO CASPEC spectra (Rauch 2000, A&A 356, 665) was hampered by the relatively long exposure times (1 h) and hence, a relatively large orbital velocity coverage. Thus there remains a discrepancy between the resulting stellar parameters from this analysis and those derived from the radial-velocity and the eclipse curves.

We present an analysis of the rotational velocity of AA Dor based on 105 new high-resolution and high-S/N ESO VLT UVES spectra which cover the complete orbital period of this binary system.

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Chemical Composition of White Dwarfs in the Solar Neighbourhood

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Due to several new sky surveys the number of cool and intrinsically faint white dwarfs within a distance of 20 pc seems to be complete as well as the number of polarized and strongly magnetic objects.

The analysis of polarized spectra by model atmosphere technique shows best results for the very cool objects for intermediate composition with ratios of He/H between 0.01 and 1000. The hydrogen abundance, important for the opacity in the infrared and the blue region of the spectra, is definitely larger than for some of the nonmagnetic white dwarfs in the same area of the sky like vMa2 and R640. Thus the assumption of changes in the diffusion time scale due to a strong magnetic field seems to be justified.

P 50

Improved Results for Equilibrium Abundances from Diffusion Calculations

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The atmospheric composition of hot white dwarfs is governed by the competing processes of gravitational settling and radiative levitation. Incorporating the interplay between these forces into non-LTE stellar atmosphere models through an equilibrium calculation approach provides self-consistent predictions for the vertical stratification of metals. Synthetic spectra derived from such chemically stratified models can quantitativly describe the EUV spectra observed from hot DA white dwarfs. But while superior to homogeneous models in the EUV range, the stratified models have so far not been elaborate enough to truthfully reproduce all of the many features evident in the UV spectral range simultaneously. This can at least in part be attributed to the very obvious shortcoming of not having included much more than a handful of the most important elements. We now present improved models with predictions for more elements as well as their first confrontations with high-resolution spectra.

P 51

Analysis of the FUSE spectrum of the sdOB EC11481–2303

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We are analyzing an archival high resolution FUV spectrum of a peculiar hot high-gravity pre-white dwarf. As pointed out by Stys et al. (2000), based on its optical spectrum EC11481–2303 appears to be an sdOB star, however, in the IUE SWP spectral region (1150–1950A) the energy distribution is curiously flattened. No combination of effective temperature and interstellar reddening is able to explain this. As an explanation, it has been argued that the atmosphere is chemically stratified, or a "spot" model might apply, or that the spectrum might be a composite binary spectrum. In contrary we claim that the unusual UV energy distribution is caused by exceptionally strong line blanketing from iron group elements, which is corroborated by a comparison of new models with IUE high resolution spectra. The FUSE spectrum allows to confirm this claim and, thanks to the high resolution, to derive unambiguously individual metal abundances.

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Wavelength Dependence of Pulsation Amplitudes in DBV White Dwarfs

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The wavelength dependence of pulsation amplitudes has in recent years been established as a useful method to identify pulsation modes in variable white dwarfs. Robinson et al. (1982, ApJ 259, 219, RKN) have laid the foundation for all these studies by demonstrating that the amplitudes depend solely on the spherical degree of the mode l.

In general these attempts have not been as successful as expected. Ising & Koester (2001, A&A 374, 116, IK) have therefore developed a different method, following important work by Brickhill (1992, MN 259, 529 and earlier). In this method the response of a column through the outer layer of the star (including the complete convection zone) on pulsating pressure at the lower boundary is calculated for different amplitudes. As shown by IK for the case of DAV the central assumptions of the RKN method (linear flux response at the surface and constant phase) are indeed often violated, especially at larger amplitude. However, the effects (i and a dependence of chromatic amplitudes) is negligible for $l = 1$, and often small for $l = 2$. In this paper we extend that research to the study of fractional amplitudes in DBV and its challenging prototyp GD 358. Both theoretical methods give almost identical results, but neither of them fits the observations. Different solutions for these problems are discussed.

P 53

Structure of Interstellar Bubbles: A Numerical Time-Dependent Calculation

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Interstellar bubbles are large (sizes ≤ 60 pc), low density (n $\sim 10^{-2}$-10^{-3}), hot (T $\geq 10^6$ K) cavities produced in the interstellar medium by the action of strong stellar winds. Weaver et al. (1977, ApJ 218, 377) discuss the structure and evolution of interstellar bubbles in a uniform interstellar medium. We report provisional results of numerical time-dependent calculations for the first 10^5 years of the development of spherically symmetric interstellar bubbles without considering electron thermal conduction. The inner and outer boundary conditions are defined and explained. We discuss our results in relation to the results of numerical simulations of the evolution of interstellar bubbles in an inhomogeneous interstellar medium (Cowie et al., 1981, ApJ 247, 908). We present a newly found interstellar nebula shaped by a stellar wind.

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Lunar Occultation Observations of MIR Sources

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We present one-dimensional high-resolution images of AGB-stars, obtained with lunar occultation observations in the MIR with TIMMI mounted at the ESO 3.6 m telescope.

In this presentation, we focus on the two sources CW Leo (IRC +10216) and Z Cnc. The one-dimensional images show the inner parts of the dust shells of this two sources, with a spatial resolution of 20 mas.

For Z Cnc we present an improved model of the dust shell. The adjustment of the modelled intensity distribution to the observed one in conjunction with the knowledge of the distance to the source from Hipparcos measurements restrict the free parameters of the model, above all the inner diameter of the dust shell.

P 55

IR Colour – Mass Loss Relations of Dust-Driven Winds

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Towards the end of their evolution on the tip of the Asymptotic Giant Branch (AGB), intermediate mass stars ($\sim$1.3–8 $M_\odot$) undergo phases of heavy mass loss (up to $\sim 10^{-4}\ M_\odot \mathrm{yr}^{-1}$). This process is the result of radiation pressure on dust grains which are formed a few stellar radii above the photosphere. Due to the dust, most of these objects are obscured in visible light, but bright in the infrared (IR). Since the mass loss (ML) itself cannot be observed directly, relations between the ML rate and easily obtainable observables are highly desired. In particular, (semi-)empirical relations between the ML rate and near-IR colour indices have been found for carbon stars (Le Bertre 1997, A&A 324, 1059) and oxygen-rich Miras (Le Bertre & Winters 1998, A&A 334, 173). These relations were derived from phase-dependent spectral modelling of the individual sources, and they do not cover the most extreme cases (i. e., they are restricted to, e. g., $J - K \leq 6$).

We here present a complementary approach by means of consistent hydrodynamical model computations for dust-driven, C-rich winds in pulsating atmospheres. We used time-averaged ML rates and IR colour indices of a set of 50 models where the mass loss is initiated by radiation pressure on dust (Winters et al. 2000, A&A 361, 641) and find tight correlations between the IR colour indices and the ML rate. An additional, secondary factor determining the ML rate is the stellar luminosity $L_\star$. With the distance known, ML rates can therefore be determined from, e. g., the IR colour index J-K. Also, these relations can provide a verification of theoretical ML predictions, on the basis of stellar samples, by a direct comparison with available photometry.

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Asteromineralogy of O-rich Evolved Stars. I. Silicates

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The detection of the SiO_4 vibrational bands at 10 and 18 μm in about 2000 O-rich stellar spectra has proved silicates to be the main stardust component. The appearance of the band profiles points to amorphous carriers silicates that cannot be subject of mineralogical analysis. Nevertheless, these bands and their heuristic investigation via laboratory analogs laid the base for including circumstellar solids in mineralogical considerations. However, the unexpected ISO discovery that stardust silicates contain a crystalline portion paved the way to genuine mineralogical authenticity via spectroscopy, resulting in the new special branch "asteromineralogy" with silicates as the main mineral class.

Since dust formation in the outflowing stellar gas is expected to result in amorphous grain structure, the "ISO revolution" forces to investigate the transformation of the primary silicates to minerals that can be exactly classified.

We present a series of amorphous Mg-silicates of the type Mg_xSiO_{2+x} with $0 \leq x \leq 2.4$ which were prepared by the sol-gel technique. They provide the so far best reproduction of AGB-star silicate spectra with strong silicate emissions and a deep trough by laboratory analogs. Spectra with a much less distinctive trough point to a non-silicate opacity source at 11–16 μm. Due to their small content of non-associated Si–OH bonds in the silicate network the new analogs drastically lower the crystallization threshold for the transition of the primary silicates to forsterite and enstatite.

(Submitted to A&A: Jäger et al., Steps toward interstellar silicate mineralogy VII. Spectral properties and crystallization behaviour of Mg silicates produced by sol-gel method)

P 57

Asteromineralogy of O-rich Evolved Stars. II. Oxides

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The dust emission spectra of O-rich evolved stars show variety both in the silicate band profiles and, in particular, in the "trough" depth. A new study of amorphous Mg silicates (cf. poster I) has shown that amorphous Mg silicates alone cannot fill up the trough. Stellar corundum, spinel, hibonite, and titanium oxide grains from primitive meteorites strengthen the suspicion that the cumulative effect of such metal oxides could mask the silicate opacity, in particular in the trough region. As laboratory studies show amorphous Al_2O_3 grains would effectively enhance the trough opacity. Optical data of periclase (MgO), wuestite (FeO) and magnesio-wuestite ((Mg,Fe)O) have broad bands that interfere with the 18 μm silicate band.

A weak, but distinct band at 13.1 μm found first in IRAS LRS spectra and confirmed by ISO SWS spectra had been first attributed to Al–O vibrations of corundum grains. However, spinel ($MgAl_2O_4$) grains agree much better with the observations and are supported by additional spinel bands observed at 16.8 and 31.8 μm.

Mixed Ca-Al oxides, e. g. hibonite ($CaAl_6O_{19}$) and grossite $CaAl_2O_4$, could be further candidates. There is, however, not yet sufficient spectral evidence to prove their existence.

A longstanding problem are circumstellar grains of Fe-oxides, which so far were indirectly supported by a conspicuous Fe underabundance in post-AGB stars. We now found a band centered at 19.5 μm in ISO-SWS spectra of AGB stars that exactly matches with Fe-rich magnesio-wuestite grains.

P 58

Nucleosynthesis Constraints from Gamma-Ray Line Observations

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Cosmic sites of nucleosynthesis produce radioactive by-products, the decay of which leads to gamma-ray line emission which can be observed with current telescopes. Among the seven candidate isotopes for such measurements, ^{26}Al (and ^{60}Fe) originate in diffuse interstellar space, superimposed from many individual sources; ^{56}Co gamma-rays from the ^{56}Ni decay chain are produced by supernovae of type Ia, and ^{44}Ti decay gamma-rays most likely by core collapse supernovae. Such gamma-ray line observations are more direct than, e. g., atomic transitions observed in X-rays, UV, or optical, because radioactive decay is independent of conditions in the post-nucleosynthesis environment such as density or temperature. On the other hand, gamma-ray telescopes have sensitivities of about 10^{-5} ph cm^{-2}s^{-1} and angular resolutions of $\simeq$ 1 degree, which limits diffuse emission studies to nearby (Galactic) nucleosynthesis, and supernova studies to distances less than $\simeq$10 Mpc.

The ^{26}Al mapping with COMPTEL shows the locations of Galactic nucleosynthesis over the past million years. It enlightens the interactions of groups of massive stars with their surrounding ISM, as shown specifically in the Cygnus and Orion regions. The ^{44}Ti measurements from the Cas A supernova remnant explore the inner processes of gravitational collapse, while hints and limits on the ^{56}Ni radioactivity from SN1991T and SN1998bu are

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Radioactive ^{26}Al in the Cygnus Region

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Gamma-ray emission from the radioactive aluminum isotope ^{26}Al has been mapped over the whole sky by the COMPTEL telescope aboard NASA's Compton Gamma-Ray Observatory.

This map shows a distribution of ^{26}Al consistent with its origin in regions where recent formation of massive stars took place.

One of these regions is Cygnus, our choice as a test case for our model of massive star associations, which is aimed mainly at the emission of radioactive isotopes and kinetic energy in stellar winds and supernova ejecta.

We present our models of gamma-ray emission from ^{26}Al in the Cygnus region, compare them with observations performed by COMPTEL over the course of its nine year mission and dicuss implications of this study on different scenarios for the star formation history in Cygnus.

P 60

Photometric and Proper Motion Studies of the Open Cluster NGC 7243

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NGC 7243, a sparse open star cluster located very close to the galactic plane, has been poorly investigated up to now. Its members are in number almost overwhelmed by the large amount of field stars.

We determined proper motions using the USNO-A2.0-Catalog as first epoch data and Johnson-BV CCD images as second epoch, obtained in 2001 with the 1m telescope at the Hoher List Observatory (Germany).

For membership determination we tried to fit two 2-dimensional Gaussians to the proper motion distribution of the cluster members and the field population simultaneously. This method failed due to the sparse cluster population in relation to the large abundance of field stars. Instead we used reduced proper motion diagrams as a combination of photometric and kinematic data to separate cluster members from field stars. Isochrone fitting on the obtained member population with 120 stars was performed and we determined an age of 160 Myr, a metallicity of $Z = 0.03$ and a distance of 900 pc. With the average proper motion of the cluster members and a literature radial velocity we were able to calculate the orbit of this open cluster using a galactic potential model. We obtained a typical thin disk orbit.

The IMF with a slope of $\Gamma = 1.9$ was derived from the upper main sequence, which is not contaminated by field stars. Due to the small amount of cluster members, the determined IMF is influenced by low number statistics.

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BVR Photometry of Old Open Clusters

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We present BVR photometry of the old and sparsely populated open clusters IC 4651, NGC 6134, NGC 6208, NGC 5823, and NGC 3496, which are little studied until present.

Deep CCD mosaic images were obtained using the MPG/ESO 2.2 m telescope and Wide Field Imager during two nights of observation. The observed targets are supposed to span an age range from 1 to 6 Gyrs.

We show colour-magnitude diagrams for the clusters, from which we derive distances, ages and reddenings. Our new values are, in part, considerably different from those in the literature. We are able to confirm the existence of all clusters except NGC 5823. Special emphasis is given to the identification of solar-like cluster members, i. e., main-sequence stars of spectral types F, G, and K.

This work is intended as a preparatory study for a future investigation of the evolution of stellar activity.

P 62

Fokker Planck Models of Rotating Clusters

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Recently a wealth of new observational data are being obtained with ground based (e. g. CFHT, Gebhardt et al. 2000) or space based (HST, King & Andersen 2001) modern telescopes on the internal motions in globular clusters. All results show that the time of 1D simple modelling has come to an end. The clusters, though not dominated by rotation, show significant rotational velocities, for which at least a 2D model is necessary. The only dynamical models available for rotating star-clusters have been obtained by Einsel & Spurzem (1999) using the numerical solution of an orbit-averaged 2D Fokker-Planck equation. We present a detailed set of models of rotating clusters using the method of Einsel & Spurzem (1999) and Kim et al. (2002). Evolution in time of energy, angular momentum, velocity dispersion, rotational velocity and ellipticity is simulated, in order to update the comparison-data with last observational measurements of these objects. This work is part of an ongoing project which will also provide dynamical evolutionary models of dense star clusters surrounding massive black holes with rotation. The results will be analysed and compared with future N-Body calculations and another studies of these rotating systems.
References
Einsel C., Spurzem R. 1999, MNRAS 302, 81
Gebhardt K., Pryor C., O'Connell R.D, Williams T.B., Hesser, J.E. 2000, AJ 119, 1268
Kim E., Einsel C., Lee H.M., Spurzem R., Lee M.G. 2002, MNRAS
King I.R., Anderson J. 2001, in S. Deiters et al. (eds), Dynamics of Star Clusters and the Milky Way, ASP Conf. Ser. 228, 19

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CN Abundance Variations on the Main Sequence of 47 Tuc

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We report on a deep spectroscopic survey for star-to-star CN variations along the main sequence (MS) of the globular cluster 47 Tuc with ESO's VLT. We find a significant bimodal distribution in the S(3839) index for main-sequence stars in the mass range of ~ 0.85 to 0.65 $M_{\odot}$, or from the main-sequence turn-off down to ~ 2.5 mag below the main sequence turn-off. This bimodality more than doubles with decreasing luminosity. A weak radial gradient in the distribution of CN-rich and CN-poor stars is found. An anti-correlation of CN and CH appears to be visible on the MS. The result is discussed in the context of the ability of faint MS stars to alter their surface composition through internal evolutionary effects. We argue against internal stellar evolution as the only origin for the abundance spread in 47 Tuc; an external origin such as pollution seems to be more likely.

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The Tidal Tails of Palomar 5: New Observational Results

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Deep wide-field multi-band photometry from the Sloan Digital Sky Survey (SDSS) shows that the Galactic globular cluster Palomar 5 is accompanied by a massive stream of debris. This stream provides impressive direct evidence for the ongoing tidal disruption of this cluster. The first clear detection of tidal debris from Pal 5 came from data obtained during the commissioning of the SDSS (Odenkirchen et al. 2001, ApJ 548, L165; Rockosi et al. 2002, AJ 124, 349). Meanwhile, the Sloan survey covers a much larger field around Pal 5 and thus allows an extended search for tidal debris. Our analysis of the new dataset reveals that the tidal tails of Pal 5 extend over an arc of at least 10° on the sky, with a projected FWHM of only 21′. This corresponds to a length of at least 4 kpc and a projected width of about 140 pc in the Galactic halo. The stellar mass visible in these long narrow tails adds up to 1.3× the mass of stars in the cluster. Pal 5 is the first globular cluster to exhibit such a well-defined halo stream and hence the best known example of a tidally disrupting cluster. The tidal stream of Pal 5 provides unique traces of the cluster's local orbit. We present a map of the distribution of tidal debris, determine its surface density profile, show a model of the cluster's global Galactic orbit, and derive an estimate of the mass loss rate based on the mass and geometry of the tails and on the orbit.

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The Mass Function of the Globular Cluster Palomar 5 and Its Tidal Tails

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Palomar 5 is a sparse globular cluster in the Galactic halo that is currently being torn apart by the tidal forces of the Milky Way. In a separate study, we discovered two massive tidal streams emanating from the cluster (Odenkirchen et al. 2001).

We are now investigating whether predominantly low-mass stars were removed from the cluster as would be expected if the cluster is experiencing mass segregation, or whether the stellar mass function in the tidal tails and in the cluster are comparable. For this purpose we obtained deep imaging data with the Wide Field Imager at the MPG/ESO 2.2 m telescope at La Silla. Our individual frames have a limiting magnitude of 23.5 mag in V, which we will extend to fainter magnitudes by stacking multiple exposures. We will present the main sequence luminosity function (MSLF) of the cluster's main body and compare it to that of a portion of the northern tail located 50′ northeast of the center. Our preliminary results indicate that the mass function of the cluster itself exhibits the expected degree of flattening due to its advanced dynamical evolution. Yet we find no evidence of mass segregation in terms of an enhanced number of faint stars in the MSLF of the off-center field. We conclude that though mass loss played a major role in the dynamical evolution of Palomar 5, the effects of mass segregation through energy equipartition appear to be negligible.

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To Be or Not To Be a Late Hot Flasher

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The globular clusters ω Cen and NGC 2808 show a population of extremely hot horizontal branch stars, that cannot be explained by canonical stellar evolution. Such stars show up in UV observations of these clusters as stars below the zero-age horizontal branch ("blue hook" stars) and populate the blue tail below $M_V \approx 5$ in visual colour-magnitude diagrams. Stars which suffer unusually large mass loss on the red giant branch and thus experience the helium core flash while descending the white dwarf cooling curve could populate this region. Theory predicts that such "late hot flashers" should show higher temperatures than the hottest canonical HB stars and should have helium- and carbon-rich atmospheres. We obtained and analysed medium resolution spectra of such "late hot flasher" candidates both in ω Cen and NGC 2808 and will present and discuss the results of our spectroscopic analyses.

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The KOSMA Large-scale mm- and Submm CO Survey of Clouds in the Galactic Molecular Ring

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We present the current status and first results of the KOSMA large-scale observations of clouds in the Galactic Molecular Ring (GMR) in CO J = 3–2, CO J = 2–1 and ^{13}CO J = 2–1 following up the BU-FCRAO ^{13}CO 1–0 Galactic Ring survey (Simon, R. et al. 2001). Observations of the 2–1 and 3–2 CO transitions traces the dense and warm molecular material along the lines of sight, since their critical densities and upper level excitation temperatures reach 10^4 cm^{-3} and 33 K. Observations of these lines thus allow to distinguish between extended, quiescent gas and localized regions, influenced by star formation.

The Milky Way Galaxy is known to be a spiral barred galaxy with a prominent ring midway to the Galactic center. Ringed disk galaxies are an important subgroup of the barred spiral galaxy population. Rings are thought to form by gas accumulation at resonances, under the continuous action of gravity torques from the bar pattern. The GMR is known for its high star formation rate. To study the excitation conditions and their variations in the GMR we started an ongoing low-J CO survey of clouds in the GMR with the KOSMA 3 m telescope. At present, we have observed an 1350 arcmin^2 area at 2′ resolution. It shows one high-mass-star forming cloud at the edge of the GMR in 6.0 kpc distance to the observer. In addition, the selected region shows an intervening quiescent cloud at a distance to the observer of 1.8 kpc. This study thus allows to compare different parts of the Milky Way simultaneously along the line of sight.

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The Gaseous Arms of the Magellanic System

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The LMC, SMC, and the Milky Way are a spectacular set of interacting galaxies with gaseous arms that protrude from the Magellanic Clouds covering a large part of the southern sky. The proximity of these arms make them a highly suitable object for a detailed investigation of an interacting galaxy system.

We present results from the Parkes narrow-band H I survey of the entire Magellanic System. This survey uses the central seven beams of the Parkes multi-beam facility offering an angular resolution of 14′. Our survey comprises full sampling and high velocity resolution ($\Delta v = 0.8$ km s^{-1}). Both are necessary for a detailed analysis of the dynamical evolution of the gaseous tidal arms, i. e. the Magellanic Bridge, the Magellanic Stream, and the Leading Arm. The data show significant differences between clouds in the Magellanic Stream and in the Leading Arm in the column density distribution and in the shapes of the line profiles. Clouds in the Leading Arm show quite often two gas phases in form of a low and a high velocity dispersion component. Clouds forming a so-called head-tail structure indicate an interaction with their ambient medium.

We performed follow-up observations of a number of individual clouds spread over the extent of the gaseous features using the ATCA interferometer ($\approx 1'$ resolution). These data revealed small-scale structure down to the angular resolution limit and proved the existence of cold ($T_{Kin} < 150$ K) and dense condensations within the Magellanic Stream and the Leading Arm.

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The Large-Scale Structure of the Sextans Dwarf Galaxy from Sloan Digital Sky Survey Imaging Data

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We present a study of the large-scale structure of the dwarf spheroidal galaxy Sextans, a Milky Way satellite at a distance of ~ 86 kpc, using imaging data from the Sloan Digital Sky Survey (SDSS). We find the overall distribution of stars to be approximately ellipsoidal with a mean eccentricity of 0.35. The radial stellar density profile is well fit by a King profile over three orders of magnitude. The King profile has a concentration parameter of 0.98 and yields a limiting radius of 160′ in good agreement with earlier studies. There is no evidence for the existence of a pronounced extratidal component around Sextans. The spatial distribution of stars within this low-density galaxy is slightly asymmetric and shows a slight density enhancement on the southern and south-western part. These findings stand in contrast to our recent SDSS study of the nearby dwarf spheroidal galaxy Draco, which we found to have a very regular and symmetric structure and to be 40 % more extended than previously thought (Odenkirchen et al. 2001).

The red horizontal branch stars in Sextans are more strongly centrally concentrated than the extended distribution of blue horizontal branch stars, confirming the population gradient we found earlier within a smaller field centered on Sextans (Harbeck et al. 2001).

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A New Extremely Metal-Poor Galaxy Discovered in the Sloan Digital Sky Survey

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The SDSS spectroscopic database, which will ultimately contain spectra of one million galaxies, provides an ideal resource for searches for extremely low-metallicity galaxies. We analyzed 135,000 galaxy spectra to calculate oxygen abundances. We used only spectra in which the [OIII] 4363 Å line was detected. Among this vast number of galaxies, we discovered only one new extremely metal-poor galaxy: SDSS J0519+0007. It has an oxygen abundance of only $12+\log(\mathrm{O/H}) = 7.45 \pm 0.02$ or 1/30 of our Sun. This makes it the sixth galaxy in the short list of very metal-poor galaxies, and the first one discovered with SDSS data. We derived abundances of O, Ne, Ar, N, S, and He for SDSS J0519+0007. Abundance ratios for α-elements for this galaxy are in good agreement with the mean values for other very metal-deficient blue compact galaxies (except for nitrogen). The broad low-contrast component in the Hα emission line indicates the presence of fast motions in this galaxy. We also detect the characteristic blue bump, a signature of Wolf-Rayet stars, in the SDSS spectrum. SDSS J0519+0007 is a new low-metallicity dwarf galaxy with a luminosity of $M_B \sim -18.5$ mag (redshift 0.044). This is more than 3 mag brighter than any previously known galaxy of such low metallicity and indicates that such objects may span a total range of luminosities of more than 6 magnitudes.

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Search for Low Surface Brightness Galaxies with SDSS Imaging Data

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We explore the possibility to use imaging data from the Sloan Digital Sky Survey (SDSS) to search for low-surface-brightness (LSB) galaxies. To deal with the SDSS data most effectively a new photometry software was created. We present results based on our new selection algorithms for a test sample of 92 LSB galaxies from Impey et al. (1996), which are distributed over 93 fields in the SDSS Early Data Release (EDR). The total area covered by these fields is 3 square degrees. 87 of 92 test sample galaxies were recovered, implying a detection rate of $\sim 94.5\,\%$. Furthermore, 32 new LSB galaxies were detected by our algorithms in these EDR fields (i. e., $\sim$35 % additional objects). Using SDSS data we can detect LSB galaxies as faint as $\mu_0(g) = 26$ mag acrsec^{-2}.

P 72

The First Star Formation Epoch and High Redshift Quasars

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Quasars are among the most luminous objects in the universe. Hence, they can be observed in detail up to the highest redshifts. Assuming that the gas associated with quasars is closely related to their host galaxy, they can be used to trace star formation history and to probe the conditions of the early universe.

The chemical composition of the interstellar medium depends on the stellar processes and the corresponding evolutionary time scales of the dominant sources for the release of individual elements. α-elements, e. g. O, Ne, Mg, Si, produced predominantly in high mass stars on short time scales ($\sim 10^7$ yrs). Although SN II ejecta may contribute modestly to the iron abundance it is generally believed that the main source of iron is given by SN Ia explosions. The significantly longer time scale of the evolution of SN Ia progenitors results in an iron enrichment delay of ~ 1 Gyr with respect to α-elements. Because this delay does not depend on any of the evolution time scales (e. g., the star formation rate), it can serve as an absolute *clock* for dating the age of stellar populations.

We observed high redshift quasars ($3.5 \lesssim z \lesssim 5$) in the near infrared to measure the strength of rest-frame ultraviolet iron emission features. The line ratio FeII/MgII2798 is a valuable indicator of the Fe/α-element ratio in quasars. The relative strength of the iron emission will be compared with results obtained for local quasar populations. A measurement of high Fe/α-element abundances would suggest that the first substantial star formation epoch occured $\lesssim 1$ Gyr prior to $z \simeq 4$, i. e., at least at $z_f \simeq 10$. A result for low Fe/α-element, on the other hand, would suggest that the stellar populations are young, although we could not rule out the possibility that the IMF is peculiar in the early universe.

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Design and Status of the MPE Fast Timing Photo-Polarimeter OPTIMA

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Cosmic high-energy sources are often characterized by extremely fast variations in wide spectral bands. Relativistic particle populations in strong electro-magnetic fields and high temperature plasmas generate primarily X- and γ-ray photons. Optical radiation from these sources can be closely related to the high energy processes and is readily observed from the ground. For this multiwavelength extension of our studies of high energy sources into the optical range we have built a sensitive, portable high-speed photometer called OPTIMA ("Optical Pulsar Timing Analyzer").

OPTIMA is based on a set of single photon sensitive counters (avalanche photodiodes, APD) which are coupled to astronomical targets with an array of optical fibers embedded in the focal plane of large telescopes. APDs have quantum efficiencies exceeding 50 % in the range 450–950 nm. A GPS timing receiver, a CCD camera for target acquisition and stand-alone PC control units complete the instrument. Single photons can be recorded with an absolute timing accuracy of ~ 2 μs. Recently a rotating polarisation filter and a prism spectrograph that allows to simultaneously record photons in 4-color bands, have been added as optional equipment. The polarimeter has been verified in Crab pulsar observations; the spectrograph has been tested in May 2002 on selected sources. OPTIMA has so far been used on the 1.3 m telescope (Skinakas), on the 3.5 m telescope (CAHA) and in the southern hemisphere (74 in. Mt. Stromlo, 2.2 m La Silla).

P 74

HEGRA CT1 Observations of 3C 273 and 3C 279 in 1999 and 2000 as Part of MWL Campaigns

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Contemporaneous multiwavelength observations (radio to gamma-ray energies) of the gamma-ray blazars 3C 273 ($z = 0.1583$) and 3C 279 ($z = 0.538$) have been carried out in early 1999 and again in early 2000 by a variety of instruments. At high energies the Rossi X-ray Timing Explorer (RXTE), covering the 2–20 keV band, the experiments aboard the Compton Gamma-Ray Observatory (CGRO), covering energies between 50 keV and 10 GeV, and, in particular, the HEGRA CT1 Cherenkov telescope partcipated measuring in the band between 1 and 10 TeV.

The HEGRA CT1 observations for both sources and both periods yielded upper limits such that νF_ν(TeV) lies well below the values found at lower energies.

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The TeV Spectrum and Lightcurve of Mkn 421 in 1999/2000 as Observed with the HEGRA Cherenkov Telescope CT1

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The HEGRA collaboration has observed Mkn 421 in 1999/2000 for more than 200 hours, partly during moonshine.

Although Mkn 421 was not as active in 1999–2000 as it was in 2001, some strong flares have been observed. The lightcurve and the spectrum are presented. Some further investigations regarding variable spectral indices from the combined data of 1999–2000 and of 2001 will also be shown.

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Upper Limit for the Dust-enshrouded Star Formation Rate in the Universe

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The measurement of gamma-ray absorption can be used to probe star formation and cosmological parameters. An upper limit on the dust-enshrouded, global star formation rate (SFR) is derived for two different cosmologies. We find a value of 0.5 $M_{\odot}yr^{-1}Mpc^{-3}$ (SCDM) and 0.4 $M_{\odot}yr^{-1}Mpc^{-3}$ (λCDM). This method can be used in the future to determine the total SFR, if more gamma-sources at higher redshifts will be detected in the near future by the 2nd generation of IACTs (MAGIC, HESS, Cangaroo and Veritas).

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VLT NIR and Optical Iimages of Hot Spots in Radio Galaxies

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Hot spots at the ends of the lobes of powerful radio galaxies mark the "working surface" of supersonic jets in which their kinetic energy is believed to be dissipated into the acceleration of relativistic particles. The mere fact that optical hot spot emission is detected at all in large radio galaxies directly proves that relativistic electrons in the radio hot spots are accelerated by Fermi-I acceleration processes in a strong shock. The search for optical emission from hot spots has a long history but up to now only very few hot spots with optical synchrotron radiation have been detected.

We have embarked on a project to search for optical hot spot emission with the VLT. We present the first results of ISAAC NIR and FORSI optical imaging which detected optical synchrotron emission with a success rate of some 70 % (6/9). We display the high-resolution radio maps of the hot spots in our sample along with their NIR/optical counterparts. The optical images have been obtained with a typical seeing of $< 0\farcs6$.

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On the Decline in the Comoving Density of Quasars between $z = 2$ and $z = 4$

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We compiled a complete sample of 13 optically bright radio-loud quasars with $3.9 < z < 4.5$ by cross-correlating the FIRST and the APM surveys. For this sample we derived a comoving space density of $\rho = 0.74 \pm 0.19$ Gpc^{-3}. Comparison with a sample of equally luminous radio-loud quasars from the FIRST Bright Quasar Survey, at $z \approx 2$, shows a drop by a factor of 2 ± 0.7 in comoving space density from $z = 2$ to $z = 4$.

From a new accurate measurement of the radio-loud fraction of quasars we calculated the total space density of quasars with $M_{AB}(1450) < -27^m$ to be $\rho = 6.4 \pm 1.6$ Gpc^{-3}. By comparison with the comoving space density at $z = 2$ of the 2dF quasar survey, at the same optical luminosity, we find a ratio of 2.8 ± 0.8, fully consistent with that of the radio-loud quasars, but significantly different from the generally quoted ratio ≥ 10. Since our quasar sample includes the higher optical luminosities, we argue that the decline of

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Discovery of High Faraday Rotation Measures in Giant Radio Galaxies

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We report Rotation Measure (RM) estimates of five Giant Radio Galaxies (GRGs) observed by Mack et al. (1997, A&A 123, 423). GRGs are radio galaxies with projected linear sizes exceeding 1 Mpc. In four GRGs (NGC 315, DA 240, 3C 236 and NGC 6251), we found $|\mathrm{RM}| > 100\,\mathrm{rad/m^2}$ after the correction for the galactic foreground contribution.

In three well-resolved GRGs (NGC 315, DA 240 and NGC 6251), the product $\langle \overline{B_\parallel} \cdot n_e \rangle \approx 10^{-3} \mu\mathrm{G\,cm^{-3}}$. Assuming pressure balance between the magnetic and the gas pressure, $p_m/p_g = 1$, and a single-cell Faraday medium model, we derive magnetic field strengths of a few μG and a thermal electron density of a few $10^{-4}\,\mathrm{cm^{-3}}$. These densities are one or two orders of magnitude higher than the extrapolation from the X-ray halo of NGC 315 (Worrall & Birkinshaw 2000, ApJ 530, 719).

The relatively high particle density in the extended lobes along with the weak X-ray emission make the gravitational binding of the Faraday medium around GRGs and the gravitation-related amplification (merger, cooling flow) of the magnetic field unlikely.

An alternative could be the inter-cluster 'weather' (Burns 1998, Sci 280, 400). In the case of NGC 315, we can compare the magnetic energy and the energy from the large-scale flow (Enßlin et al. 2001, ApJL 549, 39). The total magnetic energy contained in the RM structure of NGC 315 can be explained if such a flow has a time scale of 10^8 yr.

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New ROSAT Detections of Brown Dwarfs and VLM Stars in Chamaeleon I

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We report on 12 new X-ray detections of brown dwarfs and very low-mass stars (spectral types M4 to M7), which had been identified in a recent optical survey of the Chamaeleon I cloud. Thereby we roughly double the sample studied by Comerón et al. (2000). Our 12 new X-ray detections represent about 16 % of our optical sources in the region covered by ROSAT pointed observations. Most of these objects are only detected in the hard band (0.5 to 2.0 keV), in agreement with them being young. Our results show no obvious decrease of the X-ray emission with the spectral type down to M7. Thus, young brown dwarfs seem to be as active as very low-mass stars of similar age. No significant correlation is found between X-ray emission and Hα emission. We conclude that the latter must be dominated by the accretion processes taking place in such young objects. Better understanding of magnetic activity in young brown dwarfs will be achieved with the results of our recent XMM-Newton observations in Cha I.

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X-ray Analysis of the Interstellar Medium Towards the Northern Polar Cap

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We present a correlation analysis of the ROSAT all-sky survey and the Leiden/Dwingeloo H I 21-cm line survey covering the half northern polar cap ($l = 90° \ldots 270°, b = 45° \ldots 90°$).

The Galactic interstellar medium is most transparent for soft X-ray emission at high Galactic latitudes. Therefore we focus our analysis on the above-mentioned sky region. Moreover, the H I data allow unique clues on the column density and velocity distribution of the neutral X-ray absorbing gas. We only sample the local interstellar medium away from any velocity crowding common in Galactic plane fields. Accordingly, the northern polar cap is the ideal region to study the composition of the X-ray emitting and absorbing interstellar medium in great detail.

Our analysis reveals that the coronal gas within the Milky Way halo has a smooth intensity distribution. At the Galactic anti-center the X-ray halo intensity reaches its minimum and increases towards higher and lower longitudes. This center/anti-center asymmetry is most significantly observed in the ROSAT 3/4 keV energy band. This suggest that most of the observed diffuse 3/4 keV X-ray emission originates from a hot plasma within the Milky Way halo ($T \simeq 10^{6.2}$ K). Moreover, we show that coherent large scale H I filaments (tens of degrees) are observable towards the northern polar cap. These filaments are detected as soft X-ray absorption features. Analysing the X-ray emission in the different X-ray energy bands towards these filaments allows to disentangle the contribution of the Local Hot Bubble emission from that of the Milky Way Halo.

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XMM Newton Observations of Quasar 3C 273

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We present preliminary results of several X-ray observations of the quasar 3C 273 from 2000 June and 2001 December using the EPIC instrument on ESA's XMM-*Newton*. We discuss small differences in the spectra obtained with the three EPIC detectors (MOS1, MOS2, PN) as predicted by cross calibration. One simultaneous observation using NASA's *Rossi X-ray Timing Explorer* (PCA) enables the comparison of the high energy part (3–10 keV) of the spectra with an independent instrument.

X-ray spectra of quasars often show a "soft excess" of flux compared to the extrapolation of the relatively flat power law that fit the spectra at energies above 2 keV.

The quasar 3C 273 provides an excellent candidate because of its low redshift ($z = 0.158$) and its high flux in X-rays. 3C 273 also shows a variable Fe-Kα line. Previous observations found this line to be narrow (Grandi et al. 1997), broad (Yaqoob & Serlemitsos 2000), or not detectable.

Different models suggested by previous observations to describe the soft excess in the continuum spectrum are discussed. There is no significant detection of an Fe-line (upper limit of EW $\sim$ 70 eV for a narrow line). We provide upper limits for a broad or narrow Fe-line.

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A Window to the Galactic X-ray Halo: Modeling the Galactic X-ray Emission towards the Lockman Area

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We present an analysis of the soft X-ray background radiation towards the Lockman window using ROSAT all-sky survey data. The Lockman window is known as the region with the lowest neutral atomic hydrogen column density in the northern hemisphere.

We correlate the ROSAT all-sky survey (1/4 keV and 3/4 keV energy bands) with the Leiden/Dwingeloo survey (Galactic H I 21-cm line emission) in order to model the soft X-ray background by using radiation transfer calculation. This is done for both energy bands across an area of $60° \times 60°$, including the Lockman window.

For the Lockman window it turns out, that a significant fraction (up to 50 %) of the X-ray absorbing material is not entirely traced by the H I. An explanation for this result might be, that towards the Lockman window a significant fraction of the neutral atomic hydrogen has been ionized. A possible reason for the ionization itself could be a high-velocity cloud, which is located close to the Lockman window.

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A Deep XMM/EPIC Image of the Star Forming Region NGC 1333

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We present the results of a deep (50 ksec) XMM/EPIC observation of the of the highly active star forming region NGC 1333. Most of the young stellar objects in NGC 1333 are still deeply embedded in the molecular cloud ($A_V \sim 5 - 30$ mag).

In the XMM images we detect more than 60 X-ray sources, most of which can be identified with embedded young stellar objects. We discuss the spectral properties and the lightcurves of the sources. We also compare our XMM data with the results of a deep Chandra/ACIS observation of NGC 1333. Despite its higher sensitivity, especially for hard X-rays, XMM reveals only a single X-ray source not seen by Chandra.

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Deep XMM-Observation of the Marano Field

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The Marano Field is an area in the southern sky which was extensively studied in different wavelength. In the optical, multicolor imaging, slitless and slit spectroscopy, and variability studies were performed. In the X-rays the field was observed with *ROSAT* for a total of ≈ 60 ksec integration time, and in the radio band the region was surveyed with the *ATCA* at 1.4 and 2.4 GHz. Including the recently performed *ISO* observation and our *XMM-Newton* deep pointing, it is one of the best studied regions of the sky at all wavelengths. We present new results of our deep (≈ 100 ksec) *XMM-Newton* observation of the Marano Field including source field statistics with improved fluxes, hardness ratios and first classifications. In addition we cross-correlated the optical, radio and X-ray catalogues and calculated broadband indices to further improve source classification.

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X- and γ-ray correlation studies of the blazars 3C273 and 3C279

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The study of Active Galactic Nuclei (AGN), which are the most powerful objects known in the universe, has become an important part of astrophysics during the last few decades. As new and improved telescopes provide data in all energy bands from the radio to gamma-rays, multiwavelength studies are a powerful tool to give new insights into AGN physics.

Our work focuses on the high energy end of the spectrum. For our sample of five AGN (PKS 0528+134, PKS 1622–297, 3C273, 3C279 and Mrk421), all simultaneously observed data, which was availible for the years 1996 to 2000 from the X-ray experiment RXTE and the gamma-telescopes COMPTEL and EGRET abord the Compton Gamma Ray Observatory (CGRO), was analysed and examined for correlation. On the one hand, it is tested whether the flux and the photon index are correlated for the XTE data as well as for the EGRET data in order to see if a flare in the X- or gamma-rays goes together with a significant spectral hardening or softening in that energy regime. On the other hand it is examined if there is a correlation between the fluxes of the three different energy regimes, as this is an indication whether the emission processes are related to each other.

This poster presents the lightcurves in the high energy ranges and the findings of our correlation analyses for the blazars 3C273 and 3C279.

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Galaxy Populations in the Infall Regions of $z \approx 0.25$ Clusters

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We present first results from a project to study the transformation of galaxies as they fall into the cluster environment. For each cluster, we investigate the galaxy populations in all environments – from the densest central regions, through smaller, infalling groups, to the uninfluenced field population. For this purpose we have conducted a large observational campaign with MOSCA at the Calar Alto observatory in spring 2002 to gain low-resolution spectra of galaxies in 3 sky regions. Each field was selected to contain 2 clusters at $z = 0.2-0.3$ from the coincident optical and X-ray survey, XDCS (Gilbank, PhD thesis 2001), with V and I data from the WFC on the INT, La Palma, and deep ROSAT PSPC X-ray imaging. The clusters cover a range of X-ray luminosities ($L_{x,\mathrm{bol}} = 0.2 - 1.2 \times 10^{44}$ erg/s, LCDM). The size of an individual field is $\approx 40' \times 40'$ (covering ~ 4 virial radii per cluster). Each field was observed with 7–8 masks yielding a total of 553 spectra of galaxies. Integration times ranged from 1 h to 3 h per mask (> 5 nights).

The spectroscopy provides us with redshifts to build up a picture of the large-scale structure around the clusters in 3 dimensions. Spectral line analyses (mainly from the measurement of the equivalent width of [O II]3727, in parts of Hδ or Hα) allows us to determine the evolutionary status of the individual galaxies (passive, normal starforming, starburst or post-starburst galaxy). In conjunction with our photometry and in comparison to the latest models of stellar populations, we are thus able to quantify the role of the environment in determining a galaxy's star-formation history.

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Warps and Rotation Curves in Edge-On Galaxies

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We present our investigation on the effect of warps on the extraction of rotation curves in edge-on galaxies. The method to derive the rotation curve from the position-velocity diagram in warped edge-on systems yields underestimated velocities, and the tilted-ring model is not reliable in highly inclined, poorly resolved galaxies. In a warped system the kinematical major axis is different from the optical major axis. While this is generally a limit in optical slit spectroscopy, in the HI emission which extends far from the optical body where self-gravity is weaker and the effect of warping is more pronounced, this represents a severe effect to be considered in the procedure to extract the rotation curve. We propose a new approach to extract the rotation curve in highly inclined, warped galaxies, called *WArped Modified Envelope Tracing* (WAMET) method. We suggest to trace the points along the ridge of the warp fitting a Gaussian distribution parallel to the minor axes of the HI total intensity distribution, as outlined by García-Ruiz et al. (2002, A&A in press). Then, with this spatial information we derive the rotation curve and the P. A. at each radius from the centre, fitting half a Gaussian to the edge of the H I profiles at the positions localized not along a fixed axis, but rather along the ridge of the warp. The other kinematical parameters (centre, systemic velocity, inclination) were obtained by minimizing the residual velocity field, which was obtained by subtracting the model from the observed velocity field. Based on this new approach, we are able to accurately trace reliable rotation curves using all the information contained in the 3D spectroscopic data.

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The Supersoft Symbiotic Nova RX J0048.4–7332 in the SMC

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The Small Magellanic Cloud symbiotic nova SMC 3 (= RX J0048.4–7332) had an outburst between December 1980 and December 1981. During ROSAT all-sky-survey observations performed in October 1990 the nova has been detected as a supersoft X-ray source. The nova which is most likely in a state of steady nuclear burning has been followed up during ROSAT PSPC and HRI observations performed from October 1991 till November 1996. This is therefore the first symbiotic nova for which a supersoft X-ray light curve has been measured which extends over ∼6 years. The X-ray light curve shows a pronouced X-ray dip. A likely physical mechanism which causes the X-ray variability will be discussed. Making use of these archival ROSAT observations and taking additional information into account the nature and evolution of this SMC symbiotic nova will be discussed.

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Detailed Galactic Wind Models for the Starburst Galaxies M82 and NGC 253

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Starburst galaxies are important astrophysical laboratories to study the connection between the star formation rate and galactic outflow parameters, such as velocity and mass loss rate, respectively. However, the ISM that is blown away in a starburst is a multiphase and multi-component medium, including in particular cosmic rays and magnetic fields. Very few previous models have taken this into account. We have started a project, investigating the time-dependent evolution of galactic winds, driven by thermal plasma, cosmic rays and MHD waves, subject to a realistic magnetic field geometry.

In order to simulate realistic cases, such as the nearby edge-on galaxies M82 and NGC 253, we have included a detailed modeling of the injection of gas and particles using the publicly available STARBURST99 code. Here boundary conditions, such as e. g. duration and initial mass function determine the physical and chemical state at the base of the outflow. Our time-dependent galactic wind simulations show that a substantial fration of the ISM in the starburst region is blown away. Typical wind velocities range between $500 - 800$ km/s for NGC 253 and $800 - 1000$ km/s for M82. Especially in the more violent latter case, mass loss rates of up to $40\,M_\odot$/yr are achieved. Another interesting result is that due to time-variations in the starburst, shocks are propagating through the outflow region, thereby accelerating cosmic ray particles up to several 10^{16} eV. Implications for observations of the outflowing gas and the energetic particles will be discussed in detail.

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The Progenitors of Dwarf Spheroidal Galaxies

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The gas-deficient dwarf spheroidal (dSph) galaxies are an evolutionary puzzle that we explore in early-type and late-type dwarfs in the Local Group and in the nearby field. Consistent stellar metallicity estimates from red giant branches are derived and are combined with high sensitivity H I 21-cm line data from the literature. Although dSphs experienced star formation over extended time spans in their youths, today all but one are completely free of detectable interstellar material, even in cases like Fornax, where stars formed in the last hundred million years. We confirm the well-established offset in luminosity-metallicity relationships for dSphs and dwarf irregular (dIrr) galaxies: dSphs have higher mean stellar metallicities for a fixed optical luminosity. This difference is consistent with more vigorous star formation in younger dSphs than in the youthful dIrrs. Luminosity-metallicity correlations allow us to identify galaxies whose older stellar populations resemble those of dSphs: "transition-type dwarfs", which have mixed dIrr/dSph morphologies, low stellar masses, and H I contents of at most a few 10^6 $M_\odot$. Unlike dIrrs, transition-type dwarfs would closely resemble dSphs if their gas were removed, as required to become a dSph; they are likely dSph progenitors. Among possible gas removal processes, internal mechanisms are found to be inadequate; ram pressure stripping is favored (e. g., through a clumpy intergalactic medium) to clean the bulk of interstellar matter from dSphs. Thus dSph galaxies arise from a combination of rapid early evolution and the effectiveness of gas removal. In this model true field dSphs should be very rare, but their dSph/dIrr equivalents may be relatively common.

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Does Morphological and Radial Velocity Dependence Exist Concerning Galaxy Orientations?

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We present an analysis of the orientations of 5398 LSC galaxies having radial velocities less than 3000 km s^{-1}.

A strong morphological dependence is noticed concerning galaxy orientations. It is found that the spin vector orientations of early-type spiral galaxies in the LSC tend to orient perpendicular to the LSC plane whereas the late-type spirals show a bimodal tendency. The spin vectors of early-type SB galaxies in the LSC tend to be inclined with 45° to the LSC plane whereas the late-type SB galaxies tend to orient perpendicular to the LSC plane. In the azimuthal angle distribution, spiral galaxies show isotropy whereas the SB and irregular give anisotropy. Isotropy is found in the polar angle distribution of S0, SB and irregular galaxies in the LSC. The projections of the spin vectors of SB and irregular galaxies in the LSC tend to point towards the LSC center. The S0 galaxies show a bimodal tendency in the azimuthal angle distribution. Our results suggest that the origin of spirals and S0 might be different.

No preferred orientation can be seen when investigating low and high radial velocity LSC galaxies in the polar angle distributions. In the azimuthal angle distribution, low radial velocity galaxies (RV $<$ 1500 km s^{-1}) in the LSC show a bimodal orientation whereas the high radial velocity LSC galaxies (RV $>$ 2500 km s^{-1}) show their spin vectors projections tend to point perpendicular to the LSC center.

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How Old are the Oldest Age-dateable Populations in Dwarf Galaxies?

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While Population III stars have yet to be detected in dwarf galaxies, the oldest populations that we can reliably detect belong to Population II. In order to be detectable and to allow us to age-date them, they need to be sufficiently numerous to produce observable main-sequence turn-offs. I. e., we cannot at present age-date individual old stars in dwarf galaxies. For old populations as a whole, we can carry out differential age dating by comparing them to the oldest known globular clusters in the Galactic halo and bulge. Interestingly, every dwarf galaxy studied to date in sufficient depth and resolution exhibits an old population as indicated by the detection of horizontal branch stars (including RR Lyrae variables) or even an old main sequence turn-off. At least among the nearby dwarf galaxy sample there is no evidence for galaxies whose first episode of star formation occurred only recently. Moreover, a careful comparison of differential age tracers indicates that in the majority of cases the first measurable epoch of star formation started at the same time as in the oldest Galactic globular clusters. Thus within the measurement accuracy, most of these nearby dwarfs share a common episode of ancient star formation with the Milky Way.

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Chemical Abundances of Southern Dwarf Galaxies in Nearby Groups and the Field

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As part of an ongoing survey of dwarf galaxies within the Local Volume (< 5 Mpc), extensive photometric and spectroscopic observations are being conducted with the HST and ground-based telescopes. New optical spectroscopic data at CTIO have been obtained of H II regions in 17 southern dwarf irregular galaxies, including those in the Centaurus A group, the Sculptor group, the Local Group, and the field. A majority of the dwarfs are metal-poor with oxygen abundances, $12 + \log(\mathrm{O/H})$, in the range between 7.4 and 8.0 (approximately 3 % to 10 % of solar). However, two of the dwarf galaxies appear to be metal-rich (about 60 % of solar) and may be nearby examples of dwarf spirals.

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Search for and Study of Extremely Metal-deficient Galaxies

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Exremely metal-deficient (XMD) gas-rich galaxies (conditionally with $12+\log(\mathrm{O/H}) < 7.65$), are very rare objects in Local Universe. They are the best approximation of the properties of young galaxies formed ~10–15 Gyr ago. Their study gives us the hints on the processes taking place in the galaxy formation epoch. Since real young galaxies at large look-back times are too faint and too distant to be studied in detail, their local cousins provide valuable information on the complex process of galaxy formation and early evolution. Moreover, some of XMD gas-rich galaxies may be truly young local galaxies, just recently past the phase of protogalaxy. They can be real around-the-corner laboratories for studies of galaxies in formation.

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Spectral Analysis of four Water-megamaser Galaxies: Rotation-curves, Emission-line Profiles and Ratios

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Despite deliberate searches, H_2O megamaser sources have only been found in about two dozen of active galactic nuclei. They may arise in the innermost torus of molecular gas, possibly exited by the AGN X-ray source, or could be induced by strong jets. In order to uncover the particular geometry of AGN with megamaser activity in comparison to normal AGN, we analyzed optical spectra of the megamaser galaxies NGC 5506, IC 1481, ESO 103-G035, and TXS 2226-184. We present rotation-curves, profiles and intensity ratios of various emission lines. Line profiles of [N II], [S II], [O I] as well as of Hα and Hβ have been decomposed in order to isolate outflowing gas systems from rotating disks. We draw inferences on the geometry of the emission-line regions and discuss the relationship to the excitation of the megamaser sources.

P 97

Interaction and Activity in CGs: A Newly Identified Group in the Zone of Avoidance

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Close pairs and/or multiple systems of galaxies have been selected from the Innsbruck database of ZoA galaxies and observed by means of optical photometry in the framework of a project devoted to evaluate the total foreground Galactic extinction at low galactic latitudes. A spectroscopic follow-up of these selected systems, whose properties are still widely unknown, allowed to identify those physically bound. We have discovered in this way a new group of galaxies, CG J0247+44.9 ($l = 143°.64$, $b = -13°.29$), which satisfies the Hickson's criteria for Compact Groups (CGs). Our group consists of six members out of which a close interacting pair, IRAS 02443+4437, comprised of an early-type galaxy and a starbursting spiral both showing strong morphological distortions. Among the other members we have identified another early-type galaxy and three spirals whose emission-line spectra are typical of a Seyfert 2, a LINER and a weak H II galaxy, respectively. None of these four additional members show clear morphological signs of recent interaction. The group is located at a median distance of 156.4 Mpc ($H_0 = 75$ km s^{-1} Mpc^{-1}), and the centers of its members are contained into a circle of radius 120 kpc. The relatively high velocity dispersion of the group, $\sigma = 458$ km s^{-1}, combined with the low fraction of gas-rich members and the low estimated crossing time ($H_0 t_c = 0.016$) would suggest that the group is dynamically old.
(Based on data obtained at Calar Alto (Spain) and Asiago (Italy) Observatories.)

P 98

Search for Galaxy Alignment in the Virgo Cluster by Investigating Rotational Curves and Axes

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Based on the famous Virgo Cluster catalog by Bingelli et al. (1985), a new catalog was created with the help of LEDA (Lyon Extragalactic Database) to investigate the spatial alignment of galaxies. This had to be done, because the Bingelli et al. (1985) catalog does not contain the postion angles (PA) which are needed for studying spatial alignments of galaxies. The new sample consists of 1977 galaxies within an area of about 8 degrees around the Virgo Cluster center ($\alpha = 12.5$ h, $\delta = 10$ deg (2000)).

Investigations on the spin vectors of the spiral galaxies were done by using the Flin & Godlowski (1986) transformation. The PA and the angles δ and η (Flin & Godlowski (1986)) of the 587 spiral galaxies within our catalog were compared with a random distribution (Aryal & Saurer (2000)). At the moment we cannot find any significant anisotropy. In order to compare the predictions of various galaxy cluster evolution models we investigated furthermore the sense of rotation (SOR) of 89 spiral galaxies in the Virgo Cluster. A catalog of 89 rotation-curves of spiral galaxies by Rubin et al. (1999) gave us the appropriate information. The search for a favoured SOR, as well as a dependency of SOR on PA or spatial orientation, again yielded isotropy. This leads to the preliminary conclusion that only models like the tidal spin-up soicheme provide usable predictions for the spatial alignment of spiral galaxies.

P 99

A Statistical Approach to Possible Galaxy Alignment in Abell 426

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The search for possible spin vector alignments of galaxies in large-scale structures such as superclusters offers a good method for proving existing theories on the origin of large structures. Different theories predicts different spin vector alignments from equidistribution up to complete alignment. Of course encounters can disturb the orientations, but there should be some remnants found (A. Coutts, 1996, MNRAS 278, 87).

In this work we investigate the Perseus cluster (Abell 426) with three statistical methods (χ^2-test, Kolmogorov-Smirnov test and the Kuiper statistics, all with a significance level of 5 %). We used a homogenous set of data based on a survey by Brunzendorf & Meusinger (1999, Astron. Astrophys. Suppl. Ser. 139, 141) consisting of 660 records. Rejecting E-type and known background galaxies the remaining 443 S-type galaxies were divided into 15 subsamples including the center, several peripheral regions and circular rings with different radii around the center. All samples were investigated for parallel and radial position angle alignments and, additional to that, we applied the position angle-inclination method as proposed by Flin & Godlowski (1986, MNRAS 222, 525) with the Holmberg galaxy model to obtain three dimensional information on the galaxy orientations. This information is expressed with two angles which give the orientation of the spin vectors with respect to an arbitrary reference system. So we applied all statistical tests also on the distribution of these angles.

As null hypothesis an equidistribution as proposed by Aryal & Saurer (2000, Astron. Astrophys. 364, L97) was used. First results show no significant alignment in the distribution of the spin vectors.

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The Current Health of Dwarf Irregular Galaxies in the Virgo Cluster

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The Virgo Cluster is one of the nearest laboratories where the effects of the cluster environment can be examined. Owing to their lower gravitational potentials, the gas content of dwarfs should be very sensitive to alterations in flows, such as through tidal or ram-pressure stripping, so observable effects are expected as seen in Virgo Cluster spirals. Dwarf irregular galaxies (dIs) can be used as test objects to evaluate their current "health" with respect to their living conditions. Two key diagrams are used as evolutionary diagnostics: oxygen abundance versus luminosity and oxygen abundance versus baryonic gas fraction. A detection of a systematic shift between a sample of nearby dIs and a sample of cluster dIs would be evidence that environment influences gas flows. For a selection of dIs in the inner and outer regions of the cluster, new emission-line spectra are obtained and oxygen abundances are derived. A comparison of dIs in the Virgo Cluster sample with dIs in the field (e. g., Local Volume) sample shows that: (1) differential evolution is not strongly manifested in the oxygen abundance versus luminosity diagram; (2) differences, however, are revealed when the gas content is taken into account; and (3) Virgo dIs passing through the hot and dense intracluster medium have probably been stripped of their gas in recent times. UGC 7636 in particular may be a prototype of recently stripped dIs in Virgo. A quantitative measure of gas deficiency in dIs, independent of size, type, and distance, is defined for the first time.

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Interaction in a Wide Galaxy Pair: the UGC2855/UGC2866 System

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Interaction is the driving force of activity and evolution in galaxies. The most spectacular and obvious kind of interaction may be merging, but even members of a wide galaxy pair might be influenced deeply by the presence of the companion. We present an example of such a pair here: the UGC 2855/UGC 2866 system at a distance of $\sim$ 20 Mpc. The galaxies are about $10'$ apart (corresponding to a projected distance of 60 kpc). UGC 2855 is an SBc galaxy with a bar rich in molecular gas (Hüttemeister et al. 1999), likely to be in a pre-starburst state, i. e. still in the process of concentrating gas in the central region. Its smaller companion, UGC 2866, has an irregular morphology and is very bright in Hα – it clearly hosts a nuclear starburst, also indicated by a concentration of $\sim 2 \cdot 10^9 M_\odot$ of molecular gas in the central region. Both galaxies are luminous in the Far Infrared (FIR) at $\sim 5 \cdot 10^{10} L_\odot$, pointing to above average star formation activity even in the morphologically 'quiescent' UGC 2855. Our data include sensitive interferometric neutral hydrogen (H I) maps as well as multicolor Near Infrared (JHK) and optical images. H I is the most sensitive tracer of tidal interactions, and, indeed, the data show an extended tidal structure, including a bridge between the galaxies and several tails and detached clouds. These features are not visible in the optical. With the NIR images we are able to study the mass distribution, which is directly linked to the surface brightness. Furthermore NIR two-color diagrams show the intermediate age population of Asymptotic Giant Branch stars. Since few galaxies are isolated, the UGC 2855/UGC 2866 system may be typical for processes driving galaxy evolution in general.

P 102

Ram Pressure Stripping on Disk Galaxies in Clusters

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An important aspect in the evolution of galaxies is the influence of the environment. Comparative observations of disk galaxies in clusters and of those in the field reveal mainly differences that are connected with their gas contents. Cluster galaxies often show truncated H I and Hα disks, but undisturbed stellar disks. Also the star formation rate in the outer regions of cluster disk galaxies is truncated. A good candidate to explain these observations is the process of ram pressure stripping, the removal of the galaxy's own gas by the wind it feels while moving through the cluster gas. This process is investigated by means of hydrodynamical simulations using a 2D Eulerian code. Heating due to the photoelectric effect, cosmic rays and diffuse X-rays and cooling due to bremsstrahlung, recombination and line emission are implemented.

We want to address the question how effective the stripping can be for different ICM parameters and compare the simulations with a simple analytical estimation.

P 103

Studies of Two Compact Group Candidates

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Compact groups of galaxies (CGs) are ideal objects to observe galaxy interactions and with it galaxy formation and evolution, e. g. the merging into bright field ellipticals.

We have found two possible CG candidates one of which lies in the Zone of Avoidance. For this newly-detected ultra-dense CG candidate we present BVRI photometry. CCD images have been obtained using the 2.5 m Nordic Optical Telescope (NOT) in September 2000. The images reveal five possible group members, configured in a chain-like structure. A B–V color map has been built which shows a color gradient across them. No information on redshift is available until present, but judging from the angular size of the galaxy candidates we estimate that a radial velocity of 15 000 to 20 000 $\mathrm{km\,s^{-1}}$ might be a reasonable assumption. This would lead to a median projected separation of only 8 to 11 kpc making this object one of the densest CGs known ($\mathrm{H_0 = 75\ km\,s^{-1}\,Mpc^{-1}}$).

The second candidate, MCG+01-19-001 is classified as S/I galaxy but the images we obtained with the Asiago Faint Object Spectrograph and Camera (AFOSC) at the 1.82 m Copernico telescope show several adjacent clumps which could be possible companion galaxies. Radial velocities of these objects have been measured at low resolution long-slit spectra. The highest velocity difference relative to the galaxy nucleus, 500 $\mathrm{km\,s^{-1}}$, has been found for the region located between the nucleus itself and one of the clumps. However, the high velocity error and the poor spectral resolution do not yet allow any conclusions about the nature of the clumps.

P 104

Investigation of Galaxy Orientations in the Coma Cluster

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The discussion about the intrinsic shape of the statistical distribution of galaxy orientations has a long history. There have been at least three rivaling models in existence as to how galaxy clusters form and any of them predicts a different spatial orientation of the spin vectors in a galaxy ensemble (Sugai H., Iye M., 1995, MNRAS, 276, 327). Therefore knowledge about the statistics of galaxy orientation will help answer questions about the origin and the evolution of galaxy clusters.

In this work a large sample of over 6700 galaxies in the Coma Cluster (Godwin J. D., Metcalfe N., Peach J. V., 1983, MNRAS 202, 113) was tested for a possible anisotropy in the alignment of the galaxies spin vectors. In earlier works of such content only the position angle of galaxies had been taken into account while in this new approach also the inclination of galaxies is included in the analysis (after Flin P., Godlowski W., 1986, MNRAS 222, 525). Unfortunately from the ratio of minor to major axis of a galaxy image the spin-vector can only be determined four-fold degenerate. Therefore all four possible solutions must be included in the statistical tests in which the data is searched for deviations from the hypothetical distribution that would have been produced by a completely isotropic orientation. To date no significant proof for either isotropy or anisotropy could be found in the Coma Cluster applying simple χ^2, auto-correlation and Fourier tests because different tests yield different answers. However further investigation seems worthwhile, since a final result allowing a decision in order to settle the case is still pending.

P 105

Metal-poor Accretion in the Early Universe

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In the early Universe, the chemical composition of matter was different from the one today, as then the heavier elements present today were still missing.

The structure, evolution and stability of accretion discs depends on the chemical composition of the material. I will present first results of model calculations of vertically self-gravitating accretion discs with primordial chemical composition. The models are stationary and use both, a generalized viscosity prescription and newly computed opacities in the temperature range from 40 to 40 000 K for primordial matter.

We find that these primordial opacities are different from simple zero-metallicity opacities due to the influence of lithium which already at low temperatures yields free electrons for the formation of H^--ions. In the absence of dust-forming heavier elements like carbon the discs are optically thin.

Finally we compare models with different metallicities using OPAL-opacities.

P 106

A Calibration Map for the Wide Field Imager

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The Wide Field Imager (WFI) at the ESO/MPG 2.2 m telescope at La Silla shows significant large-scale spatial gradients across the entire field of view and across each CCD chip individually. Using photometric data from the Sloan Digital Sky Survey that cover the same area as our exposures as a calibrated comparison sample, we were able to model the dependence of the WFI photometry on location on the WFI CCDs. Our sample comprises a total number of 17 754 stars from the globular cluster Palomar 5 and adjacent fields taken in the V and R filters.

It turns out that fitting a complete polynomial of second order to every single chip is a sufficient model for eliminating the systematic variations across each chip and for reducing the systematic errors from ± 0.04 mag to ± 0.01 mag in V. We find a close similarity between the calibration maps in both V and R. We conclude that the gradients across individual CCDs are primarily caused by variations in the CCD response. Our model can be applied to calibrate forthcoming data for these spatial effects and is available in tabular form from http://www.mpia-hd.mpg.de/SDSS/data.

P 107

Restauration of Digitized Astronomical Plates with the Pixon Method

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Applications of the Pixon Restauration Method to digitized plates of the Sonneberg Plate Archive – the world's 2nd largest – are displayed. Results so far obtained show that the severe astigmatism/coma distortion present in the outer parts of the wide field images can almost completely be removed. Also, object definition (FHWM) of point sources and S/N improve by factors of 2 to 7, depending on the object strength and location, background etc. We discuss consequences for the automated astronomical processing of the restaured plates, which are of crucial importance for the inclusion of digitzed archives in the virtual observatory context.

P 108

The Nearby Stars

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The release of the HIPPARCOS data five years ago made it possible to describe the brighter portion of the nearby stars within 25 pc of the Sun and beyond to a very high degree of completeness. Whereas the fainter nearby stars could only profite to a much smaller amount from HIPPARCOS due to magnitude limit imposed.

The hunt for new extra-solar planets as well as the search for brown dwarf stars led in recent years to an enormous revival in the research on the nearest stars. Especially the combination of infrared surveys like 2MASS or DENIS with optical surveys like POSS, APM, or not to forget Luyten's 20 year old NLTT proper motion survey provide valuable information to fill the gap of the still missing low luminosity objects in the immediate solar neighbourhood.

The present status of our basic knowledge of the stars within 25 pc of the Sun will be presented, and an outlook on the development within the near future will be given.

P 109

What's new with DIVA?

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In April 2002 DIVA successfully passed the Preliminary Design Review. Within the present planning horizon of DLR, DIVA can be launched in early 2006.

DIVA will measure astrometric and photometric parameters of about 35,000,000 stars with high accuracy and additionally provide spectrophotometric information for about 12,000,000 stars.

In this poster we present the current optical and mechanical design of the DIVA main and UV instruments. The DIVA performance is compared with that of HIPPARCOS and of GAIA. The impact of DIVA measurements on astronomy is shown by a few examples.

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Java Applets for Teaching (Astro-)Physics

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The programming language JAVA offers a relatively easy way to create interactive simulations that can be made available on the Web, i. e. independent of the machine or operating system. The speed available on present machines makes it possible to hide rather complex simulations – including non-linear partial differential equations and Monte Carlo simulations – behind a graphical user interface that gives to the user as much control over the input and the visualization of the results as the designer envisages. Thus, they offer full liberty to explore mathematically complex models and to concentrate on understanding the behaviour of the model rather than to have to tackle the difficulties of programming and numerics. They have proven to be useful in coursework, exercises, homework, self-study, and as utilities for research. My collection of applets is available at
http://astro.u-strasbg.fr/~koppen/apindex.html

P 111

An Interactive Visualization of the Catalogue of Galactic Planetary Nebulae

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At http://astro.u-strasbg.fr/~koppen/png/png.html you'll find the first release of an interactive version of the Strasbourg-ESO Catalogue of Galactic Planetary Nebulae by Acker et al. (1992). The observational data of 1185 planetary nebulae can be inspected in detail numerically. Any two properties can be plotted against each other, with interactive zooming, graphical marking of groups of nebulae with certain properties, and identification and display of the data of any individually selected object. Any third parameter may be displayed in a colour coded maps of the plane of any two parameters. Nebulae may be selected according to their names or observed parameters. This interactive catalogue is an application of the JAVA applet CatPlot which permits the user to read in one's own catalogue file residing in the public space of his own machine and also to display images and x–y plots (a detailed description may be found in the explanatory pages at http://astro.u-strasbg.fr/~koppen/catplot/CatPlotHelp.html).

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