THE STAR FORMATION NEWSLETTER

An electronic publication dedicated to early stellar evolution and molecular clouds

No. 166 — 9 August 2006 Editor: Bo Reipurth (reipurth@ifa.hawaii.edu)

Abstracts of recently accepted papers

A survey for nanodiamond features in the 3 micron spectra of Herbig Ae/Be stars

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We have carried out a survey of 60 Herbig Ae/Be stars in the 3 micron wavelength region in search for the rare spectral features at 3.43 and 3.53 micron. These features have been attributed to the presence of large, hot, hydrogen-terminated nanodiamonds. Only two Herbig Ae/Be stars, HD 97048 and Elias 3−1 are known to display both these features. We have obtained medium-resolution spectra ($R \sim 2500$) with the ESO near-IR instrument ISAAC in the 3.15−3.65 micron range. In our sample, no new examples of sources with prominent nanodiamond features in their 3 micron spectra were discovered. Less than 4% of the Herbig targets show the prominent emission features at 3.43 and/or 3.53 μm. Both features are detected in our spectrum of HD 97048. We confirm the detection of the 3.53 μm feature and the non-detection of the 3.43 μm feature in MWC 297. Furthermore, we report tentative 3.53 μm detections in V921 Sco, HD 163296 and T CrA. The sources which display the nanodiamond features are not exceptional in the group of Herbig stars with respect to disk properties, stellar characteristics, or disk and stellar activity. Moreover, the nanodiamond sources are very different from each other in terms of these parameters. We do not find evidence for a recent supernova in the vicinity of any of the nanodiamond sources.
We have analyzed the PAH 3.3 μm feature and the Pfund δ hydrogen emission line, two other spectral features which occur in the 3 micron wavelength range. We reinforce the conclusion of previous authors that flared-disk systems display significantly more PAH emission than self-shadowed-disk sources. The Pf δ line detection rate is higher in self-shadowed-disk sources than in the flared-disk systems.
We discuss the possible origin and paucity of the (nano)diamond features in Herbig stars. Different creation mechanisms have been proposed in the literature, amongst others in-situ and supernova-induced formation. Our data set is inconclusive in proving or disproving either formation mechanism.

Accepted by Astronomy & Astrophysics

http://arxiv.org/abs/astro-ph/0606650

NICMOS/HST Observations of the Embedded Cluster Associated with Mon R2: Constraining the sub–stellar Initial Mass Function

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We have analyzed HST/NICMOS2 F110W, F160W, F165M, and F207M band images covering the central $1' \times 1'$ region of the cluster associated with Mon R2 in order to constrain the Initial Mass Function (IMF) down to 20 M_{jup}. The flux ratio between the F165M and F160W bands was used to measure the strength of the water band absorption feature and select a sample of 12 out of the total sample of 181 objects that have effective temperatures between 2700 K and 3300 K. These objects are placed in the HR diagram together with sources observed by Carpenter et al. (1997) to estimate an age of ∼1 Myr for the low mass cluster population. By constructing extinction limited samples, we are able to constrain the IMF and the fraction of stars with a circumstellar disk in a sample that is 90% complete for both high and low mass objects. For stars with estimated masses between 0.1 $M_\odot$ and 1.0 $M_\odot$ for a 1 Myr population with $A_V \leq 19$ mag, we find that $27 \pm 9\%$ have a near–infrared excess indicative of a circumstellar disk. The derived fraction is similar to, or slightly lower than, the fraction found in other star forming regions of comparable age. We constrain the number of stars in the mass interval 0.08–1.0 $M_\odot$ to the number of objects in the mass interval 0.02–0.08 $M_\odot$ by forming the ratio, R^{**}=N(0.08–1 $M_\odot$)/N(0.02–0.08 $M_\odot$) for objects in an extinction limited sample complete for $A_V \leq 7$ mag. The ratio is found to be $R^{**} = 2.2 \pm 1.3$ assuming an age of 1 Myr, consistent with the similar ratio predicted by the system IMF proposed by Chabrier (2003). The ratio is similar to the ratios observed towards the Orion Nebula Cluster and IC 348 as well as the ratio derived in the 28 square degree survey of Taurus by Guieu et al. (2006).

Accepted by Astronomical Journal

Six Myths on the Virial Theorem for Interstellar Clouds

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It has been paid little or no attention to the implications that turbulent fragmentation has on the validity of at least six common assumptions on the Virial Theorem (VT), which are: (i) the only role of turbulent motions within a cloud is to provide support against collapse, (ii) the surface terms are negligible compared to the volumetric ones, (iii) the gravitational term is a binding source for the clouds, (iv) the sign of the second-time derivative of the moment of inertia determines whether the cloud is contracting or expanding, (v) interstellar clouds are in Virial Equilibrium (VE), and (vi) Larson's (1981) relations are the observational proof that clouds are in VE. Interstellar clouds cannot fulfill these assumptions, however, because turbulent fragmentation will induce flux of mass, moment and energy between the clouds and their environment, and will favor local collapse while may disrupt the clouds within a dynamical timescale. It is argued that, although the observational and numerical evidence suggests that interstellar clouds are not in VE, the so-called "Virial Mass" estimations, which actually should be called "energy-equipartition mass" estimations, are good order-of magnitude estimations of the actual mass of the clouds just because observational surveys will tend to detect interstellar clouds appearing to be close to energy equipartition. However, since clouds are actually out of VE, as suggested by asymmetrical line profiles, they should be transient entities. These results are compatible with observationally-based estimations for rapid star formation, and call into question the models for the star formation efficiency based on clouds being in VE.

Accepted by MNRAS

astro-ph/0606071

A Survey for Spectroscopic Binaries among Very Low Mass Stars

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We report on the results of a survey for radial velocity variability in a heterogeneous sample of very low mass stars and brown dwarfs. One distinguishing characteristic of the survey is its time span, which allows an overlap between spectroscopic binaries and those that can be found by high angular resolution imaging. Despite our relatively low velocity precision, we are able to place a new constraint on the total binary fraction in these objects, which suggests that they are more likely the result of extending the same processes at work at higher masses into this mass range, rather than a distinct mode of formation. Our basic result is that there are 6 ± 2 out of 53, or 11% $^{+0.07}_{-0.04}$, spectroscopic

binaries in the separation range 0-6 AU, nearly as many as resolved binaries. This leads to an estimate of an upper limit of 26% ± 10% for the binary fraction of very low mass objects (it is an upper limit because of the possible overlap between the spectroscopic and resolved populations). A reasonable estimate for the very low mass binary fraction is 20%-25%. We consider several possible separation and frequency distributions, including the one found for GK stars, a compressed version of that, a version of the compressed distribution truncated at 15 AU, and a theoretical distribution that considers the evaporation of small-N clusters. We conclude that the latter two bracket the observations, which may mean that these systems form with intrinsically smaller separations due to their smaller mass and then are truncated due to their smaller binding energy. We do not find support for the "ejection hypothesis" as their dominant mode of formation, particularly in view of the similarity in the total binary fraction compared with slightly more massive stars and the difficulty this mechanism has in producing numerous binary systems. Our conclusions must be viewed as tentative until studies with larger and better-posed samples and higher velocity precision are conducted.

Published by The Astronomical Journal (Vol. 132, p. 663)

Molecular line intensities as measures of cloud masses - I. Sensitivity of CO emissions to physical parameter variations

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A reliable estimate of the molecular gas content in galaxies plays a crucial role in determining their dynamical and star-forming properties. However, H_2, the dominant molecular species, is difficult to observe directly, particularly in the regions where most molecular gas is thought to reside. Its mass is therefore commonly inferred by assuming a direct proportionality with the integrated intensity of the $^{12}CO(J = 1 \rightarrow 0)$ emission line, using a CO-to-H_2 conversion factor, X. Although a canonical value for X is used extensively in such estimates, there is increasing evidence, both theoretical and observational, that the conversion factor may vary by over an order of magnitude under conditions different to those of the local neighbourhood. In an effort to understand the influence of changing environmental conditions on the conversion factor, we derive theoretical estimates of X for a wide range of physical parameters using a photon-dominated region (PDR) time-dependent chemical model, benchmarking key results against those of an independent PDR code to ensure reliability. Based on these results, the sensitivity of the X factor to change in each physical parameter is interpreted in terms of the chemistry and physical processes within the cloud. In addition to confirming previous observationally derived trends, we find that the time-dependence of the chemistry, often neglected in such models, has a considerable influence on the value of the conversion factor.

Accepted by MNRAS

astro-ph/0607428

The Thermal Regulation of Gravitational Instabilities in Protoplanetary Disks III. Simulations with Radiative Cooling and Realistic Opacities

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This paper presents a fully three-dimensional radiative hydrodymanics simulation with realistic opacities for a gravitationally unstable 0.07 $M_\odot$ disk around a 0.5 $M_\odot$ star. We address the following aspects of disk evolution: the strength of gravitational instabilities under realistic cooling, mass transport in the disk that arises from GIs, comparisons between the gravitational and Reynolds stresses measured in the disk and those expected in an α-disk, and comparisons between the SED derived for the disk and SEDs derived from observationally determined parameters. The mass transport in this disk is dominated by global modes, and the cooling times are too long to permit fragmentation for

all radii. Moreover, our results suggest a plausible explanation for the FU Ori outburst phenomenon.

Accepted by ApJ

astro-ph/0607112 or http://westworld.astro.indiana.edu

Formation and Collapse of Nonaxisymmetric Protostellar Cores in Planar Magnetic Interstellar Clouds: Formulation of the Problem and Linear Analysis

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We formulate the problem of the formation and collapse of nonaxisymmetric protostellar cores in weakly ionized, self-gravitating, magnetic molecular clouds. In our formulation, molecular clouds are approximated as isothermal, thin (but with finite thickness) sheets. We present the governing dynamical equations for the multifluid system of neutral gas and ions, including ambipolar diffusion, and also a self-consistent treatment of thermal pressure, gravitational, and magnetic (pressure and tension) forces. The dimensionless free parameters characterizing model clouds are discussed. The response of cloud models to linear perturbations is also examined, with particular emphasis on length and time scales for the growth of gravitational instability in magnetically subcritical and supercritical clouds. We investigate their dependence on a cloud's initial mass-to-magnetic-flux ratio μ_0 (normalized to the critical value for collapse), the dimensionless initial neutral-ion collision time $\tilde{\tau}_{\rm ni,0}$, and also the relative external pressure exerted on a model cloud $\tilde{P}_{\rm ext}$. Among our results, we find that nearly-critical model clouds have significantly larger characteristic instability lengthscales than do more distinctly sub- or supercritical models. Another result is that the effect of a greater external pressure is to reduce the critical lengthscale for instability. Numerical simulations showing the evolution of model clouds during the linear regime of evolution are also presented, and compared to the results of the dispersion analysis. They are found to be in agreement with the dispersion results, and confirm the dependence of the characteristic length and time scales on parameters such as μ_0 and $\tilde{P}_{\rm ext}$.

Accepted by The Astrophysical Journal

http://xxx.lanl.gov/abs/astro-ph/0607622

Protostellar Jet Collisions Reduce the Efficiency of Outflow-Driven Turbulence in Molecular Clouds

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We present a series of numerical studies of the interaction of colliding radiative, hydrodynamic young stellar outflows. We study the effect of the collision impact parameter on the acceleration of ambient material and the degree to which the flow is isotropized by the collision as a mechanism for driving turbulence in the parent molecular cloud. Our results indicate that the high degree of compression of outflow material, achieved through radiative shocks near the vertex of the interaction, prevents the redirected outflow from spraying over a large spatial region. Furthermore, the collision reduces the redirected outflow's ability to entrain and impart momentum into the ambient cloud. Consideration of the probabilities of outflow collisions leads us to conclude that individual low-velocity fossil outflows are the principle coupling between outflows and the cloud.

Published by The Astrophysical Journal (Vol. 646, p. 1059)

Triggered massive-star formation on the borders of Galactic H II regions. III. Star formation at the periphery of Sh2-219

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Context: Massive-star formation triggered by the expansion of H II regions.

Aims: We have observed the molecular environment of Sh2-219 in order to understand if sequential star formation is taking place at the periphery of this H II region. *Methods:* We present ^{12}CO $J = 2 \rightarrow 1$ line observations of this region, obtained at IRAM 30-m telescope (Pico Veleta, Spain).

Results: In the optical, Sh2-219 is spherically symmetric around its exciting star; furthermore it is surrounded along three quarters of its periphery by a ring of atomic hydrogen. This spherical symmetry breaks down at infrared and millimetre wavelengths. A molecular cloud of about 2000 $M_{\odot}$ lies at the southwestern border of Sh2-219, in the H I gap. Two molecular condensations, elongated along the ionization front, probably result from the interaction between the expanding H II region and the molecular cloud. In this region of interaction lies a cluster which contains many highly reddened stars, as well as a massive star exciting an ultracompact H II region. More surprisingly, the brightest parts of the molecular cloud form a 'chimney', perpendicular to the ionization front. This chimney is closed at its south-west extremity by Hα walls, thus forming a cavity. The whole structure is 7.5 pc long. A luminous Hα emission-line star, lying at one end of the chimney near the ionization front, may be responsible for this structure. Confrontation of the observations with models of H II region evolution shows that Sh2-219 is probably 10^5 yrs old. The age and origin of the near-IR cluster observed on the borders of Sh2-219 remain unknown.

Accepted by A&A

http://www.oamp.fr/matiere/s219.pdf

The formation of molecular clouds in spiral galaxies

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We present Smoothed Particle Hydrodynamics (SPH) simulations of molecular cloud formation in spiral galaxies. These simulations model the response of a non-self-gravitating gaseous disk to a galactic potential. The spiral shock induces high densities in the gas, and considerable structure in the spiral arms, which we identify as molecular clouds. We regard the formation of these structures as due to the dynamics of clumpy shocks, which perturb the flow of gas through the spiral arms. In addition, the spiral shocks induce a large velocity dispersion in the spiral arms, comparable with the magnitude of the velocity dispersion observed in molecular clouds. We estimate the formation of molecular hydrogen, by post-processing our results and assuming the gas is isothermal. Provided the gas is cold ($T \leq 100$ K), the gas is compressed sufficiently in the spiral shock for molecular hydrogen formation to occur in the dense spiral arm clumps. These molecular clouds are largely confined to the spiral arms, since most molecular gas is photodissociated to atomic hydrogen upon leaving the arms.

Accepted by MNRAS

http://xxx.lanl.gov/abs/astro-ph/0602103

Accurate stellar masses in the multiple system T Tau

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We obtain accurate estimates for the individual masses of the components of the tight binary system T Tau S to settle the ongoing debate on the nature of T Tau Sa, a so-called infrared companion. We take advantage of the fact that T Tau S belongs to a triple system composed of two hierarchical orbits to simultaneously analyze the motion of T Tau Sb in the rest frames of T Tau Sa and T Tau N. With this method, it is possible to pinpoint the location of the center of mass of T Tau S and, thereby, to determine individual masses for T Tau Sa and T Tau Sb with no prior assumption about the mass/flux ratio of the system. This improvement over previous studies of the system results in much better constraints on orbital parameters. We find individual masses of $2.73\pm0.31\,M_\odot$ for T Tau Sa and of $0.61\pm0.17\,M_\odot$ for T Tau Sb (in agreement with its early-M spectral type), including the uncertainty on the distance to the system. These are among the most precise estimates of the mass of any Pre-Main Sequence star, a remarkable result since this is the first system in which individual masses of T Tauri stars can be determined from astrometry only. This model-independent analysis confirms that T Tau Sa is an intermediate-mass star, presumably a very young Herbig Ae star, that may possess an almost edge-on disk.

Accepted by Astronomy & Astrophysics Letters

http://fr.arxiv.org/abs/astro-ph/0608018

The Spitzer c2d Survey of Nearby Dense Cores: I: First Direct Detection of the Embedded Source in IRAM 04191+1522

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We report the first detections of the Class 0 protostellar source IRAM 04191+1522 at wavelengths shortward of 60 μm with the *Spitzer Space Telescope*. We see extended emission in the *Spitzer* images that suggests the presence of an outflow cavity in the circumstellar envelope. We combine the *Spitzer* observations with existing data to form a complete dataset ranging from 3.6 to 1300 μm and use these data to construct radiative transfer models of the source. We conclude that the internal luminosity of IRAM 04191+1522, defined to be the sum of the luminosity from the internal sources (a star and a disk), is $L_{int} = 0.08 \pm 0.04$ $L_\odot$, placing it among the lowest luminosity protostars known. Though it was discovered before the launch of the *Spitzer Space Telescope*, IRAM 04191+1522 falls within a new class of Very Low Luminosity Objects being discovered by *Spitzer*. Unlike the two other well-studied objects in this class, which are associated either with weak, compact outflows or no outflows at all, IRAM 04191+1522 has a well-defined molecular outflow with properties consistent with those expected based on relations derived from higher luminosity ($L_{int} \geq 1$ $L_\odot$) protostars. We discuss the difficulties in understanding IRAM 04191+1522 in the context of the standard model of star formation, and suggest a possible explanation for the very low luminosity of this source.

Accepted by Astrophysical Journal

http://peggysue.as.utexas.edu/SIRTF/

Testing the Disk-Locking Paradigm: An Association Between U-V Excess and Rotation in NGC 2264

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We present some results from a UVI photometric study of a field in the young open cluster NGC 2264 aimed, in part, at testing whether accretion in pre-main sequence stars is linked to rotation. We confirm that U-V excess is well correlated with H-alpha equivalent width for the stars in our sample. We show that for the more massive stars in the cluster sample (roughly 0.4-1.2 Msun) there is also a significant association between U-V excess and rotation, in the sense that slow rotators are more likely to show excess U-band emission and variability. This constitutes significant new evidence in support of the disk-locking paradigm.

Accepted by ApJ Letters

http://xxx.lanl.gov/abs/astro-ph/0607206

A High Order Godunov Scheme with Constrained Transport and Adaptive Mesh Refinement for Astrophysical MHD

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In this paper, we present a new method to perform numerical simulations of astrophysical MHD flows using the Adaptive Mesh Refinement framework and Constrained Transport. The algorithm is based on a previous work in which the MUSCL–Hancock scheme was used to evolve the induction equation. In this paper, we detail the extension of this scheme to the full MHD equations and discuss its properties. Through a series of test problems, we illustrate the performances of this new code using two different MHD Riemann solvers (Lax–Friedrich and Roe) and the need of the Adaptive Mesh Refinement capabilities in some cases. Finally, we show its versatility by applying it to two completely different astrophysical situations well studied in the past years: the growth of the magnetorotational instability in the shearing box and the collapse of magnetized cloud cores. We have implemented a new Godunov scheme to solve the ideal MHD equations in the AMR code RAMSES. We have shown that it results in a powerful tool that can be applied to a great variety of astrophysical problems, ranging from galaxies formation in the early universe to high resolution studies of molecular cloud collapse in our galaxy.

Accepted by Astronomy & Astrophysics

http://lanl.arxiv.org/abs/astro-ph/0607230

A Survey and Analysis of Spitzer Infrared Spectrograph Spectra of T Tauri Stars in Taurus

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We present mid-infrared spectra of T Tauri stars in the Taurus star-forming region obtained with the Spitzer Infrared Spectrograph (IRS). For the first time, the 5-36 μm spectra of a large sample of T Tauri stars belonging to the same star-forming region is studied, revealing details of the mid-infrared excess due to dust in circumstellar disks. We analyze common features and differences in the mid-IR spectra based on disk structure, dust grain properties, and the presence of companions. Our analysis encompasses spectral energy distributions from the optical to the far-infrared, a morphological sequence based on the IRS spectra, and spectral indices in IRS wave bands representative of continuum emission. By comparing the observed spectra to a grid of accretion disk models, we infer some basic disk properties for our sample of T Tauri stars and find additional evidence for dust settling.

Published by The Astrophysical Journal Supplement Series (Vol. 165, p. 568)

Formation of methyl formate and other organic species in the warm-up phase of hot molecular cores

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Aims: The production of saturated organic molecules in hot cores and corinos is not well understood. The standard approach is to assume that, as temperatures heat up during star formation, methanol and other species evaporate from grain surfaces and undergo a warm gas-phase chemistry at 100 K or greater to produce species such as methyl formate, dimethyl ether, and others. But a series of laboratory results shows that protonated ions, typical precursors to final products in ion-molecule schemes, tend to fragment upon dissociative recombination with electrons rather than just ejecting a hydrogen atom. Moreover, the specific proposed reaction to produce protonated methyl formate is now known not to occur at all.

Methods: We utilize a gas-grain chemical network to probe the chemistry of the relatively ignored stage of hot core evolution during which the protostar switches on and the temperature of the surrounding gas and dust rises from 10 K to over 100 K. During this stage, surface chemistry involving heavy radicals becomes more important as surface hydrogen atoms tend to evaporate rather than react.

Results: Our results show that complex species such as methyl formate, formic acid, and dimethyl ether can be produced in large abundance during the protostellar switch-on phase, but that both grain-surface and gas-phase processes help to produce most species. The longer the timescale for protostellar switch-on, the more important the surface processes.

Accepted by Astronomy & Astrophysics

astro-ph/0607560

The nature of turbulence in OMC1 at the scale of star formation: observations and simulations

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Aims. To study turbulence in the Orion Molecular Cloud (OMC1) by comparing observed and simulated characteristics of the gas motions.
Methods. Using a dataset of vibrationally excited H_2 emission in OMC1 containing radial velocity and brightness which covers scales from 70 AU to 30 000 AU, we present the structure functions and the scaling of the structure functions with their order. These are compared with the predictions of two-dimensional projections of simulations of supersonic hydrodynamic turbulence.
Results. The structure functions of OMC1 are not well represented by power laws, but show clear deviations below

2000 AU. However, using the technique of extended self-similarity, power laws are recovered at scales down to 160 AU. The scaling of the higher order structure functions with order deviates from the standard scaling for supersonic turbulence. This is explained as a selection effect of preferentially observing the shocked part of the gas and the scaling can be reproduced using line-of-sight integrated velocity data from subsets of supersonic turbulence simulations. These subsets select regions of strong flow convergence and high density associated with shock structure. Deviations of the structure functions in OMC1 from power laws cannot however be reproduced in simulations and remains an outstanding issue.

Published by Astronomy & Astrophysics (Vol. 454, p. 815)

Resolving and probing the circumstellar disk of the Herbig Ae star MWC 480 at λ=1.4 mm: Evolved dust?

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We present high resolution 0.45"×0.32" observations from the BIMA array toward the Herbig Ae system MWC 480 in the $\lambda = 1.4$ mm dust continuum. We resolve a circumstellar disk of radius ∼170 AU and constrain the disk parameters by comparing the observations to flat disk models. These results show that the typical fit parameters of the disk, such as the mass, $M_D \sim$ 0.04-0.18 $M_\odot$, and the surface density power law index, p=0.5 or 1, are comparable to those of the lower mass T Tauri stars. The dust in the MWC 480 disk can be modeled as processed dust material ($\beta \approx$ 0.8), similar to the Herbig Ae star CQ Tau disk; the fitted disk parameters are also consistent with less-evolved dust ($\beta \approx 1.2$). The possibility of grain growth in the MWC 480 circumstellar disk is supported by the acceptable fits with $\beta \approx 0.8$. The surface density power-law profiles of p=0.5 and p=1 can be easily fit to the MWC 480 disk; however, a surface density power-law profile similar to the minimum mass solar nebula model p=1.5 is ruled out at an 80% confidence level.

Accepted by Astrophysical Journal

http://arxiv.org/abs/astro-ph/0607232

Spitzer observations of the Orion OB1 association: second generation dust disks at 5-10 Myr.

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We report new Spitzer observations of intermediate mass stars in two regions of the Orion OB1 association located in the subassociations OB1a (∼10 Myr) and OB1b (∼5 Myr). In a representative sample of stars earlier than F5 of both stellar groups, we find a population of stars surrounded of debris disks, without excess in the IRAC bands and without emission lines in their optical spectra, but with a varying degree of 24μm excess. Comparing our samples with 24μm observations of intermediate mass stars in other stellar groups, spanning a range of ages from 2.5 Myr to 150 Myr, we find that debris disks are more frequent and have larger 24μm excess at 10 Myr (OB1a). This trend agrees with predictions of models of evolution of solids in the outer regions of disks (>30 AU), where large icy objects (∼1000 Km) begin to form at ∼10 Myr; the presence of these objects in the disk initiates a collisional cascade, producing enough dust particles to explain the relatively large 24 μm excess observed in OB1a. The dust luminosity observed in the stellar groups older than 10 Myr declines roughly as predicted by collisional cascade models. Combining Spitzer observations, optical spectra and 2MASS data, we found a new Herbig Ae/Be star (HD290543) and a star (HD36444)

with a large 24 μm excess, both in OB1b. This last object could be explained as a intermediate stage between HAeBe and true debris systems or as a massive debris disk produced by a collision between two large objects (>1000 Km).

Accepted by Astrophysical Journal

http://xxx.lanl.gov/abs/astro-ph/0607562

2.3 μm CO emission and absorption from young high-mass stars in M17

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We are studying the extremely young cluster of M17 to investigate the birth of high-mass stars and the initial mass function. Deep $JHKL$ imaging and K-band spectroscopy from the VLT of 201 stars toward the cluster is presented. The majority of 104 stars show the CO band-head in absorption. Half of them emit X-rays and/or have infrared excess, indicative of very young objects. Their intrinsic IR luminosity is compatible with intermediate and high-mass pre-main sequence stars. Nine additional stars have the CO feature in emission, while sixty sources are lacking any stellar spectral feature due to veiling by circumstellar dust. We suggest that CO absorption is – as in the case of low-mass stars – also a common feature during the early evolution of stars with higher masses. According to model calculations the observed CO absorption is most likely a sign of heavily accreting protostars with mass accretion rates above $10^{-5}\,M_{\odot}\,yr^{-1}$.

Accepted by Astronomy & Astrophysics

astro-ph/0608077

Subaru/COMICS Study on Silicate Dust Processing around Young Low-Mass Stars

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We have obtained 8-13 μm spectra of 30 young (1-10 Myr) low-mass premain-sequence stars using COMICS on the 8.2 m Subaru Telescope to examine dust evolution in protoplanetary disks. Most spectra show silicate emission features of various strengths and shapes, indicative of dust processing during the different stages of protoplanetary disk evolution. We have analyzed the observed silicate emission features using a simple model previously applied to the more massive and luminous Herbig Ae/Be systems. We determined the feature strength and shape and derived the composition and typical size of the silicate dust grains. We confirm the previously reported dependency of the silicate feature strength and shape on the grain size of the amorphous silicate dust. We examine the relation between the derived dust properties and stellar and circumstellar disk parameters, such as systemic age, luminosity of Hα (LHα), disk mass, and opacity power-law index β at radio wavelengths. A possible relation is found between silicate feature strength (grain size indicator) and the LHα, which may be an indicator of accretion activity. It implies that the turbulence induced by accretion activity may be important for grain size evolution in the disk. No clear correlation between the

crystallinity and the stellar/disk parameters is found. We find that on average 5%-20% in mass of the silicate dust grains is in crystalline form, irrespective of systemic age. This latter finding supports the idea that crystalline silicate is formed at an early evolutionary phase, probably at the protostellar phase, and is remaining during the later stages.

Published by The Astrophysical Journal (Vol. 646, p. 1024)

Dynamical Expansion of Ionization and Dissociation Front around a Massive Star : A Starburst Mechanism

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We quantitatively examine the significance of star formation triggered in the swept-up shell around an expanding H II region. If the swept-up molecular gas is sufficiently massive, new OB stars massive enough to repeat the triggering process will form in the shell. We determine the lower limit ($M_{\rm thr}$) for the mass of the star that sweeps up the molecular gas, where at least one new star with mass $M_* > M_{\rm thr}$ forms after the shell fragmentation. To calculate the threshold stellar mass, $M_{\rm thr}$, we examine how massive molecular shells can form around various central stars, by performing detailed numerical radiation hydrodynamics calculations. The mass of the photodissociated gas is generally larger than the mass of the photoionized gas. However, the swept-up molecular mass exceeds the photodissociated mass with a higher-mass star of $M_* > 20\ M_\odot$. The accumulated molecular mass generally increases with the stellar mass, and amounts to $10^{4-5}\ M_\odot$ for $M_* > 20\ M_\odot$ with an ambient density of $n \sim 10^2$ cm^{-3}. The threshold stellar mass is $M_{\rm thr} \sim 18\ M_\odot$ with the star-formation efficiency of $\epsilon \sim 0.1$ and $n \sim 10^2$ cm^{-3}. We examine the generality of this mode of run-away triggering for different sets of parameters, and found that $M_{\rm thr} \sim 15 - 20\ M_\odot$ in various situations. If the ambient density is too high or the star-formation efficiency is too low, the triggering is not run-away, but a single event.

Accepted by ApJL

http://arxiv.org/abs/astro-ph/0607587

Discovery of a Young Planetary Mass Binary

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We report the discovery of a companion to a young planetary mass brown dwarf, Oph 162225−240515. This pair therefore forms a resolved binary consisting of two objects with masses comparable to those of extra-solar giant planets. The coevality of the two and several lines of evidence that confirm their youth suggest that they form a physical binary. Models yield masses of $\sim 14\,{\rm M}_{Jupiter}$ and $\sim 7\,{\rm M}_{Jupiter}$, for the primary and the secondary respectively, at an age of ∼1 million years. A wide (∼240 AU) binary in the ultra-low-mass regime poses a challenge to some popular models of brown dwarf formation.

Accepted by Science

http://www.astro.utoronto.ca/∼rayjay/parselink.php?link=research

High-resolution mapping of interstellar clouds with near-infrared scattered light

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Context. With current wide-field near-infrared (NIR) instruments the scattered light in the near-infrared can be mapped over large areas. Below $A_V \sim 10$ mag the surface brightness is directly proportional to the column density, and at slightly higher column densities the saturation of the intensity values can be corrected using the ratios of the intensity in different NIR bands. Therefore, NIR scattered light provides a promising new method for the mapping of quiescent interstellar clouds.
Aims. We develop a method to convert the observed near-infrared surface brightness into estimates of the column density. We study and quantify the effect that different error sources could have on the accuracy of such estimates. We also propose to reduce systematic errors by combining surface brightness data with extinction measurements derived from the near-infrared colour excess of background stars.
Methods. Our study is based on a set of three-dimensional magnetohydrodynamic turbulence simulations. Maps of near-infrared scattered light are obtained with radiative transfer calculations, and the maps are converted back into column density estimates using the proposed method. The results are compared with the true column densities. Extinction measurements are simulated using the same turbulence simulations, and are used as a complementary column density tracer.
Results. We find that NIR intensities can be converted into a reliable estimate of the column density in regions with A_V up to almost 20 mag. We show that the errors can be further reduced with detailed radiative transfer modelling and especially by using the lower resolution information available through the colour excess data.
Conclusions. We urge the observers to try this new method out in practice.

Accepted by Astronomy & Astrophysics

http://lanl.arxiv.org/abs/astro-ph/0603354

The Large- and Small-Scale Structures of Dust in the Star-forming Perseus Molecular Cloud

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We present an analysis of ~ 3.5 deg^2 of submillimeter continuum and extinction data of the Perseus molecular cloud. We identify 58 clumps in the submillimeter map, and we identify 39 structures ("cores") and 11 associations of structures ("super cores") in the extinction map. The cumulative mass distributions of the submillimeter clumps and extinction cores have steep slopes ($\alpha \sim 2$ and 1.5-2, respectively), steeper than the Salpeter initial mass function (IMF; $\alpha = 1.35$), while the distribution of extinction super cores has a shallow slope ($\alpha \sim 1$). Most of the submillimeter clumps are well fit by stable Bonnor-Ebert spheres with 10 K $<$ T $<$ 19 K and $5.5 < \log_{10}(\mathrm{P}_{ext}/k) < 6.0$. The clumps are found only in the highest column density regions ($A_V >$ 5-7 mag), although Bonnor-Ebert models suggest that we should have been able to detect them at lower column densities if they exist. These observations provide a stronger case for an extinction threshold than that found in analysis of less sensitive observations of the Ophiuchus molecular cloud (Johnstone et al.). The relationship between submillimeter clumps and their parent extinction core has been analyzed. The submillimeter clumps tend to lie offset from the larger extinction peaks, suggesting that the clumps formed via an external triggering event, consistent with previous observations.

Published by The Astrophysical Journal (Vol. 646, p. 1009)

Binary Stars in the Orion Nebula Cluster

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We report on a high-spatial-resolution survey for binary stars in the periphery of the Orion Nebula Cluster, at 5–15 arcmin (0.65 – 2 pc) from the cluster center. We observed 228 stars with adaptive optics systems, in order to find companions at separations of $0\farcs13$ – $1\farcs12$ (60 – 500 AU), and detected 13 new binaries. Combined with the results of Petr (1998), we have a sample of 275 objects, about half of which have masses from the literature and high probabilities to be cluster members. We used an improved method to derive the completeness limits of the observations, which takes into account the elongated point spread function of stars at relatively large distances from the adaptive optics guide star. The multiplicity of stars with masses $> 2\,M_\odot$ is found to be significantly larger than that of low-mass stars. The companion star frequency of low-mass stars is comparable to that of main-sequence M-dwarfs, less than half that of solar-type main-sequence stars, and 3.5 to 5 times lower than in the Taurus-Auriga and Scorpius-Centaurus star-forming regions. We find the binary frequency of low-mass stars in the periphery of the cluster to be the same or only slightly higher than for stars in the cluster core (<3 arcmin from θ^1C Ori). This is in contrast to the prediction of the theory that the low binary frequency in the cluster is caused by the disruption of binaries due to dynamical interactions. There are two ways out of this dilemma: Either the initial binary frequency in the Orion Nebula Cluster was lower than in Taurus-Auriga, or the Orion Nebula Cluster was originally much denser and dynamically more active.

Accepted by Astronomy and Astrophysics

astro-ph/0607670, http://www.strw.leidenuniv.nl/˜koehler/Papers/index.html

2MASS wide field extinction maps - I. The Pipe nebula

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Aims. We present a $8^\circ \times 6^\circ$, high resolution extinction map of the Pipe nebula using 4.5 million stars from the Two Micron All Sky Survey (2MASS) point source catalog.
Methods. The use of NICER (Lombardi & Alves 2001, A&A, 377, 1023), a robust and optimal technique to map the dust column density, allows us to detect a $A_{\rm V} = 0.5$ mag extinction at a 3-σ level with a 1 arcmin resolution.
Results. (i) We find for the Pipe nebula a normal reddening law, $E(J-H) = (1.85 \pm 0.15) E(H-K)$. (ii) We measure the cloud distance using Hipparchos and Tycho parallaxes, and obtain 130^{+24}_{-58} pc. This, together with the total estimated mass, $10^4\ M_\odot$, makes the Pipe the closest massive cloud complex to Earth. (iii) We compare the NICER extinction map to the NANTEN ^{12}CO observations and derive with unprecedented accuracy the relationship between the near-infrared extinction and the ^{12}CO column density and hence (indirectly) the ^{12}CO X-factor, that we estimate to be $2.91 \times 10^{20}\ {\rm cm^{-2}\,K^{-1}\,km^{-1}\,s}$ in the range $A_{\rm V} \in [0.9, 5.4]$ mag. (iv) We identify approximately 1500 OH/IR stars located within the Galactic bulge in the direction of the Pipe field. This represents a significant increase of the known numbers of such stars in the Galaxy.
Conclusions. Our analysis confirms the power and simplicity of the color excess technique to study molecular clouds. The comparison with the NANTEN ^{12}CO data corroborates the insensitivity of CO observations to low column densities (up to approximately 2 mag in $A_{\rm V}$), and shows also an irreducible uncertainty in the dust-CO correlation of about 1 mag of visual extinction.

Published by Astronomy & Astrophysics (Vol. 454, p. 781)

The First Jet in the Universe: Protostellar Jets from the First Stars

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The protostellar jets driven by the formation of the first stars are studied by using three-dimensional MHD nested grid simulations. Starting from a slowly rotating spherical cloud of $5.1 \times 10^4\, M_\odot$ permeated by a uniform magnetic field, we follow the evolution from the central number density $n_{\rm c} = 10^3\,{\rm cm}^{-3}$ to $n_c \simeq 10^{23}\,{\rm cm}^{-3}$. Protostars of $\simeq 10^{-3}\, M_\odot$ are formed at $n_{\rm c} \simeq 10^{22}\,{\rm cm}^{-3}$, and the magnetic flux density is amplified by 10 orders of magnitude from the initial value. Consequently, the formed protostar possesses the magnetic field of $\sim 10^6$ G, which is much larger than the flux density of the present counterparts, reflecting the fact that the dissipation of a magnetic field is ineffective in primordial gas clouds. If the initial magnetic field $B > 10^{-9} (n_{\rm c}/10^3\,{\rm cm}^{-3})^{2/3}\,$G, the protostellar jet is launched, whose velocity reaches ~ 70 km s^{-1}. As a result, a fraction $(3 - 10\%)$ of the accreting matter is blown off from the central region. If this jet continues to sweep out the surrounding gas that otherwise accretes onto the central star or circumstellar disk, the final mass of the first star can be substantially reduced. In addition, dense post-shock regions behind the bow shocks are expected to promote the chemical reactions, and this provides possible environments for subsequent low-mass star formation in the early universe.

Accepted by The Astrophysical Journal Letters

http://arxiv.org/abs/astro-ph/0605146

A low fraction of nitrogen in molecular form in a dark cloud

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Nitrogen is the fifth most abundant element in the Universe. In the interstellar medium, it has been thought to be mostly molecular (N_2). However, N_2 has no observable rotational or vibrational transitions, so its abundance in the interstellar medium remains poorly known. In comets, the N_2 abundance is very low, while the elemental nitrogen abundance is deficient with respect to the solar value. Moreover, large nitrogen isotopic anomalies are observed in meteorites and interstellar dust particles. Here we report the N_2H^+ (and by inference the N_2) abundance inside a cold dark molecular cloud. We find that only a small fraction of nitrogen in the gas phase is molecular, with most of it being atomic. Because the compositions of comets probably reflect those of dark clouds, this result explains the low N_2 abundance in comets. We argue that the elemental nitrogen abundance deficiency in comets can be understood if the atomic oxygen abundance is lower than predicted by present chemical models. Furthermore, the lack of molecular nitrogen in molecular clouds explains the nitrogen anomalies in meteorites and interstellar dust particles, as nitrogen fractionation is enhanced if gaseous nitrogen is atomic.

Accepted by Nature

http://www.nature.com/nature/journal/v442/n7101/abs/nature04919.html

Images of the Vega Dust Ring at 350 and 450 μm: New Clues to the Trapping of Multiple-Sized Dust Particles in Planetary Resonances

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We have used the SHARC II camera at Caltech Submillimeter Observatory to make 350 and 450 μm images of the

Vega dust disk at spatial resolutions (FWHM) of 9.″7 and 11.″1, respectively. The images show a ringlike morphology (radius ∼ 100 AU) with inhomogeneous structure that is qualitatively different from that previously reported at 850 μm and longer wavelengths. We attribute the 350/450 μm emission to a grain population whose characteristic size (∼1 mm) is intermediate between that of the centimeter-sized grains responsible for emission longward of 850 μm and the much smaller grains ($\lesssim$18 μm) in the extensive halo, visible at 70 μm, discussed by Su et al. We have combined our submillimeter images with Spitzer data at 70 μm to produce two-dimensional maps of line-of-sight optical depth (relative column density). These "tau maps" suggest that the millimeter-sized grains are located preferentially in three symmetrically located concentrations. If so, then this structure could be understood in terms of the Wyatt model in which planetesimals are trapped in the mean motion resonances of a Neptune-mass planet at 65 AU, provided allowance is made for the spatial distribution of dust grains to differ from that of the parent planetesimals. The peaks of the tau maps are, in fact, located near the expected positions corresponding to the 4 : 3 resonance. If this identification is confirmed by future observations, it would resolve an ambiguity with regard to the location of the planet.

Published by The Astrophysical Journal (Vol. 646, p. L77)

Velocity study of axisymmetric protostellar jets with molecular cooling

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Jets of gas released from young stars excavate cavities and drive bipolar outflows. The outflow properties may be related to the speed of the jets. To test this, we study the propagation of supersonic over-dense jets through axisymmetric hydrodynamic simulations with radiative cooling and chemistry, building on previous studies by injecting molecular and atomic jets with a wide range of speeds, between 50 and 300 km s^{-1}, into both molecular and atomic media. We show that the high collimation of outflows driven by molecular jets holds for all jet speeds. At the higher speeds, we find that the jet Mach number is the critical parameter which determines the shape of the cavity and the cavity is filled with atomic gas. However, at low speeds the jet material is the key factor with atomic jets producing much wider cavities while molecular jets produce narrow cool molecular sheaths. A Mach disk is associated with the leading edge of the atomic simulations while oblique shocks which refocus the jet are found in molecular flows. We also examine the mass spectra (distribution of mass with radial velocity), generally finding quite shallow relationships for all jet speeds (i.e the γ index is typically 1–2). Steep molecular mass spectra are, however, associated with the atomic–jet/molecular–medium combination. We conclude that the properties of bipolar outflows possess signatures related to the jet speed but are probably more sensitive to other factors.

Accepted by MNRAS

Can We Trust the Dust? Evidence of Dust Segregation in Molecular Clouds

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Maps of estimated dust column density in molecular clouds are usually assumed to reliably trace the total gas column density structure. In this work we present results showing a clear discrepancy between the dust and the gas distribution in the Taurus molecular cloud complex. We compute the power spectrum of a 2MASS extinction map of the Taurus region and find it is much shallower than the power spectrum of a ^{13}CO map of the same region previously analyzed. This discrepancy may be explained as the effect of grain growth on the grain extinction efficiency. However, this would require a wide range of maximum grain sizes, which is ruled out based on constraints from the extinction curve and the available grain models. We show that major effects due to CO formation and depletion are also ruled out. Our result may therefore suggest the existence of intrinsic spatial fluctuations of the dust to gas ratio, with amplitude increasing toward smaller scales. Preliminary results of numerical simulations of trajectories of inertial particles in turbulent flows illustrate how the process of clustering of dust grains by the cloud turbulence may lead to observable effects. However, these results cannot be directly applied to large scale supersonic and magnetized turbulence at present.

Accepted by Astrophysical Journal

Ion dynamics and the magnetorotational instability in weakly-ionized discs

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The magnetorotational instability (MRI) of a weakly ionized, differentially rotating, magnetized plasma disc is investigated in the multi-fluid framework. The disc is threaded by a uniform vertical magnetic field and charge is carried by electrons and ions only. The inclusion of ion inertia causes significant modification to the conductivity tensor in a weakly ionized disc. The parallel, Pedersen and Hall component of conductivity tensor becomes time dependent quantities resulting in ac and dc components of the conductivity. The time dependence of the conductivity causes significant modification to the parameter window of magnetorotational instability .

The effect of ambipolar and Hall diffusion on the linear growth of the magnetorotational instability is examined in the presence of time dependent conductivity tensor. We find that the growth rate in the ambipolar regime can become somewhat larger than the rotational frequency, especially when the departure from ideal MHD is significant. Further, the instability operates on large scale lengths. This has important implication for angular momentum transport in the disc.

When charged grains are the dominant ions, their inertia will play important role near the mid plane of the protoplanetary discs. Ion inertia could also be important in transporting angular momentum in accretion discs around compact objects, in cataclysmic variables. For example, in cataclysmic variables, where mass flows from a companion main sequence star on to a white dwarf, the ionization fraction in the disc can vary in a wide range. The ion inertial effect in such a disc could significantly modify the magnetorotational instability and threfore, this instability could be a possible driver of the observed turbulent motion.

Accepted by MNRAS

http://arxiv.org/abs/astro-ph/0604486

Chemical differentiation in regions of high-mass star formation I. CS, dust and N_2H^+ in southern sources

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Aims. Our goals are to compare the CS, N_2H^+ and dust distributions in a representative sample of high-mass star

forming dense cores and to determine the physical and chemical properties of these cores.
Methods. We compare the results of CS(5–4) and 1.2 mm continuum mapping of twelve dense cores from the southern hemisphere presented in this work, in combination with our previous N_2H^+(1–0) and CS(2–1) data. We use numerical modeling of molecular excitation to estimate physical parameters of the cores.
Results. Most of the maps have several emission peaks (clumps). Mean sizes of 17 clumps, having counterparts in continuum and CS, are 0.30(0.06) pc (continuum) and 0.51(0.07) pc (CS). For the clumps with IRAS sources we derived dust temperatures: 24–35 K, masses: 90–6900 $M_\odot$, molecular hydrogen column densities: $(0.7-12.0)\times10^{23}$ cm^{-2} and luminosities: $(0.6-46.0)\times10^4\ L_\odot$. LVG densities towards CS peaks within the 50″ beam (0.56 pc at 2.3 kpc, the average distance of our sample source) vary from source to source in the range: (3–40)$\times10^5$ cm^{-3}. Masses calculated from LVG densities are higher than CS virial masses and masses derived from continuum data, implying small-scale clumpiness of the cores. The molecular abundances towards IRAS sources in eight objects are X(CS)=$(0.3-2.7)\times10^{-9}$ and $X(N_2H^+)$=$(0.3-4.4)\times10^{-10}$. The CS and continuum maps have been compared with each other and with the N_2H^+(1–0) maps. For most of the objects, the CS and continuum peaks are close to the IRAS point source positions. The CS(5–4) intensities correlate with continuum fluxes per beam in all cases, but only in five cases with the N_2H^+(1–0) intensities. The study of spatial variations of molecular integrated intensity ratios to continuum fluxes per beam reveals that $I(N_2H^+)/F_{1.2}$ ratios drop towards the CS peaks for most of the sources, which can be due to a N_2H^+ abundance decrease. For CS(5–4), the $I(\mathrm{CS})/F_{1.2}$ ratios show no clear trends with distance from the CS peaks, while for CS(2–1) such ratios drop towards these peaks. Possible explanations of these results are considered. The analysis of normalized velocity differences between CS and N_2H^+ lines has not revealed indications of systematic motions towards CS peaks.

Accepted by Astronomy and Astrophysics

astro-ph/0608015

A compact dusty disk around the Herbig Ae star HR 5999 resolved with VLTI / MIDI

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We have used mid-infrared long-baseline interferometry to resolve the circumstellar material around the Herbig Ae star HR 5999, providing the first direct measurement of its angular size, and to derive constraints on the spatial distribution of the dust. MIDI at the VLTI was used to obtain a set of ten spectrally dispersed ($8-13\,\mu$m) interferometric measurements of HR 5999 at different projected baseline lengths and position angles. To derive constraints on the geometrical distribution of the dust, we compared our interferometric measurements to 2D, frequency-dependent radiation transfer simulations of circumstellar disks and envelopes. The derived visibility values between ∼0.5 and ∼0.9 show that the mid-infrared emission from HR 5999 is clearly resolved. The characteristic size of the emission region depends on the projected baseline length and position angle, and it ranges between $\sim 5-15$ milliarcseconds (Gauss FWHM), corresponding to remarkably small physical sizes of $\sim 1-3$ AU. For disk models with radial power-law density distributions, the relatively weak but very extended emission from outer disk regions ($\geq$ 3 AU) leads to model visibilities that are significantly lower than the observed visibilities, making these models inconsistent with the MIDI data. Disk models in which the density is truncated at outer radii of $\sim 2-3$ AU, on the other hand, provide good agreement with the data. A satisfactory fit to the observed MIDI visibilities of HR 5999 is found with a model of a geometrically thin disk that is truncated at 2.6 AU and seen under an inclination angle of 58 deg (i.e. closer to an edge-on view than to a face-on view). Neither models of a geometrically thin disk seen nearly edge-on, nor models of spherical dust shells can achieve agreement between the observed and predicted visibilities. The reason why the disk is so compact remains unclear; we speculate that it has been truncated by a close binary companion.

Accepted by Astronomy & Astrophysics

http://www.mpifr-bonn.mpg.de/staff/tpreibis/publications.html

Structure of Passive Circumstellar Disks: Beyond the Two-Temperature Approximation

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The structure and spectral energy distributions (SEDs) of externally irradiated circumstellar disks are often computed on the basis of the two-temperature model of Chiang & Goldreich. We refine these calculations by using a more realistic temperature profile that is continuous at all optical depths and thus goes beyond the two-temperature model. It is based on the approximate solution of the radiation transfer in the disk obtained from the frequency-integrated moment equations in the Eddington approximation. We come up with a simple procedure ("constant g_z approximation") for treating the vertical structure of the disk in regions where its optical depth to stellar radiation is high. This allows us to obtain expressions for the vertical profiles of density and pressure at every point in the disk and to determine the shape of its surface. Armed with these analytical results, we calculate the full radial structure of the disk and demonstrate that it favorably agrees with the results of direct numerical calculations. We also describe a simple and efficient way of the SED calculation based on our adopted temperature profile. Resulting spectra provide very good matches (especially at short wavelengths) to the results of more detailed (but also more time-consuming) SED calculations that solve the full frequency- and angle-dependent radiation transfer within the disk.

Published by The Astrophysical Journal (Vol. 646, p. 275)

Microwave Emission from Spinning Dust in Circumstellar Disks

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In the high-density environments of circumstellar disks dust grains are expected to grow to large sizes by coagulation. Somewhat unexpectedly, recent near-IR observations of PAH features from disks around Herbig Ae/Be stars demonstrate that a substantial amount of dust mass in the surface layers of these disks (up to several tens of percent of the local carbon content) can be locked up in small nanometer-sized particles. We investigate the possibility of detecting the electric dipole emission produced by these nanoparticles (sizes ~ 1 nm) as they spin at thermal rates (tens of GHz) in cold gas. We show that such emission peaks in the microwave range and dominates over the thermal disk emission at $\nu \lesssim 50$ GHz typically by a factor of several if $\gtrsim$ 5total carbon abundance is locked up in nanoparticles. We test the sensitivity of this prediction to various stellar and disk parameters and show that if the potential contamination of the spinning dust component by the free-free and/or synchrotron emission can be removed, then the best chances of detecting this emission would be in disks with small opacities, having SEDs with steep submillimeter slopes (which minimize thermal disk emission at GHz frequencies). Detection of the spinning dust emission would provide important evidence for the existence, properties, and origin of the population of small dust particles in protoplanetary disks, with possible ramifications for planet formation.

Published by The Astrophysical Journal (Vol. 646, p. 288)

A Correlation between Pre-Main-Sequence Stellar Rotation Rates and IRAC Excesses in Orion

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Early observations of T Tauri stars suggested that stars with evidence of circumstellar accretion disks rotated slower than stars without such evidence, but more recent results are not as clear. Near-IR circumstellar disk indicators, although the most widely available, are subject to uncertainties that can result from inner disk holes and/or the system inclination. Mid-infrared observations are less sensitive to such effects, but until now, these observations have been difficult to obtain. The Spitzer Space Telescope now easily enables mid-infrared measurements of large samples of PMS stars covering a broad mass range in nearby star-forming regions. Megeath and collaborators surveyed the Orion Molecular Clouds ($\sim$ 1 Myr) with the IRAC instrument (3.6, 4.5, 5.8, 8 μm) as part of a joint IRAC and MIPS GTO program. We examine the relationship between rotation and Spitzer mid-IR fluxes for 900 stars in Orion for stars between 3 and 0.1 $M_\odot$. We find in these Spitzer data the clearest indication to date that stars with longer periods are more likely than those with short periods to have IR excesses suggestive of disks.

Published by The Astrophysical Journal (Vol. 646, p. 297)

Meteoritical and dynamical constraints on the growth mechanisms and formation times of asteroids and Jupiter

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Peak temperatures inside meteorite parent bodies are closely linked to accretion times. Most iron meteorites come from bodies that accreted ¡0.5 Myr after CAIs formed and were melted by 26Al and 60Fe, probably inside 2 AU. Chondrite groups accreted intermittently over 4 Myr starting 1 Myr after CAIs formed when planetary embryos may already have formed near 1 AU. Meteorite evidence precludes accretion of late-forming chondrites on the surface of early-formed bodies; instead chondritic and non-chondritic meteorites probably formed in separate planetesimals. Maximum metamorphic temperatures in chondrite groups correlate inversely with mean chondrule age, as expected for 26Al heating. Dynamical models suggest that asteroids accreted before Jupiter. Therefore Jupiter probably reached its current mass ¿3-5 Myr after CAIs formed. This precludes formation of Jupiter via a gravitational instability ¡1 Myr after the solar nebula formed, and strongly favors core accretion. Shocks formed by gravitational instabilities in the disk, proto-Jupiter, and planetary embryos may have generated chondrules. The minimum lifetime for the solar nebula of 3-5 Myr inferred from CAI and chondrule ages may exceed the median lifetime for protoplanetary disks of 3 Myr, but is well within the total range of 1-10 Myr. Shorter formation times for extrasolar planets may help to explain why their orbits are unlike those of solar giant planets.

Accepted by Icarus

http://arxiv.org/abs/astro-ph/0607317

Evolution of HII regions in hierarchically structured molecular clouds

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We present observations of the H 91α recombination line emission towards a sample of nine HII regions associated with 6.7-GHz methanol masers, and report arcsecond-scale emission around compact cores. We derive physical parameters for our sources, and find that although simple hydrostatic models of region evolution reproduce the observed region sizes, they significantly underestimate emission measures. We argue that these findings are consistent with young source ages in our sample, and can be explained by existence of density gradients in the ionised gas.

Accepted by MNRAS

High-Resolution Spectroscopy in Tr 37: Gas Accretion Evolution in Evolved Dusty Disks

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Using the Hectochelle multifiber spectrograph, we have obtained high-resolution (R∼34,000) spectra in the Hα region for a large number of stars in the 4 Myr-old cluster Tr 37, containing 146 previously known members and 26 newly identified ones. We present the Hα line profiles of all members, compare them to our IR observations of dusty disks (2MASS/JHK + IRAC + MIPS 24μm), use the radial velocities as a membership criterion, and calculate the rotational velocities. We find a good correlation between the accretion-broadened profiles and the presence of protoplanetary disks, noting that a small fraction of the accreting stars presents broad profiles with Hα equivalent widths smaller than the canonical limit separating CTTS and WTTS. The number of strong accretors appears to be lower than in younger regions, and a large number of CTTS have very small accretion rates ($\dot{M} \leq 10^{-9} M_{\odot}$/yr). Taking into account that the spectral energy distributions are consistent with dust evolution (grain growth/settling) in the innermost disk, this suggests a parallel evolution of the dusty and gaseous components. We also observe that about half of the "transition objects" (stars with no IR excesses at $\lambda \leq 6$ μm) do not show any signs of active accretion, whereas the other half is accreting with accretion rates $\leq 10^{-9} M_{\odot}$/yr. These zero or very low accretion rates reveal important gas evolution and/or gas depletion in the innermost disk, which could be related to grain growth up to planetesimal or even planet sizes. Finally, we examine the rotational velocities of accreting and non accreting stars, finding no significant differences that could indicate disk locking at these ages.

Accepted by AJ

http://arxiv.org/abs/astro-ph/0607534

A Simultaneous Optical and X-ray Variability Study of the Orion Nebula Cluster. I. Incidence of Time-Correlated X-ray/Optical Variations

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We present a database of $BVRI$ time-series photometry of the Orion Nebula Cluster obtained with two ground-based telescopes at different longitudes to provide simultaneous coverage with the 13-d Chandra observation of the cluster. The resulting database of simultaneous optical and X-ray light curves for some 800 pre–main-sequence (PMS) stars represents, by a factor of hundreds, the largest synoptic, multi–wavelength-regime, time-series study of young stars to date. This database will permit detailed analyses of the relationship between optical and X-ray variability among a statistically significant ensemble of PMS stars, with the goal of elucidating the origins of PMS X-ray production. In this first paper, we present the optical observations, describe the combined X-ray/optical database, and perform an analysis of time-correlated variability in the optical and X-ray light curves. We identify 40 stars (representing 5% of our study sample) with possible time-correlated optical and X-ray variability. Examples of both positive and negative time-correlations are found, possibly representing X-ray flares and persistent coronal features associated with both cool and hot surface spots (i.e. magnetically active regions and accretion shocks). We also find two possible examples of "white-light" flares coincident with X-ray flares; these may correspond to the impulsive heating phase in solar-analog flares. However, though interesting, these represent unusual cases. More generally, we find very little evidence to suggest a direct causal link between the sources of optical and X-ray variability in PMS stars. The conclusion that accretion is a primary driver of X-ray production in PMS stars is not supported by our findings.

Accepted by ApJ

http://people.vanderbilt.edu/ keivan.stassun/pubs.htm

NGC 7419: a young open cluster with a number of very young intermediate mass pre-MS stars

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We present a photometric and spectroscopic study of the young open cluster NGC 7419, which is known to host a large number of classical Be stars for reasons not well understood. Based on CCD photometric observations of 327 stars in UBV passbands, we estimated the cluster parameters as, reddening [E(BV)] = 1.65 ± 0.15 mag and distance = 2900 ± 400 pc. The turn-off age of the cluster was estimated as 25 ± 5 Myr using isochrone fits. UBV data of the stars were combined with the JHK data from Two-Micron All-Sky Survey (2MASS) and were used to create the near-infrared (NIR) (J-H) versus (H-K) colour-colour diagram. A large fraction of stars (42 per cent) was found to have NIR excess and their location in the diagram was used to identify them as intermediate mass pre-main-sequence (MS) stars. The isochrone fits to pre-MS stars in the optical colour-magnitude diagram showed that the turn-on age of the cluster is 0.3-3 Myr. This indicates that there has been a recent episode of star formation in the vicinity of the cluster.

Slitless spectra were used to identify 27 stars which showed Hα in emission in the field of the cluster, of which six are new identifications. All these stars were found to show NIR excess and are located closer to the region populated by Herbig Ae/Be stars in the (J-H) versus (H-K) diagram. Slit spectra of 25 stars were obtained in the region 3700-9000 ÅṪhe spectral features were found to be very similar to those of Herbig Be stars. These stars were found to be more reddened than the main-sequence stars by 0.4 mag, on an average. Thus, the emission-line stars found in this cluster are more similar to the Herbig Be-type stars where the circumstellar material is the remnant of the accretion disc. We conclude that the second episode of star formation has led to the formation of a large number of Herbig Be stars as well as intermediate mass pre-MS stars in the field of NGC 7419, thus explaining the presence of emission-line stars in this cluster. This could be one of the young open clusters with the largest number of Herbig Be stars.

Published by The Monthly Notices of the Royal Astronomical Society (Vol. 370, p. 743)

ASTE Observations of Warm Gas in Low-mass Protostellar Envelopes: Different Kinematics between Submillimeter and Millimeter Lines

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With the ASTE telescope, we have made observations of three low-mass protostellar envelopes around L483, B335, and L723 in the submillimeter CS (J=7–6) and HCN (J=4–3) lines. We detected both the CS and HCN lines toward all the targets, and the typical CS intensity ($\sim$ 1.0 K in T_B) is twice higher than that of the HCN line. Mapping observations of L483 in these lines have shown that the submillimeter emissions in the low-mass protostellar envelope are resolved, exhibit a western extension from the central protostar, and that the deconvolved size is $\sim$ 5500 AU $\times$ 3700 AU (P.A. = 78°) in the HCN emission. The extent of the submillimeter emissions in L483 implies the presence of higher-temperature ($\geq$ 40 K) gas at 4000 AU away from the central protostar, which suggests that we need to take 2-dimensional radiative transfer models with a flattened disklike envelope and bipolar cavity into account to explain the temperature structure inside the low-mass protostellar envelope. The position-velocity diagrams of these submillimeter lines in L483 and B335 exhibit different velocity gradients from those found in the previous millimeter observations. In particular, along the axis of the associated molecular outflow the sense of the velocity gradient traced

by the submillimeter lines is opposite to that of the millimeter observations or the associated molecular outflow, both in L483 and B335. We suggest that expanding gas motions at the surface of the flattened disklike envelope around the protostar, which is irradiated from the central star directly, are the origin of the observed submillimeter velocity structure.

Accepted by Publications of the Astronomical Society of Japan

astro-ph/0608100

HCN and HNC mapping of the protostellar core Cha-MMS1

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Aims. The purpose of this study is to investigate the distributions of the isomeric molecules HCN and HNC and estimate their abundance ratio in the protostellar core Cha-MMS1 located in Chamaeleon I.

Methods. The core was mapped in the $J = 1 - 0$ rotational lines of HCN, HNC, and $HN^{13}C$. The column densities of $H^{13}CN$, $HN^{13}C$, $H^{15}NC$ and NH_3 were estimated towards the centre of the core.

Results. The core is well delineated in all three maps. The kinetic temperature in the core, derived from the NH_3 (1,1) and (2,2) inversion lines, is 12.1 ± 0.1 K. The $HN^{13}C/H^{13}CN$ column density ratio is between 3 and 4, i.e. similar to values found in several other cold cores. The $HN^{13}C/H^{15}NC$ column density ratio is ~ 7. In case no ^{15}N fractionation occurs in HNC (as suggested by recent modelling results), the $HNC/HN^{13}C$ abundance ratio is in the range $30 - 40$, which indicates a high degree of ^{13}C fractionation in HNC. Assuming no differential ^{13}C fractionation the HCN and HNC abundances are estimated to be $\sim 7\,10^{-10}$ and $\sim 2\,10^{-9}$, respectively, the former being nearly two orders of magnitude smaller than that of NH_3. Using also previously determined column densities in Cha-MMS1, we can put the most commonly observed nitrogenous molecules in the following order according to their fractional abundances: $\chi(NH_3) > \chi(HC_3N) > \chi(HNC) > \chi(HCN) > \chi(N_2H^+)$.

Conclusions. The relationships between molecular abundances suggest that Cha-MMS1 represents an evolved chemical stage, experiencing at present the 'late-time' cyanopolyyne peak. The possibility that the relatively high HNC/HCN ratio derived here is only valid for the ^{13}C isotopic substitutes cannot be excluded on the basis of the present and other available data.

Accepted by A&A

astro-ph/0606547

"Propeller" Regime of Disk Accretion to Rapidly Rotating Stars

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We present results of axisymmetric magnetohydrodynamic simulations of the interaction of a rapidly rotating, magnetized star with an accretion disk. The disk is considered to have a finite viscosity and magnetic diffusivity. The main parameters of the system are the star's angular velocity and magnetic moment, and the disk's viscosity and diffusivity. We focus on the "propeller" regime where the inner radius of the disk is larger than the corotation radius. Two types of magnetohydrodynamic flows have been found as a result of simulations: "weak" and "strong" propellers.

The strong propellers are characterized by a powerful disk wind and a collimated magnetically dominated outflow or jet from the star. The weak propellers have only weak outflows. We investigated the time-averaged characteristics of the interaction between the main elements of the system: the star, the disk, the wind from the disk, and the jet. Rates of exchange of mass and angular momentum between the elements of the system are derived as a function of the main parameters. The propeller mechanism may be responsible for the fast spinning down of the classical T Tauri stars in the initial stages of their evolution and for the spinning down of accreting millisecond pulsars.

Published by The Astrophysical Journal (Vol. 646, p. 304)

Two Evolutionary Paths of an Axisymmetric Gravitational Instability in the Dust Layer of a Protoplanetary Disk

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We perform nonlinear numerical simulations to investigate the density evolution in the dust layer of a protoplanetary disk due to gravitational instability and dust settling toward the midplane. We restrict our study to the region where the radial pressure equilibrium is negligible so that the shear-induced instability is avoided, and we also restrict our model to an axisymmetric perturbation as a first step of nonlinear numerical simulations of the gravitational instability. We find that there are two different evolutionary paths of the gravitational instability, depending on the nondimensional gas friction time, which is defined as the product of the gas friction time and the Keplerian angular velocity. If the nondimensional gas friction time is equal to 0.01, the gravitational instability grows faster than dust settling. On the other hand, if the nondimensional gas friction time is equal to 0.1, dust aggregates settle sufficiently before the gravitational instability grows. In the latter case, an approximate analytical calculation reveals that dust settling is faster than the growth of the gravitational instability, regardless of the dust density at the midplane. Thus, the dust layer becomes extremely thin and may reach a few tenths of the material density of the dust before the gravitational instability grows, as long as there is no turbulence.

Published by The Astrophysical Journal (Vol. 646, p. L155)

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The closing date is 11th September 2006.
Interviews are planned for 2 October 2006.

Post-Doctoral Position in Submillimetre Astronomy at the University of Western Ontario.

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Assistant Professor
Canada Research Chair in star formation
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Postdoctoral Fellowship on Young Stellar Objects, their Surroundings and Jets

INAF - Osservatorio Astronomico di Palermo (OAPa) Giuseppe S. Vaiana will appoint one fellow in the area of Astrophysics under the European Commission's Marie Curie Actions Host Fellowship - Transfer of Knowledge programme "Young Stellar Objects, their Surroundings and Jets: Advanced Observational and MHD Studies" (PHOENIX). The selected fellow will work in one of the following areas:

1. Physics of YSOs and protostellar jets, with specific expertise on data analysis and emission processes in the optical and/or infrared and/or radio bands;
2. MHD of the astrophysical plasmas aimed at modeling the ambient medium surrounding YSOs and its interaction with the central star and with the protostellar jets.

The fellowship is expected to start before the end of January 2007 and to last 24 months.

Candidates should have a PhD or at least four years of full-time research experience at postgraduate level in a relevant field. In either case the candidate cannot have more than ten years of research experience.

Gross salary is fixed at 3889.25 Euro per month, for the duration of the contract, plus a mobility allowance.

Female candidates are explicitly encouraged to apply.

For eligibility and application details please check the PHOENIX website
http://www.astropa.unipa.it/ orlando/PHOENIX/POSITION/

All documents should arrive by October 31, 2006 at:

INAF - Osservatorio Astronomico di Palermo
Marie Curie Fellowship Selection (PHOENIX)
Piazza del Parlamento 1
I-90134 Palermo,
ITALY

For further information contact:
Salvatore Orlando - orlando@astropa.inaf.it
or
http://www.astropa.unipa.it/ orlando/PHOENIX

The Star Formation Newsletter is a vehicle for fast distribution of information of interest for astronomers working on star formation and molecular clouds. You can submit material for the following sections: *Abstracts of recently accepted papers* (only for papers sent to refereed journals), *Abstracts of recently accepted major reviews* (not standard conference contributions), *Dissertation Abstracts* (presenting abstracts of new Ph.D dissertations), *Meetings* (announcing meetings broadly of interest to the star and planet formation and early solar system community), *New Jobs* (advertising jobs specifically aimed towards persons within the areas of the Newsletter), and *Short Announcements* (where you can inform or request information from the community).

Latex macros for submitting abstracts and dissertation abstracts (by e-mail to reipurth@ifa.hawaii.edu) are appended to each issue of the newsletter. You can also submit via the Newsletter web interface at http://www2.ifa.hawaii.edu/star-formation/index.cfm
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The Star Formation Newsletter is available on the World Wide Web at http://www.ifa.hawaii.edu/users/reipurth or at http://www.eso.org/gen-fac/pubs/starform/ .

Graduate Position on Spectral Surveys of High-Mass Star-Forming Regions

At the Kapteyn Astronomical Institute of the University of Groningen and the Netherlands Institute for Space Research (SRON) a graduate position is available on: Spectral surveys of high-mass star-forming regions with JCMT and HIFI/Herschel Supervisors: Prof. Dr. M. Spaans (Kapteyn), Dr. F.F.S. van der Tak (SRON) and Dr. F.P. Helmich (SRON). This PhD project revolves around basic questions like: What is the physical structure of the molecular gas from which high-mass stars form? What is the effect of a clustered environment on the mass distribution of star-forming regions? What are good Galactic templates for extra-galactic star formation? The latter question is particularly pertinent because despite a wealth of observational data on both galactic and extra-galactic star formation, their relation remains basically unknown. In this light, the PhD candidate will analyze and interpret observations of molecular lines obtained in unbiased spectral surveys of two regions of Galactic high-mass star formation: AFGL 2591 and W49. The first object is a relatively nearby (1 kpc) region of isolated star formation. The second object is a very massive and luminous ($10^7 L_0$) region of clustered star formation located on the other side of our Galaxy (11 kpc). The basic goal of this project is to understand the similarities and differences between the AFGL 2591 and W49 regions in terms of physics and chemistry. The PhD candidate will then make a further comparison with regions of solar-mass star formation (such as IRAS 16293) and extra-galactic star formation (such as 30 Doradus) for which similar data already exist. This will lead to further insights into the star formation process, such as the scaling laws from the Solar neighbourhood to external (active) galaxies. Data in the 330-360 GHz window will be obtained with the HARP-B instrument on the JCMT telescope. The 500-2000 GHz data will come from the HIFI instrument onboard the Herschel space observatory. This research project is related to a HIFI/Herschel key project on 'Spectral surveys of Star-forming regions'. The research project is essential in the preparation for and subsequent interpretation of these HIFI data. The position is open to students of all nationalities with a Master (or equivalent) degree in astronomy, physics or chemistry. It is beneficial to have experience with spectroscopic data and/or molecular astrophysics. The study is expected to lead directly to a PhD degree at the University of Groningen within a period of four years. Applications should include a curriculum vitae (with a list of university courses and grades), a statement of research experience, and two letters of reference, and should arrive via email, FAX, or regular post no later than 1 October 2006 addressed to:

Prof. Dr. M. Spaans
Kapteyn Astronomical Institute
University of Groningen
P.O. Box 800
9700 AV Groningen, the Netherlands
email: spaans@astro.rug.nl
phone: +31-50-3634094, Fax: +31-50-3636100

Further information can be obtained from Prof. M. Spaans (spaans@astro.rug.nl), Dr. F.F.S. van der Tak (vdtak@sron.rug.nl) and Dr. F.P. Helmich (f.p.helmich@sron.rug.nl).

Gordon Conference on Origins of Solar Systems - note change of venue

The 2007 Gordon Research Conference on Origins of Solar Systems will be held at Mt. Holyoke College in South Hadley, MA on 8-13 July 2007. This unique interdisciplinary meeting includes astronomers and astrophysicists interested in star and planet formation, planetary scientists and meteoriticists interested in the early history of the Solar System, and plasma and life scientists. This meeting is much broader than most conferences and many fruitful research collaborations have been initiated at Gordon conferences, encouraged by the relaxed pace of the meeting (the Chair has this experience himself).

If you are interested in the subject matter; if you would like to attend a meeting which is not packed solid with talks, but has a limited number of overview talks; if you would enjoy spending extended time reading posters (or would like to have plenty of time for people to look at your poster and even speak with you); and if you might like participating in evening beverage sessions with colleagues from a wide variety of backgrounds, this is the meeting for you.

The Chair and Vice-Chair of the 2007 Origins of Solar Systems conference are Lee Hartmann (Michigan) and Sara Russell (Natural History Museum, London). The program is being developed and should be mostly in place by the end of September. Information on registering, etc. will soon be available at http://www.grc.org.

CS14 Splinter Meeting

FIRST ANNOUNCEMENT

Splinter Meeting about

THE FORMATION OF LOW-MASS PROTOSTARS and PROTO-BROWN DWARFS

during the 14th Cambridge Workshop on "Cool Stars, Stellar Systems, and the Sun

at Pasadena Hilton, USA, 7 November 2006

Web page and registration details:
http://www.mpia-hd.mpg.de/homes/stein/CS14FormationSpl/

Convenors:
Jürgen Steinacker, Jochen Eislöffel, Ralf Klessen

Selected topics include: - Extrasolar planets - Planet formation - Planet atmospheres - Astrochemistry - Extremophiles - Mars and Aurora

TIME
7 November 16:00-17:30

VENUE
Hilton Hotel, Pasadena, USA

REGISTRATION:
To register visit http://ssc.spitzer.caltech.edu/mtgs/cs14/schedule.shtml
and email stein@mpia.de.

PROGRAM:
In short presentations and posters, ongoing progress in tackling the controlling physical processes of the formation of low-mass proto-stars and proto-brown dwarfs will be highlighted.

FEES:
Registration fees for the CS14 conference are applicable. Please, visit http://ssc.spitzer.caltech.edu/mtgs/cs14/schedule.shtml for details.

Coronae of Stars and Accretion Discs

12 - 13 December 2006

Max-Planck-Institute for Radioastronomy, Bonn, Germany

http://www.mpifr-bonn.mpg.de/staff/tpreibis/coronae/index.html

Meeting Context: Coronae are an ubiquitous phenomenon among a wide variety of objects. The solar corona, the best studied case, consists of magnetic loop-like structures with an extremely complex topology confining hot plasma and relativistic particles. In combination with theoretical models, detailed observations of the dynamical interaction among these solar coronal structures provide the fundament of our understanding of coronal activity. X-ray and radio observations provide clear evidence for coronae not only, as expected, in solar-like late-type stars, but also in fully convective, very low-mass stars and even in brown dwarfs. Furthermore, young stellar objects generally show highly elevated levels of coronal activity. Coronae already exist in extremely early protostellar stages where the nuclear activity has not yet started. Finally, also accretion disks, which exist around very different classes of objects such as protostars, degenerate stellar objects, and supermassive black holes, can be surrounded by a corona; a turbulent disk dynamo can drive coronal activity, which plays an important role in disk accretion as well as the launching and collimation of outflows. Whereas significant progress in our understanding of coronal physics has been made during the last years, many aspects like the generation of magnetic fields in MHD dynamos, the heating of the coronal plasma, acceleration of particles, the complexity of coronal plasma structures and their interactions still continue to pose big challenges to observers and theoreticians.

The aim of this conference is to review the current status of the knowledge about coronae in various environments, like the Sun, stars, young stellar objects, and accretion disks. An important goal is to identify physical mechanisms that are common to all environments. Observational results as well as theoretical aspects of coronal magnetic structure and evolution will be discussed in order to spotlight existing analogies and differences.

Meeting Format: The Conference will consist of four scientific sessions. In addition to four invited review talks (30+5 min) per session, contributed papers can be presented in the form of a 5 min short-talk accompanied by a poster. The schedule is as follows:

Opening Talk: E. Rieger: Discovering a solar periodicity by chance

SESSION I: MAGNETIC RECONNECTION IN THE SUN AND STARS

1.1 Magnetic reconnection and flares – C.E. Parnell / E.R. Priest (University of St. Andrews)
1.2 Solar flares – L. Harra (Mullard Space Science Laboratory)
1.3 Preferred active longitudes in sunspot activity – S. Berdyugina (ETH Zuerich)
1.4 Stellar flaring periodicities – M. Massi (MPIfR Bonn)
1.5 Short presentations

SESSION II: SOLAR AND STELLAR CORONAE

2.1 Flux Emergenge in fast rotating stars – V. Holzwarth (University of St Andrews)
2.2 Spots on stars, Doppler Imaging – K. Strassmeier (AIP Potsdam)
2.3 X-ray and radio emission from stellar coronae – M. Güdel (Paul Scherrer Institut)
2.4 Heating the solar corona by currents – B.V. Gudiksen (University of Oslo)
2.5 Short presentations

SESSION III: YOUNG STELLAR OBJECTS

3.1 What can X-rays tell us about magnetic fields, accretion and mass loss in young stars? – T. Montmerle (Laboratoire d' Astrophysique de Grenoble)
3.2 The origin of X-ray emission from T Tauri stars – Th. Preibisch (MPIfR Bonn)
3.3 The spatial structure of coronae of T Tauri stars – M. Jardine (University of St. Andrews)
3.4 MHD aspects for star-disk-jet magnetic systems – J. Ferreira (Observatoire de Grenoble)
3.5 Short presentations

(*continued*→)

SESSION IV: ACCRETION DISCS

4.1 Accretion disc coronae in AGN/microquasars – A. Merloni (Max-Planck-Institute for Astrophysik)
4.2 Dynamos in accretion disks – A. Brandenburg (NORDITA)
4.3 Flares in accretion disk coronae – J. Malzac (Centre d'Etude Spatiale des Rayonnements)
4.4 Jet-Corona coupling – A. Lobanov (MPIfR Bonn)
4.5 Short presentations

Conference Proceedings: The conference proceedings will be published in "Memorie della Societa Astronomica Italiana" (Journal of the Italian Astronomical Society).

Scientific Organizing Committee (SOC): Manuel Güdel (Paul Scherrer Institut), Maria Massi (MPIfR, chair), Karl Menten (MPIfR), Andrea Merloni (MPIfA), Thierry Montmerle (LAOG), Thomas Preibisch (MPIfR, co-chair), Eric Priest (Un. St Andrews)

Further Information, Registration, and Abstract Submission:

Further information about the conference site and for registration and abstract submission can be found at the conference web site at `http://www.mpifr-bonn.mpg.de/staff/tpreibis/coronae/index.html` or by contacting the organizers at mmassi@mpifr-bonn.mpg.de (cc: preib@mpifr-bonn.mpg.de).

The deadline for registration and submission of abstracts is 20. September 2006. Due to space limitations, the number of participants has to be limited to 50; therefore, early registration is strongly recommended. The registration fee will be 70 Euro.

Structure Formation in the Universe: Galaxies, Stars, Planets

Chamonix, France

27 May - 1 June 2007

This is the *first annoucement* of the conference *"Structure formation in the universe"*, to be held in Chamonix, France from 27 May through 1 June 2007. The aim of the conference is to bring together researchers working in the fields of planet, star and galaxy formation in order to share their expertise and to address common physical and numerical issues in the understanding of structure formation in the present and the primordial universe.

International Scientific Organizing Committee :
P. André (CEA Saclay), I. Baraffe (ENS-Lyon), P. Bodenheimer (UCSB), V. Bromm (Austin), C. Cesarsky (ESO), G. Kauffmann (MPIA Garching), R. Klessen (Heidelberg), R. Larson (Yale), C. McKee (Berkeley), M. Mayor (Geneva), P. Myers (Harvard), J. Papaloizou (Cambridge), E. Salpeter (Cornell), F. Shu (UCSD), J. Silk (Oxford)

Scientific rationale, final program and list of speakers on: **http://chamonix2007.ens-lyon.fr/**

Organizer and contact: **G. Chabrier (ENS-Lyon; chabrier@ens-lyon.fr)**