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Abstracts of recently accepted papers

First AU-scale observations of V1647 Ori with VLTI/MIDI

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The young eruptive star V1647 Ori was observed with MIDI, the mid-infrared interferometric instrument at the Very Large Telescope Interferometer (VLTI), on March 2, 2005. We present the first spectrally resolved interferometric visibility points for this object. Our results show that (1) the mid-infrared emitting region is extended, having a size of $\approx$7 AU at 10 μm; (2) no signatures of a close companion can be seen; (3) the $8-13\,\mu$m spectrum exhibits no obvious spectral features. Comparison with similar observations of Herbig Ae stars suggests that V1647 Ori probably possesses a disk of moderate flaring. A simple disk model with $T\sim r^{-0.53}, \Sigma\sim r^{-1.5}, M_d = 0.05\,\mathrm{M}_\odot$ is able to fit both the spectral energy distribution and the observed visibility values simultaneously.

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Physical and Chemical Structure of Protoplanetary Disks with Grain Growth

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We calculate the physical structure of protoplanetary disks by evaluating the gas density and temperature self-consistently and solving separately for the dust temperature. The effect of grain growth is taken into account by assuming a power-law size distribution and varying the maximum radius of grains $a_{\rm max}$. In our fiducial model with $a_{\rm max} = 10\mu$m, the gas is warmer than the dust in the surface layer of the disk, while the gas and dust have the same temperature in deeper layers. In the models with larger $a_{\rm max}$, the gas temperature in the surface layer is lower than in the fiducial model because of reduced photo-electric heating rates from small grains, while the deeper penetration of stellar radiation warms the gas at intermediate height. A detailed chemical reaction network is solved at outer radii ($r \geq 50$ AU). Vertical distributions of some molecular species at different radii are similar, when plotted as a function of hydrogen column density $\Sigma_{\rm H}$ from the disk surface. Consequently, molecular column densities do not much depend on disk radius. In the models with larger $a_{\rm max}$, the lower temperature in the surface layer makes the geometrical thickness of the disk smaller, and the gaseous molecules are confined to smaller heights. However, if we plot the vertical distributions of molecules as a function of $\Sigma_{\rm H}$, they do not significantly depend on $a_{\rm max}$. The dependence of the molecular column densities on $a_{\rm max}$ is not significant, either. Notable exceptions are HCO^+, H_3^+ and H_2D^+, which have smaller column densities in the models with larger $a_{\rm max}$.

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http://arXiv.org/abs/astro-ph/0601230, http://nova.planet.sci.kobe-u.ac.jp/~aikawa/paper_list.html

Circular polarimetry and the line of sight to the Becklin-Neugebauer object

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The 3.1-μm absorption feature of water-ice has been observed spectroscopically in many molecular clouds and, when it has been observed spectropolarimetrically, usually a corresponding polarization feature is seen. Typically, on these occasions, and particularly for the Becklin-Neugebauer (BN) object, a distinct position angle shift between the feature and continuum is seen, which indicates both a fractionation of the icy material and a changing alignment direction along the line of sight.

Here, the dependence of circular polarimetry on fractionation along the line of sight is investigated and it is shown that the form of its spectrum, together with the sign of the position angle shift, indicates where along the line of sight the icy material lies. More specifically, a coincidence between the sign of the position angle displacement in the ice feature, measured north through east, and that of the circular polarization ice feature means that the icy grains are overlaid by bare grains. Some preliminary circular polarimetry of BN has this characteristic, and a similar situation is found in the only two other cases for which relevant observations so far exist.

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Young, Low-mass Brown Dwarfs with Mid-Infrared Excesses

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We have combined new I, J, H, and Ks imaging of portions of the Chamaeleon II, Lupus I, and Ophiuchus star-forming clouds with with 3.6 to 24 μm imaging from the Spitzer Legacy Program, "From Molecular Cores to Planet Forming Disks", to identify a sample of 19 young stars, brown dwarfs and sub-brown dwarfs showing mid-infrared excess emission. The resulting sample includes sources with luminosities of $0.5 > \log(L_*/L_\odot) > -3.1$. Six of the more luminous sources in our sample have been previously identified by other surveys for young stars and brown dwarfs. Five of the sources in our sample have nominal masses at or below the deuterium burning limit (12 M_J). Over three decades in luminosity, our sources have an approximately constant ratio of excess to stellar luminosity. We compare our observed SEDs to theoretical models of a central source with a passive irradiated circumstellar disk and test the effects of disk inclination, disk flaring, and the size of the inner disk hole on the strength/shape of the excess. The observed SEDs of all but one of our sources are well fit by models of flared and/or flat disks.

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The Stellar Mass–Accretion Rate Relation in T Tauri Stars and Brown Dwarfs

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Recent observations show a strong correlation between stellar mass and accretion rate in young stellar and sub-stellar objects, with the scaling $\dot{M}_{acc} \propto M_*^2$ holding over more than 4 orders of magnitude in accretion rate. We explore the consequences of this correlation in the context of disk evolution models. We note that such a correlation is not expected to arise from variations in disk angular momentum transport efficiency with stellar mass, and we suggest that it may reflect a systematic trend in disk initial conditions. In this case we find that brown dwarf disks initially have rather larger radii than those around more massive objects. By considering disk evolution, and invoking a simple parameterization for a shutoff in accretion at the end of the disk lifetime, we show that such models predict that the

scatter in the stellar mass–accretion rate relationship should increase with increasing stellar mass, in rough agreement with current observations! .

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Preprint available at `http://jilawww.colorado.edu/~rda/publications.html` or `astro-ph/0602059`

Photoevaporation of protoplanetary discs I: hydrodynamic models

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In this paper we consider the effect of the direct ionizing stellar radiation field on the evolution of protoplanetary discs subject to photoevaporative winds. We suggest that models which combine viscous evolution with photoevaporation of the disc (e.g. Clarke, Gendrin & Sotomayor 2001) incorrectly neglect the direct field after the inner disc has drained, at late times in the evolution. We construct models of the photoevaporative wind produced by the direct field, first using simple analytic arguments and later using detailed numerical hydrodynamics. We find that the wind produced by the direct field at late times is much larger than has previously been assumed, and we show that the mass-loss rate scales as $R_{\rm in}^{1/2}$ (where $R_{\rm in}$ is the radius of the instantaneous inner disc edge). We suggest that this result has important consequences for theories of disc evolution, and go on to consider the effects of this result on disc evolution in detail in a companion paper (Alexander, Clarke & Pringle 2006b).

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Photoevaporation of protoplanetary discs II: evolutionary models and observable properties

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We present a new model for protoplanetary disc evolution. This model combines viscous evolution with photoevaporation of the disc, in a manner similar to Clarke, Gendrin & Sotomayor (2001). However in a companion paper (Alexander, Clarke & Pringle 2006a) we have shown that at late times such models must consider the effect of stellar radiation directly incident on the inner disc edge, and here we model the observational implications of this process. We find that the entire disc is dispersed on a time-scale of order 10^5yr after a disc lifetime of a few Myr, consistent with observations of T Tauri (TT) stars. We use a simple prescription to model the spectral energy distribution of the evolving disc, and demonstrate that the model is consistent with observational data across a wide range of wavelengths. We note also that the model predicts a short "inner hole" phase in the evolution of all TT discs, and make predictions for future observations at mid-infrared and millimetre wavelengths.

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Molecular Line Mapping of the Giant Molecular Cloud Associated with RCW 106 - I: ^{13}CO

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We present the first paper in a series detailing the results of ^{13}CO observations of a ~ 1 degree square region of the Giant Molecular Cloud (GMC) complex associated with the HII region RCW 106. The ^{13}CO observations are also the first stage of a multi-molecular line study of the same region. These observations were amongst the first made using the new on-the-fly mapping capability of the Australia Telescope National Facility Mopra Telescope. In the configuration used, the instrument provided a FWHM beam size of 33 arcsec and a velocity resolution of 0.17 km s^{-1}. The gas emission takes the form of a string of knots, oriented along an axis that extends from the NW to the SE of the field of the observations, and which are surrounded by more extended, diffuse emission. We analyse the two-dimensional integrated ^{13}CO emission using the CLUMPFIND algorithm of Williams, de Geus & Blitz (1994) and identify 61 clumps. We compare the gas data in the GMC with the dust data provided by 21-μm *MSX* and 1.2-mm SEST images that we both regridded to the cell spacing of the Mopra data and smoothed to the same resolution. The ^{13}CO emission is more diffuse and extended than the dust emission revealed at the latter two wavebands, which both have a much higher contrast between the peaks and the extended emission. From comparison of their centre positions, we find that only ~ 50 per cent of the ^{13}CO clump fits to the data are associated with any dust clumps. Using the clump fits, the total LTE gas mass above the 3σ level measured from the molecular data is 2.7×10^5 $M_\odot$, whereas that measured from the smoothed 1.2-mm SEST dust data is 2.2×10^5 $M_\odot$.

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Planetary migration and extrasolar planets in the 2/1 mean-motion resonance

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In this paper, we present a new set of corotational solutions for the 2/1 commensurability, including previously known solutions and new results. Comparisons with observed exoplanets show that current orbital fits of three proposed resonant planetary systems are consistent with apsidal corotations.

We also discuss the possible relationship between the current orbital elements fits of known exoplanets in the 2/1 mean-motion resonance and the expected orbital configuration due to migration. We find that, as long as the orbital decay was sufficiently slow to be approximated by an adiabatic process, all captured planets should be in apsidal corotations. In other words, they should show a simultaneous libration of both the resonant angle and the difference in longitudes of pericenter.

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Very Cold and Massive Cores near ISOSS J18364-0221: Implications for the Initial Conditions of High-Mass Star Formation

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We report the discovery of two very cold and massive molecular cloud cores in the region ISOSS J18364-0221. The object has been identified by a systematic search for very early evolutionary stages of high-mass stars using the 170 μm ISOPHOT Serendipity Survey (ISOSS). Submillimeter continuum and molecular line measurements reveal two compact cores within this region. The first core has a temperature of 16.5 K, shows signs of ongoing infall and outflows, has no near- or mid-infrared counterpart, and is massive enough ($M \sim 75 M_{\odot}$) to form at least one O star with an associated cluster. It is therefore considered a candidate for a genuine high-mass protostar and a high-mass analog to the Class 0 objects. The second core has an average gas and dust temperature of only $\sim$ 12 K and a mass of $M \sim 280 M_{\odot}$. Its temperature and level of turbulence are below the values found for massive cores so far, and we suggest that this represents the initial conditions from which high-mass star formation occurs.

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A Hybrid N-body–Coagulation Code for Planet Formation

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We describe a hybrid algorithm to calculate the formation of planets from an initial ensemble of planetesimals. The algorithm uses a coagulation code to treat the growth of planetesimals into oligarchs and explicit N-body calculations to follow the evolution of oligarchs into planets. To validate the N-body portion of the algorithm, we use a battery of tests in planetary dynamics. Several complete calculations of terrestrial planet formation with the hybrid code yield good agreement with previously published calculations. These results demonstrate that the hybrid code provides an accurate treatment of the evolution of planetesimals into planets.

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A semi-analytic model for oligarchic growth

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A new semi-analytic model for the oligarchic growth phase of planetary accretion is developed. The model explicitly calculates damping and excitation of planetesimal eccentricities e and inclinations i due to gas drag and perturbations from embryos. The effects of planetesimal fragmentation, enhanced embryo capture cross sections due to atmospheres, inward planetesimal drift, and embryo-embryo collisions are also incorporated. In the early stages of oligarchic growth, embryos grow rapidly as e and i fall below their equilibrium values. The formation of planetesimal collision fragments also speeds up embryo growth as fragments have low-e, low-i orbits, thereby optimizing gravitational focussing. At later times, the presence of thick atmospheres captured from the nebula aids embryo growth by increasing their capture cross sections. Planetesimal drift due to gas drag can lead to substantial inward transport of solid material. However, inward drift is greatly reduced when embryo atmospheres are present, as the drift timescale is no longer short compared to the accretion timescale. Embryo-embryo collisions increase embryo growth rates by 50% compared to the case where growth is solely due to accretion of planetesimals. Formation of 0.1-Earth-mass protoplanets at 1 AU and 10-Earth-mass cores at 5 AU requires roughly 0.1 and 1 million years respectively, in a nebula where the local solid surface density is 7 g cm^{-2} at each of these locations.

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Effects of Dust Growth and Settling in T Tauri Disks

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We present self-consistent disk models of T Tauri stars that include a parameterized treatment of dust settling and grain growth, building on techniques developed in a series of papers by D'Alessio et al. The models incorporate depleted distributions of dust in upper disk layers along with larger sized particles near the disk midplane, which are expected theoretically and, as we suggested earlier, are necessary to account for millimeter-wave emission, SEDs, scattered light images, and silicate emission features simultaneously. By comparing the models with recent mid- and near-IR observations, we find that the dust-to-gas mass ratio of small grains at the upper layers should be $< 10\%$ of the standard value. The grains that have disappeared from the upper layers increase the dust-to-gas mass ratio of the disk interior; if those grains grow to maximum sizes of the order of millimeters during the settling process, then both the millimeter-wave fluxes and spectral slopes can be consistently explained. Depletion and growth of grains can also enhance the ionization of upper layers, increasing the possibility of the magnetorotational instability for driving disk accretion.

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Crystalline silicates as a probe of disk formation history

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We present a new perspective on the crystallinity of dust in protoplanetary disks. The dominant crystallization by thermal annealing happens in the very early phases of disk formation and evolution. Both the disk properties and the level of crystallinity are thereby directly linked to the properties of the molecular cloud core from which the star+disk system was formed. We show that, under the assumption of single star formation, rapidly rotating clouds produce disks which, after the main infall phase (i.e. in the optically revealed class II phase), are rather massive and have a high accretion rate but low crystallinity. Slowly rotating clouds, on the other hand, produce less massive disks with lower accretion rate, but high levels of crystallinity. Cloud fragmentation and the formation of multiple stars complicates the problem and necessitates further study. The underlying physics of the model is insufficiently understood to provide the precise relationship between crystallinity, disk mass and accretion rate. But the fact that with 'standard' input physics the model produces disks which, in comparison to observations, appear to have *either* too high levels of crystallinity *or* too high disk masses, demonstrates that the comparison of these models to observations can place strong contraints on the disk physics. The question to ask is not why some sources are so crystalline, but why some other sources have such a *low* level of crystallinity.

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New signposts of massive star formation in the S235A-B region

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We report on new aspects of the star forming region S235AB revealed through high-resolution observations at radio

and Mid-infrared wavelengths. Using the Very Large Array, we carried out sensitive observations of S235AB in the cm continuum (6, 3.6, 1.3 and 0.7) and in the 22 GHz water maser line. These were complemented with Spitzer Space Telescope Infrared Array Camera archive data to clarify the correspondence between radio and IR sources. We made also use of newly-presented data from the Medicina water maser patrol, started in 1987, to study the variability of the water masers found in the region. S235A is a classical HII region whose structure is now well resolved. To the south, no radio continuum emission is detected either from the compact molecular core or from the jet-like structure observed at 3.3 mm, suggesting emission from dust in both cases. We find two new compact radio continuum sources (VLA-1 and VLA-2) and three separate maser spots. VLA-1 coincides with one of the maser spots and with a previously identified IR source (M1). VLA-2 lies towards S235B and represents the first radio detection from this peculiar nebula, that may represent an ionized wind from a more evolved star. The two other maser spots coincide with an elongated structure previously observed within the molecular core in the $C^{34}S$ line. This structure is perpendicular to a bipolar molecular outflow observed in HCO^+(1–0) and may trace the associated equatorial disk. The Spitzer images reveal a red object towards the molecular core. This is a most viable candidate for the embedded source originating the outflow and maser phenomenology. The picture emerging from these and previous data shows the extreme complexity of a small (≤ 0.5 pc) star forming region where widely different stages of stellar evolution are present.

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http://www.arcetri.astro.it/~fmassi/papers/s235vla_subm2_strabs.ps.gz

On the Relation between Hot Jupiters and the Roche Limit

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Many of the known extrasolar planets are "hot Jupiters," giant planets with orbital periods of just a few days. We use the observed distribution of hot Jupiters to constrain the location of its inner edge in the mass-period diagram. If we assume a slope corresponding to the classical Roche limit, then we find that the edge corresponds to a separation close to twice the Roche limit, as expected if the planets started on highly eccentric orbits that were later circularized. In contrast, any migration scenario would predict an inner edge right at the Roche limit, which applies to planets approaching on nearly circular orbits. However, the current sample of hot Jupiters is not sufficient to provide a precise constraint simultaneously on both the location and the slope of the inner edge.

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Evolution of Class 0 protostars: Models vs. Observations

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The rates at which mass accumulates into protostellar cores can now be predicted in numerical simulations. Our purpose here is to develop methods to compare the statistical properties of the predicted protostars with the observable parameters. This requires (1) an evolutionary scheme to convert numerically-derived mass accretion rates into evolutionary tracks and (2) a technique to compare the tracks to the observed statistics of protostars. Here, we use a 3D-Kolmogorov-Smirnov test to quantitatively compare model evolutionary tracks and observations of Class 0 protostars.

We find that the wide range of accretion functions and timescales associated with gravoturbulent simulations naturally overcome difficulties associated with schemes that use a fixed accretion pattern. This implies that the location of a protostar on an evolutionary track does not precisely determine the present age or final accrued mass. Rather, we find that predictions of the final mass for protostars from observed T_{bol}-L_{bol} values are uncertain by a factor of two and

that the bolometric temperature is not always a reliable measure of the evolutionary stage. Furthermore, we constrain several parameters of the evolutionary scheme and estimate a lifetime of Class 0 sources of 2-6 $\cdot 10^4$ yrs, which is related to the local free-fall time and thus to the local density at the onset of the collapse. Models with Mach numbers smaller than six are found to best explain the observational data. Generally, only a probability of 70 % was found that our models explain the current observations. This is caused by not well understood selection effects in the observational sample and the simplified assumptions in the models.

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Preprints at: www.dias.ie/∼df

Radio and infrared recombination studies of the southern massive star-forming region G333.6−0.2

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We present high spatial resolution radio and near-infrared hydrogen recombination line observations of the southern massive star-forming region G333.6−0.2. The 3.4-cm continuum peak is found slightly offset from the infrared source. The H90α spectra show for the first time a double peak profile at some positions. The complex velocity structure may be accounted for by champagne outflows, which may also explain the offset between the radio and infrared sources. The 2.17-μm Brγ image and H90α map are combined to construct an extinction map which shows a trend probably set by the blister nature of the H II region. The total number of Lyman continuum photons in the central 50-arcsec is estimated to be equivalent to that emitted by up to 19 O7V stars.

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The accepted version available at `http://www.naoj.org/staff/tak/rad-paper/g333-rad.html`.
See also `astro-ph/0603017`.

Rotating Elephant Trunks

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We have collected Hα images of cold molecular pillars that are seen as dark silhouettes against the bright background of expanding H II regions surrounding young star clusters. Four such "elephant trunks" in NGC 7822, IC 1805, the Rosette Nebula and DWB 44 were selected for a detailed mapping of the radio emission, mainly of ^{12}CO and ^{13}CO. All trunks are filamentary, and show signs of being twisted. We determine mass and mean density of these trunks, and show that most of the mass is concentrated in a head facing the central cluster and in twisted sub-filaments forming the body of the trunk which is connected with V-shaped filaments to the outer expanding molecular shell.

We discovered that all four trunks rotate as rigid bodies (to a first approximation) about their major axes, and that at least two trunks are stretching along their major axes, meaning that the massive heads are lagging behind in the general expansion of the H II regions. The rotational periods are of the order of a few million years – similar to the age of the young clusters. Rotation then, is responsible for the twisted appearance of many elephant trunks, since they are rooted in the outer shells. The trunks carry surprisingly large amounts of angular momentum, 3 10^{48} – 2 10^{50} kg m^2 s^{-1}, with corresponding rotational energies of up to $\sim 10^{37}$ J. However, we estimate the total magnetic energies to be even larger. The trunks continuously reshape, and the formation of twined, and in many cases helical sub-filaments, can be understood as a consequence of electromagnetic and inertia forces inside the trunks .

A theory based on the concept of magnetically twisted trunks is further developed, where much of the initial angular momentum is a consequence of twisting of parent filaments containing mass condensations. In addition, our results point at a new process of removing angular momentum from a parent molecular cloud.

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Chandra Study of the Cepheus B Star Forming Region: Stellar Populations and the Initial Mass Function

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Cepheus B (Cep B) molecular cloud and a portion of the nearby Cep OB3b OB association, one of the most active regions of star formation within 1 kpc, has been observed with the ACIS detector on board the *Chandra* X-ray Observatory. We detect 431 X-ray sources, of which 89% are confidently identified as clustered pre-main sequence stars. Two main results are obtained. First, we provide the best census to date for the stellar population of the region. We identify many members of two rich stellar clusters: the lightly obscured Cep OB3b association, and the deeply embedded cluster in Cep B whose existence was previously traced only by a handful of radio sources and T Tauri stars. Second, we find a discrepancy between the X-ray Luminosity Functions of the Cep OB3b and the Orion Nebula Cluster. This may be due to different Initial Mass Functions of two regions (excess of $\sim$ 0.3 solar mass stars), or different age distributions. Several other results are obtained. A diffuse X-ray component seen in the field is attributed to the integrated emission of unresolved low mass PMS stars. The X-ray emission from HD 217086 (O7n), the principle ionizing source of the region, follows the standard model involving many small shocks in an unmagnetized radiatively accelerated wind. The X-ray source #294 joins a number of similar superflare PMS stars where long magnetic structures may connect the protoplanetary disk to the stellar surface.

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Eccentricity generation in hierarchical triple systems: the planetary regime

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In previous papers, we developed a technique for estimating the inner eccentricity in hierarchical triple systems, with the inner orbit being initially circular. We considered systems with well-separated components and different initial setups (e.g., coplanar and non-coplanar orbits). However, the systems we examined had comparable masses. In the present paper, the validity of some of the formulae derived previously is tested by numerically integrating the full equations of motion for systems with smaller mass ratios (from 10^{-3} to 10^3, i.e. systems with Jupiter-sized bodies). There is also discussion about HD 217107 and its planetary companions.

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Observational evidence for a truncation of the star cluster initial mass function at the high mass end

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We present the luminosity function (LF) of star clusters in M 51 based on *HST/ACS* observations taken as part of the Hubble Heritage project. The clusters are selected based on their size and with the resulting 5990 clusters we present one of the largest cluster samples of a single galaxy. We find that the LF can be approximated with a double power-law distribution with a break around $M_V = -8.9$. On the bright side the index of the power-law distribution is steeper ($\alpha = 2.75$) than on the faint-side ($\alpha = 1.93$), similar to what was found earlier for the "Antennae" galaxies. The location of the bend, however, occurs about 1.6 mag fainter in M 51. We confront the observed LF with the model for the evolution of integrated properties of cluster populations of Gieles et al. (2006, A&A, accepted), which predicts that a truncated cluster initial mass function would result in a bend in, and a double power-law behaviour of, the integrated LF. The combination of the large field-of view and the high star cluster formation rate of M 51 make it possible to detect such a bend in the LF. Hence, we conclude that there exists a fundamental upper limit to the mass of star clusters in M 51. Assuming a power-law cluster initial mass function with exponentional cut-off of the form $NdM \propto M^{-\beta}\exp(-M/M_C)dM$, we find that $M_C = 10^5 M_\odot$. A direct comparison with the LF of the "Antennae" suggests that there $M_C = 4 \times 10^5 M_\odot$.

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Metallicity, debris discs and planets

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We investigate the populations of main-sequence stars within 25 pc that have debris discs and/or giant planets detected by Doppler shift. The metallicity distribution of the debris sample is a very close match to that of stars in general, but differs with > 99 per cent confidence from the giant planet sample, which favours stars of above average metallicity. This result is not due to differences in age of the two samples. The formation of debris-generating planetesimals at tens of au thus appears independent of the metal fraction of the primordial disc, in contrast to the growth and migration history of giant planets within a few au. The data generally fit a core accumulation model, with outer planetesimals forming eventually even from a disc low in solids, while inner planets require fast core growth for gas to still be present to make an atmosphere.

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X-rays from HH 210 in the Orion nebula

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We report the detection during the *Chandra Orion Ultradeep Project* (COUP) of two soft, constant, and faint X-ray sources associated with the Herbig-Haro object HH 210. HH 210 is located at the tip of the NNE finger of the emission line system bursting out of the BN-KL complex, northwest of the Trapezium cluster in the OMC-1 molecular cloud. Using a recent Hα image obtained with the *ACS* imager on board *HST*, and taking into account the known proper motions of HH 210 emission knots, we show that the position of the brightest X-ray source, COUP 703, coincides with the emission knot 154-040a of HH 210, which is the emission knot of HH 210 having the highest tangential velocity ($425\,\mathrm{km\,s^{-1}}$). The second X-ray source, COUP 704, is located on the complicated emission tail of HH 210 close to an emission line filament and has no obvious optical/infrared counterpart. Spectral fitting indicates for both sources a plasma temperature of $\sim$0.8 MK and absorption-corrected X-ray luminosities of about $10^{30}\,\mathrm{erg\,s^{-1}}$ (0.5–2.0 keV). These X-ray sources are well explained by a model invoking a fast-moving, radiative bow shock in a neutral medium with a density of $\sim$12000 $\mathrm{cm^{-3}}$. The X-ray detection of COUP 704 therefore reveals, in the complicated HH 210 region, an energetic shock not yet identified at other wavelengths.

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Deuterated molecules in DM Tau: DCO^+, but no HDO

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We report the detection of the J=2-1 line of DCO^+ in the proto-planetary disk of DM Tau and re-analyze the spectrum covering the 465 GHz transition of HDO in this source, recently published by Ceccarelli et al. 2005. A modelling of the DCO^+ line profile with the source parameters derived from high resolution HCO^+ observations yields a DCO^+/HCO^+ abundance ratio of $\simeq 4\times10^{-3}$, an order of magnitude smaller than that derived in the low mass cores. The re-analysis of the 465 GHz spectrum, using the proper continuum flux (0.5 Jy) and source systemic velocity ($6.05\,\mathrm{km\,s^{-1}}$), makes it clear that the absorption features attributed to HDO and C_6H are almost certainly unrelated to these species. We show that the line-to-continuum ratio of an absorption line in front of a Keplerian disk can hardly exceed the ratio of the turbulent velocity to the projected rotation velocity at the disk edge, unless the line is optically very thick ($\tau > 10^4$). This ratio is typically 0.1-0.3 in proto-planetary disks and is $\simeq 0.15$ in DM Tau, much smaller than that for the alleged absorption features. We also show that the detection of H_2D^+ in DM Tau, previously reported by these authors, is only a 2-sigma detection when the proper velocity is adopted. So far, DCO^+ is thus the only deuterated molecule clearly detected in proto-planetary disks.

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The Spitzer c2d Survey of Large, Nearby, Insterstellar Clouds. II. Serpens Observed with IRAC

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We present maps of 0.89 square degree of the Serpens dark cloud at 3.6, 4.5, 5.8, and 8.0um observed with the Spitzer Space Telescope Infrared Array Camera (IRAC). We discuss in detail the data processing carried out by the c2d team on IRAC data. More than 100,000 compact sources have been extracted, but we confine most of our discussion to the most reliable subset of these sources. This includes those that are detected above 7σ in all four IRAC bands or those detected in the two shorter IRAC bands together with 2MASS. We estimate completeness limits for our survey from Monte Carlo tests with artificial sources inserted into the Spitzer maps. We compare source counts, colors, and magnitudes in the Serpens cloud to two reference data sets, a 0.10 deg^2 set of low-extinction regions near the dark cloud, and a 1 deg^2 subset of the SWIRE Elais N1 data that was processed through our pipeline. We find that it is possible to identify more than two hundred young-stellar-object (YSO) candidates from color-magnitude and color-color diagrams, most of which were previously unknown. In addition to the dense area of new star formation known before in the "Core" region (Cluster A), we also find a moderately rich area to the south (Cluster B). Our mapped area also includes the Herbig Ae star, VV Ser, whose Spitzer images have been carefully modelled in a separate study. The extreme sensitivity of IRAC/Spitzer allows us to search to very low luminosity limits for young sub-stellar objects. The comparison of the Serpens region with the reference areas suggests that a population of infrared-excess sources exists in Serpens at least down to luminosities of L $\sim 10^{-3}$ L$_\odot$ and possibly lower.

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An unbiased deep survey for small-area molecular structures

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Small-area molecular structures (SAMS) resembling those clumpuscules, proposed by Pfenniger and Combes (1994) as candidates for baryonic dark matter, have recently been detected (Heithausen 2002, 2004) in an area where the shielding is too low for them to survive for a long time. To study the frequency of occurence of such structures I present the results of an unbiased deep search for molecular clumpuscules. The area surrounding these structures has been surveyed using the FCRAO 14m telescope in the CO ($1 \rightarrow 0$) transition. The field covered is $20'$ by $20'$. The resulting rms of the data is only 0.04 K in a 0.127 km/s wide channel. Also, high-angular resolution observations of the ^{13}CO and C^{18}O ($J = 1 \rightarrow 0$) transitions were obtained with the IRAM Plateau-de-Bure Interferometer. 3 new SAMS have been detected. The structures have very low intensities which makes it impossible to detect them in large scale CO surveys conducted to map the molecular gas of the Milky way. They move with a similar radial velocity as the surrounding HI gas. The clouds follow the same size-linewidth relation as found for giant molecular clouds or Galactic cirrus clouds. The observations clearly show that most of the large linewidths observed at low angular resolution is caused by a large velocity difference among the clumps seen at highest angular resolution. The non-detection of the structures in the high-angular resolution observations of the ^{13}CO and C^{18}O ($J = 1 \rightarrow 0$) transitions shows that the ^{12}CO ($J = 1 \rightarrow 0$) transition must have a low optical depth. At an adopted distance of 100 pc the structures have masses of only Jupiter mass or below. My observations show that SAMS might be an abundant phenomenon in the interstellar medium however not recognized as such due to their small size. If they are made of ordinary interstellar matter with solar metallicity they likely contribute only little to the total interstellar mass.

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A dynamical model for the dusty ring in the Coalsack

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Lada et al. recently presented a detailed near-infrared extinction map of Globule G2 in the Coalsack molecular cloud complex, showing that this starless core has a well-defined central extinction minimum. We propose a model for G2 in which a rapid increase in external pressure is driving an approximately symmetric compression wave into the core. The rapid increase in external pressure could arise because the core has recently been assimilated by the Coalsack cloud complex, or because the Coalsack has recently been created by two large-scale converging flows. The resulting compression wave has not yet converged on the centre of the core, so there is a central rarefaction. The compression wave has increased the density in the swept-up gas by about a factor of ten, and accelerated it inwards to speeds of order $0.4\,\mathrm{km\,s^{-1}}$. It is shown that even small levels of initial turbulence destroy the ring seen in projection almost completely. In the scenario of strong external compression that we are proposing this implies that the initial turbulent energy in this globule is such that $E_{\rm turb}/E_{\rm grav} \leq 2\%$. Protostar formation should occur in about $40,000$ years.

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The Origins of Fluorescent H_2 Emission From T Tauri Stars

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We survey fluorescent H_2 emission in *HST*/STIS spectra of the classical T Tauri stars (CTTSs) TW Hya, DF Tau, RU Lupi, T Tau, and DG Tau, and the weak-lined T Tauri star (WTTS) V836 Tau. From each of those sources we detect between 41–209 narrow H_2 emission lines, most of which are pumped by strong Lyα emission. H_2 emission is not detected from the WTTS V410 Tau. The fluorescent H_2 emission appears to be common to circumstellar environments around all CTTSs, but high spectral and spatial resolution STIS observations reveal diverse phenomenon. Blueshifted H_2 emission detected from RU Lupi, T Tau, and DG Tau is consistent with an origin in an outflow. The H_2 emission from TW Hya, DF Tau, and V836 Tau is centered at the radial velocity of the star and is consistent with an origin in a warm disk surface. The H_2 lines from RU Lupi, DF Tau, and T Tau also have excess blueshifted H_2 emission that extends to as much as -100 km s^{-1}. The strength of this blueshifted component from DF Tau and T Tau depends on the upper level of the transition. In all cases, the small aperture and attenuation of H_2 emission by stellar winds restricts the H_2 emission to be formed close to the star. The Lyα and the H_2 emission blueshifted by 15 km s^{-1} relative to RU Lupi are extended to the SW by ~ 0.07 arcsec, although the faster H_2 gas that extends to ~ 100 km s^{-1} is not spatially extended. We also find a small reservoir of H_2 emission from TW Hya and DF Tau consistent with an excitation temperature of $\sim 2.5 \times 10^4$ K.

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Scattering of Planetesimals by a Planet: Formation of Comet Cloud Candidates

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We have investigated the first dynamical stage of comet cloud formation, the scattering of planetesimals by a planet. The orbits of planetesimals were calculated using circular restricted three-body formalism. We obtained the probabilities of the following results of scattering as functions of the orbital parameters of the planets and planetesimals: (1)

collision with the planet, (2) escape from the planetary system, and (3) candidacy as a member of the comet cloud (planetesimals with large semimajor axes). We also derived simple empirical formulae for these probabilities that are accurate enough for order-of-magnitude estimation. We found that a planetesimal with an initial eccentricity of $e \geq 0.4$ can escape from the planetary system or be a candidate for an element of the comet cloud due to scattering by a planet. As the energy range of the comet cloud is narrow, the probability of any planet producing escapers is always much higher than that of producing candidates. Using the probabilities and assuming a distribution of planetesimals, we obtained the efficiencies of collision, escape, and candidacy for a given planet. We applied the results to the solar system and found that, among the four giant planets, Jupiter is the planet most responsible for producing candidate elements of the Oort Cloud, as long as the inclination of planetesimals is constant or proportional to the reduced Hill radius of each planet.

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Millimetre Continuum Observations of Southern Massive Star Formation Regions II. SCUBA observations of cold cores and the dust grain emissivity index β.

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We report the results of a submillimetre continuum emission survey targeted toward 78 star formation regions, 72 of which are devoid of methanol maser and UC HII regions, identified in the SEST/SIMBA millimetre continuum survey of Hill et al. (2005). At least 45 per cent of the latter sources, dubbed 'mm-only', detected in this survey are also devoid of mid infrared *MSX* emission. The 450 and 850μm continuum emission was mapped using the Submillimetre Common User Bolometer Array (SCUBA) instrument on the James Clerk Maxwell Telescope (JCMT). Emission is detected toward 97 per cent of the 78 sources targeted as well as towards 28 other SIMBA sources lying in the SCUBA fields.

In total, we have identified 212 cores in this submillimetre survey, including 106 previously known from the SIMBA survey. Of the remaining 106 sources, 53 result from resolving a SIMBA source into multiple submillimetre components, whilst the other 53 sources are submillimetre cores, not seen in SIMBA. Additionally, we have identified two further mm-only sources in the SIMBA images. Of the total 405 sources identified in the SIMBA survey, 255 are only seen at millimetre wavelengths.

We concatenate the results from four (sub)millimetre continuum surveys of massive star formation [Walsh et al. (2003), Hill et al. (2005), Thompson et al. (2006); as well as this work], together with the Galactic Plane map of Pierce-Price (2000) in order to determine the dust grain emissivity index β for each of the sources in the SIMBA source list. We examine the value of β with respect to temperature, as well as for the source classes identified in the SIMBA survey, for variation of this index. Our results indicate that β is typically 2, which is consistent with previous determinations in the literature, but for a considerably larger sample than previous work.

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Star Formation in Space and Time: The Orion Nebula Cluster

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We examine the pattern of star birth in the Orion Nebula Cluster (ONC), with the goal of discerning the cluster's

formation mechanism. Outside of the Trapezium, the distribution of stellar masses is remarkably uniform, and is not accurately described by the field-star initial mass function. The deconvolved, three-dimensional density of cluster members peaks at the Trapezium stars, which are truly anomalous in mass. Using theoretical pre-main-sequence tracks, we confirm the earlier finding that star formation has accelerated over the past 10 Myr. We further show that the rate of acceleration has been the same for all masses. Thus, there is no correlation between stellar mass and age, contrary to previous claims. Finally, the acceleration has been spatially uniform throughout the cluster.

Our reconstruction of the parent molecular cloud spawning the cluster shows that it had a mass of 6700 solar masses prior to its destruction by the Trapezium. If the cloud was supported against self-gravity by mildly dissipative turbulence, then it contracted in a quasi-static, but accelerating manner. We demonstrate this contraction theoretically through a simple energy argument. The mean turbulent speed increased to its recent value, which is reflected in the present-day velocity dispersion.

The ONC will be gravitationally unbound once cloud destruction is complete, and is destined to become a dispersing OB association. We hypothesize that similarly crowded groups seen at the centers of distant OB associations are also unbound, and do not give rise to the Galactic population of open clusters. Finally, accelerating star formation implies that most clumps within giant molecular complexes should have relatively low formation activity. Sensitive infrared surveys could confirm this hypothesis.

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Large dust grains in the inner region of circumstellar disks

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CONTEXT: Simple geometrical ring models account well for near-infrared interferometric observations of dusty disks surrounding pre-main sequence stars of intermediate mass. Such models demonstrate that the dust distribution in these disks has an inner hole and puffed-up inner edge consistent with theoretical expectations.
AIMS: In this paper, we reanalyze the available interferometric observations of six intermediate mass pre-main sequence stars (CQ Tau, VV Ser, MWC 480, MWC 758, V1295 Aql and AB Aur) in the framework of a more detailed physical model of the inner region of the dusty disk. Our aim is to verify whether the model will allow us to constrain the disk and dust properties.
METHODS: Observed visibilities from the literature are compared with theoretical visibilities from our model. With the assumption that silicates are the most refractory dust species, our model computes self-consistently the shape and emission of the inner edge of the dusty disk (and hence its visibilities for given interferometer con gurations). The only free parameters in our model are the inner disk orientation and the size of the dust grains.
RESULTS: In all objects with the exception of AB Aur, our self-consistent models reproduce both the interferometric results and the near-infrared spectral energy distribution. In four cases, grains larger than 1.2 micron, and possibly much larger are either required by or consistent with the observations. The inclination of the inner disk is found to be always larger than 30deg , and in at least two objects much larger.

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Early ComeOn+ Adaptive Optics Observation of GQ Lup and its Substellar Companion

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An analysis of adaptive optics K-band imaging data of GQ Lup acquired in 1994 by the first generation adaptive optics system ComeOn+ at the ESO 3.6m optical telescope in La Silla is presented. The data reveal a likely candidate for

the low-mass companion recently reported in the literature. An a posteriori detection in the 11 year old data would provide a useful astrometric data point for the very long period ($\sim$ 1000 yr) orbit of the GQ Lup system. However, the data is severely contaminated by speckle noise at the given projected separation, which decreases the confidence of the detection. Still, from the data we can conclude that GQ Lup B is not an unrelated background source, but instead a physical companion to GQ Lup A. We present here the reduction and analysis of the ComeOn+ images, as well as the results. We also discuss the nature of the companion based on data and models available in the scientific literature and examine claims made regarding the classification of the object as a planet.

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X-ray emission from T Tauri stars

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We have modelled the X-ray emission of T Tauri stars assuming that they have isothermal, magnetically-confined coronae. These coronae extend outwards until either the pressure of the hot coronal gas overcomes the magnetic field, or, if the corona interacts with a disk before this happens, by the action of the disk itself. This work is motivated by the results of the Chandra Orion Ultradeep Project (COUP) that show an increase in the X-ray emission measure with increasing stellar mass. We find that this variation (and its large scatter) result naturally from the variation in the sizes of the stellar coronae. The reduction in the magnitude of the X-ray emission due to the presence of a disk stripping the outer parts of the stellar corona is most pronounced for the lower mass stars. The higher mass stars with their greater surface gravities have coronae than typically do not extend out as far as the inner edge of the disk and so are less affected by it. For these stars, accretion takes place along open field lines that connect to the disk. By extrapolating surface magnetograms of young main sequence stars we have examined the effect on the X-ray emission of a realistic degree of field complexity. We find that the complex fields (which are more compact) give densities of some $(2.5 - 0.6) \times 10^{10}\mathrm{cm}^{-3}$. This is consistent with density estimates of $(1 - 8) \times 10^{10}\mathrm{cm}^{-3}$ from modelling of individual flares. A simple dipole field in contrast gives densities typically an order of magnitude less. For the complex fields, we also find surface hotspots at a range of latitudes and longitudes with surface filling factors of only a few percent. We find that the dipolar fields give a relationship between X-ray emission measure and stellar mass that is somewhat steeper than observed, while the complex fields give a relation that is shallower than observed. This may suggest that T Tauri stars have coronal fields that are slightly more extended than their main sequence counterparts, but not as extended as a purely dipolar fields.

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Dust sedimentation and self-sustained Kelvin-Helmholtz turbulence in protoplanetary disk mid-planes. I. Radially symmetric simulations.

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We perform numerical simulations of the Kelvin-Helmholtz instability in the mid-plane of a protoplanetary disk. A two-dimensional corotating slice in the azimuthal–vertical plane of the disk is considered where we include the Coriolis force and the radial advection of the Keplerian rotation flow. Dust grains, treated as individual particles, move under the influence of friction with the gas, while the gas is treated as a compressible fluid. The friction force from the dust grains on the gas leads to a vertical shear in the gas rotation velocity. As the particles settle around the mid-plane due to gravity, the shear increases, and eventually the flow becomes unstable to the Kelvin-Helmholtz instability. The Kelvin-Helmholtz turbulence saturates when the vertical settling of the dust is balanced by the turbulent diffusion away from the mid-plane. The azimuthally averaged state of the self-sustained Kelvin-Helmholtz turbulence is found

to have a constant Richardson number in the region around the mid-plane where the dust-to-gas ratio is significant. Nevertheless the dust density has a strong non-axisymmetric component. We identify a powerful clumping mechanism, caused by the dependence of the rotation velocity of the dust grains on the dust-to-gas ratio, as the source of the non-axisymmetry. Our simulations confirm recent findings that the critical Richardson number for Kelvin-Helmholtz instability is around unity or larger, rather than the classical value of 1/4.

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The ratio of $N(C^{18}O)$ and A_V in Chamaeleon I and III-B – Using 2MASS and SEST

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We investigate the relationship between the $C^{18}O$ column density and the visual extinction in Chamaeleon I and in a part of the Chamaeleon III molecular cloud. The $C^{18}O$ column densities, $N(C^{18}O)$, are calculated from $J = 1 - 0$ rotational line data observed with the SEST telescope. The visual extinctions, A_V, are derived using JHK photometry from the 2MASS survey and the NICER color excess technique. In contrast with the previous results of Hayakawa et al. (2001, PASJ, 53, 1109), we find that the average $N(C^{18}O)/A_V$ ratios are similar in Cha I and Cha III, and lie close to values derived for other clouds, i.e. $N(C^18O) \approx 2 \times 10^{14}$ cm^{-2} $(A_V - 2)$. We find, however, clear deviations from this average relationship towards individual clumps. Larger than average $N(C^{18}O)/A_V$ ratios can be found in clumps associated with the active star forming region in the northern part of Cha I. On the other hand, some regions in the relatively quiescent southern part of Cha I show smaller than average $N(C^{18}O)/A_V$ ratios and also very shallow proportionality between $N(C^{18}O)$ and A_V. The shallow proportionality suggests that $C^{18}O$ is heavily depleted in these regions. As the degree of depletion is proportional to the gas density, these regions probably contain very dense, cold cores, which do not stand out in CO mappings. A comparison with the dust temperature map derived from the ISO data shows that the most prominent of the potentially depleted cores indeed coincides with a dust temperature minimum. It seems therefore feasible to use $N(C^{18}O)$ and A_V data together for identifying cold, dense cores in large scale mappings.

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Mid-Infrared Emission at Photodissociation Regions in the Orion Nebula

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The mid-infrared emission from a photodissociation region (PDR) viewed edge-on in the Orion Nebula is examined through $8.7 - 20.6\mu$m images and $8 - 13\mu$m spectra. The polycyclic aromatic hydrocarbon (PAH) emission is located between the edges of H II regions and layers of [C I] emission, agreeing with PDR theory. Using a simple model, the spatial variations in the emission from PAHs detected at 8.6, 11.2, and 12.7 μm are demonstrated to be directly proportional to the material column density and the intensity of the UV field. For a homogeneous, neutral cloud illuminated by a bright OB star, PDR theory predicts that the ultraviolet (UV) radiation is attenuated exponentially ($e^{-1.8A_V}$). The predicted UV attenuation is confirmed by observations of broad PAH emission features found at 8.6, 11.2, and 12.7 μm. The PAH emission is found in cool regions having greater optical depths relative to regions where mid-infrared emission from ionized gas is observed. Through modeling we determine a gas density of 9.7×10^4 cm^{-3}. On large and small size scales, the relative strengths of the 8.6, 11.2, and 12.7 μm PAH features at the bar of the

Orion Nebula indicate that there is not a simple transition from ionized to neutral PAHs across the PDR.

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A Molecular Line Survey of W3(OH) and W3 IRS 5 from 84.7 to 115.6 GHz: Observational Data and Analyses

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We have carried out observations toward the W3 complex and G34.3+0.15 using the TRAO 14 m radio telescope to examine in detail the chemical variations occurring while molecular clouds evolve from the prestellar to the H II region phase. Observations include spectral surveys of these objects between 84.7 and 115.6 GHz; mapping observations toward W3(OH) with the emissions of CS $(2-1)$, HCN $(1-0)$, HNC $(1-0)$, and HCO^+ $(1-0)$; and mapping of CS $(2-1)$ emission toward W3 IRS 5. Chemical model calculations are used to estimate the age of W3(OH) by comparing with the fractional abundances of detected molecules. We found that G34.3+0.15 and W3(OH) are at a similar evolutionary stage, although large differences in the fractional abundances are found in CH_3CN and HC_3N. Overall, the properties of the detected species and abundances in three regions support the view that chemistry varies as molecular clouds evolve from a cold, collapsing phase to a high-temperature phase, such as the hot core and H II phase. Chemical model calculations for W3(OH) indicate that the evolutionary age of the cloud is $10^4 - 10^5$ yr with temperature in the range $10 - 60$ K.

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Star formation in the Cepheus Flare region - Implications from morphology and infrared properties of optically selected clouds

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A complex study of visual and infrared properties of ISM and examination of cloud morphology was carried out using USNO, 2MASS, DIRBE, IRAS and ISO data of an extended region in Cepheus in order to explore the conditions of cloud and star formation. sufficiently large area. We mapped the distribution of visual extinction in a 256 square degree area of Cepheus. We identified clouds and described their morphology quantitatively in order to find features such as globular and head-tail shape. We also characterized the region using infrared data and combined the results with those obtained from visual data. Eight cloud complexes and four voids were identified, 208 dark clouds were localised, 86 of them have not been catalogued previously. previously catalogued associated cloud. The observed distribution of cloud axis ratios corresponds to near prolate ellipsoidal clouds with random alignment. The cloud mass spectrum found is $dN_{cloud}/dM_{cloud} = 6.1 \times 10^2 (M_{cloud}/M_\odot)^{-1.70} M_\odot^{-1}$. We found a linear relationship between FIR colour temperature and galactic latitude at intermediate galactic latitudes ($3^\circ < b < 18^\circ$) relationship for minimum cloud temperatures. in clouds. The observed FIR colours of dark clouds were found to agree well with model calculations. We pointed out the signs of connection between the far-IR loop GIRL G109+11 and active triggered star formation of adjacent cloud complexes. Relatioships between the star forming efficiency, peak extinction and cloud mass were found and

described with empirical formulae. YSOs were found in 7 of the 11 clouds with extinction above 4 mag. These 11 clouds represent 20% of the total cloud mass and contain 52% of all YSO candidates. High, 0.52% and 0.56%, star forming efficiencies were found in globular and head-tail clouds, respectively, relative to the mean efficiency for the clouds in the region (0.16%). Cloud mass and peak extinction were found to be the most important factors of star forming efficiency besides cloud morphology. The estimated intrinsic axis ratio distribution is consistent with cloud formation from large scale external forcing.

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http://astro.elte.hu/∼kissz/preprint/

Disk eccentricity and embedded planets

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Aims. We investigate the response of an accretion disk to the presence of a perturbing protoplanet embedded in the disk through time dependent hydrodynamical simulations.

Methods. The disk is treated as a two-dimensional viscous fluid and the planet is kept on a fixed orbit. We run a set of simulations varying the planet mass, and the viscosity and temperature of the disk. All runs are followed until they reach a quasi-equilibrium state.

Results. We find that for planetary masses above a certain minimum mass, already $3M_{Jup}$ for a viscosity of $\nu = 10^{-5}$, the disk makes a transition from a nearly circular state into an eccentric state. Increasing the planetary mass leads to a saturation of disk eccentricity with a maximum value of around 0.25. The transition to the eccentric state is driven by the excitation of an $m = 2$ spiral wave at the outer 1:3 Lindblad resonance. The effect occurs only if the planetary mass is large enough to clear a sufficiently wide and deep gap to reduce the damping effect of the outer 1:2 Lindblad resonance. An increase in viscosity or temperature in the disk, which both tend to close the gap, have an adverse influence on the disk eccentricity.

Conclusions. In the eccentric state the mass accretion rate onto the planet is greatly enhanced, an effect that may ease the formation of massive planets beyond about 5 M_{Jup} that are otherwise difficult to reach.

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Radiation Feedback and Fragmentation in Massive Protostellar Cores

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Star formation generally proceeds inside-out, with overdense regions inside protostellar cores collapsing rapidly and progressively less dense regions following later. Consequently, a small protostar will form early in the evolution of a core, and collapsing material will fall to the protostellar surface and radiate away its gravitational potential energy. The resulting accretion luminosity will heat the core and may substantially affect the process of fragmentation. This is of particular interest for massive cores that, at their initial temperatures, have masses much greater than a thermal Jeans mass and thus might be expected to fragment into many stars during collapse. Here I show that accretion luminosity can heat the inner parts of a core to > 100 K very early in the star formation process, and that this in turn strongly suppresses fragmentation. This has implications for a number of outstanding problems in star formation, including the mechanism of massive star formation, the origin of the stellar initial mass function and its relationship to the core mass function, the demographics of massive binaries, and the equation of state in star-forming gas.

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Stellar Multiplicity and the IMF: Most Stars Are Single

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In this short communication I compare recent findings suggesting a low binary star fraction for late type stars with knowledge concerning the forms of the stellar initial and present day mass functions for masses down to the hydrogen burning limit. This comparison indicates that most stellar systems formed in the Galaxy are likely single and not binary as has been often asserted. Indeed, in the current epoch two-thirds of all main sequence stellar systems in the Galactic disk are composed of single stars. Some implications of this realization for understanding the star and planet formation process are briefly mentioned.

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http://www.cfa.harvard.edu/ clada/pubs_html/binaries.html

Gas Flow Across Gaps in Protoplanetary Disks

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We analyze the gas accretion flow through a planet-produced gap in a protoplanetary disk. We adopt the alpha disk model and ignore effects of planetary migration. We develop a semi-analytic, one-dimensional model that accounts for the effects of the planet as a mass sink and also carry out two-dimensional hydrodynamical simulations of a planet embedded in a disk. The predictions of the mass flow rate through the gap based on the semi-analytic model generally agree with the hydrodynamical simulations at the 25% level. Through these models, we are able to explore steady state disk structures and over large spatial ranges. The presence of an accreting $\sim 1 M_J$ planet significantly lowers the density of the disk within a region of several times the planet's orbital radius. The mass flow rate across the gap (and onto the central star) is typically 10% to 25% of the mass accretion rate outside the orbit of the planet, for planet-to-star mass ratios that range from 5×10^{-5} to 1×10^{-3}.

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The nearest young moving groups

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The latest results in the research of forming planetary systems have led several authors to compile a sample of candidates for searching for planets in the vicinity of the sun. Young stellar associations are indeed excellent laboratories for this study, but some of them are not close enough to allow the detection of planets through adaptive optics techniques. However, the existence of very close young moving groups can solve this problem. Here we have compiled the members of the nearest young moving groups, as well as a list of new candidates from our catalogue of *late-type stars possible members of young stellar kinematic groups*, studying their membership through spectroscopic and photometric criteria.

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http://www.ucm.es/info/Astrof/invest/actividad/skg/skg_sag.html

Post-Outburst Phase of McNeil's Nebula (V1647 Orionis)

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We present a detailed study of the post-outburst phase of McNeil's nebula (V1647 Orionis) using optical B, V, R, I and near-infrared (NIR) J, H, K photometric and low resolution optical spectroscopic observations. The observations were carried out with the HFOSC, NIRCAM, TIRCAM and NICMOS cameras on the 2m HCT and 1.2m PRL telescopes during the period 2004 February – 2005 December. The optical and NIR observations show a general decline in brightness of the exciting source of McNeil's nebula (V1647 Ori). Our recent optical images show that V1647 Ori has faded by more than 3 magnitudes since February 2004. McNeil's nebula itself has also faded considerably. The optical/NIR photometric data also show a significant variation in the magnitudes ($\Delta V = 0.78$ mag, $\Delta R = 0.44$ mag, $\Delta I = 0.21$ mag, $\Delta J = 0.24$ mag and $\Delta H = 0.20$ mag) of V1647 Ori within a period of one month, which is possibly undergoing a phase similar to eruptive variables, like EXors or FUors. The optical spectra show a few features such as strong $H\alpha$ emission with blue-shifted absorption and the Ca II IR triplet (8498Å, 8542Å and 8662Å) in emission. As compared to the period just after outburst, there is a decrease in the depth and extent of the blue-shifted absorption component, indicating a weakening in the powerful stellar wind. The presence of the Ca II IR triplet in emission confirms that V1647 Ori is a pre-main-sequence star. The long-term, post-outburst photometric observations of V1647 Ori suggest an EXor, rather than an FUor event. An optical/IR comparison of the region surrounding McNeil's nebula shows that the optical nebula is more widely and predominantly extended to the north, whereas the IR nebula is relatively confined (diameter $\sim$ 60"), but definitely extended, to the south, too. The large colour gradient from north to south and the sudden absence of an optical nebula to the south is suggestive of a large scale disk-like structure (or envelope) surrounding the central source that hides the southern nebula.

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Circumstellar discs in the young sigma Orionis cluster

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We present new K- and L′-band imaging observations for members of the young (3−5 Myr) σ Orionis cluster, obtained with UIST at UKIRT. We determine $(K - L')$ colour excesses with respect to the photospheres, finding evidence for warm circumstellar dust around 27 out of 83 cluster members that have masses between $0.04\,M_\odot$ and $1.0\,M_\odot$. This indicates a circumstellar disc frequency of at least $(33 \pm 6)\%$ for this cluster, consistent with previous determinations from smaller samples (Oliveira et al. 2004) and also consistent with the 3 Myr disc half-life suggested by Haisch et al (2001). There is marginal evidence that the disc frequency declines towards lower masses, but the data are also consistent with no mass-dependence at all. There is no evidence for spatial segregation of objects with and without circumstellar discs.

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Hydrodynamical simulations of the decay of high-speed molecular turbulence. II. Divergence from isothermality

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A roughly constant temperature over a wide range of densities is maintained in molecular clouds through radiative heating and cooling. An isothermal equation of state is therefore frequently employed in molecular cloud simulations. However, the dynamical processes in molecular clouds include shock waves, expansion waves, cooling induced collapse and baroclinic vorticity, all incompatible with the assumption of a purely isothermal flow. Here, we incorporate an energy equation including all the important heating and cooling rates and a simple chemical network into simulations of three-dimensional, hydrodynamic, decaying turbulence. This allows us to test the accuracy of the isothermal assumption by directly comparing a model run with the modified energy equation to an isothermal model. We compute an extreme case in which the initial turbulence is sufficiently strong to dissociate much of the gas and alter the specific heat ratio. The molecules then reform as the turbulence weakens. We track the true specific heat ratio as well as its effective value. We analyse power spectra, vorticity and shock structures, and discuss scaling laws for decaying turbulence. We derive some limitations to the isothermal approximation for simulations of the interstellar medium using simple projection techniques. Overall, even given the extreme conditions, we find that an isothermal flow provides an adequate physical and observational description of many properties. The main exceptions revealed here concern behaviour directly related to the high temperature zones behind the shock waves.

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High mass star formation in the infrared dark cloud G11.11-0.12

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We report detection of moderate to high-mass star formation in an infrared dark cloud (G11.11-0.12) where we discovered class II methanol and water maser emission at 6.7 GHz and 22.2 GHz, respectively. We also observed the object in ammonia inversion transitions. Strong emission from the (3, 3) line indicates a hot (60 K) compact component associated with the maser emission. The line width of the hot component (4 km s^{-1}), as well as the methanol maser detection, are indicative of high mass star formation. To further constrain the physical parameters of the source, we derived the spectral energy distribution (SED) of the dust continuum by analysing data from the 2MASS survey, HIRAS, MSX, the *Spitzer Space Telescope*, and interferometric 3 mm observations. The SED was modelled in a radiative transfer program: a) the stellar luminosity equals $\sim 1200 L_{\odot}$ corresponding to a ZAMS star of 8 $M_{\odot}$; b) the bulk of the envelope has a temperature of 19 K; c) the mass of the remnant protostellar cloud in an area 8×10^{17} cm or 15" across amounts to 500 $M_{\odot}$, if assuming standard dust of the diffuse medium, and to about 60 $M_{\odot}$, should the grains be fluffy and have ice mantles; d) the corresponding visual extinction towards the star, A_V, is a few hundred magnitudes. The near IR data can be explained by scattering from tenuous material above a hypothetical disk. The class II methanol maser lines are spread out in velocity over 11 km s^{-1}. To explain the kinematics of the masing spots, we propose that they are located in a Kepler disk at a distance of about 250 AU. The dust temperatures there are around 150 K, high enough to evaporate methanol-containing ice mantles.

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Reducing the probability of capture into resonance

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A migrating planet can capture planetesimals into mean motion resonances. However, resonant trapping can be

prevented when the drift or migration rate is sufficiently high. Using a simple Hamiltonian system for first- and second-order resonances, we explore how the capture probability depends on the order of the resonance, drift rate and initial particle eccentricity. We present scaling factors as a function of the planet mass and resonance strength to estimate the planetary migration rate above which the capture probability drops to less than half. Applying our framework to multiple extrasolar planetary systems that have two planets locked in resonance, we estimate lower limits for the outer planet's migration rate, allowing resonance capture of the inner planet.

Mean motion resonances are comprised of multiple resonant subterms. We find that the corotation subterm can reduce the probability of capture when the planet eccentricity is above a critical value. We present factors that can be used to estimate this critical planet eccentricity. Applying our framework to the migration of Neptune, we find that Neptune's eccentricity is near the critical value that would make its $2:1$ resonance fail to capture twotinos. The capture probability is affected by the separation between resonant subterms and so is also a function of the precession rates of the longitudes of periapse of both planet and particle near resonance.

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A Keplerian Disk around the Herbig Ae star HD169142

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We present Submillimeter Array observations of the Herbig Ae star HD169142 in 1.3 millimeter continuum emission and ^{12}CO J=2-1 line emission at ~ 1.5 arcsecond resolution that reveal a circumstellar disk. The continuum emission is centered on the star position and resolved, and provides a mass estimate of $\sim 0.02\ M_\odot$ for the disk. The CO images show patterns in position and velocity that are well matched by a disk in Keplerian rotation with low inclination to the line-of-sight. We use radiative transfer calculations based on a flared, passive disk model to constrain the disk parameters by comparison to the spectral line emission. The derived disk radius is 235 AU, and the inclination is 13°. The model also necessitates modest depletion of the CO molecules, similar to that found in Keplerian disks around T Tauri stars.

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Chandra X-Ray Observations of Young Clusters. III. NGC 2264 and the Orion Flanking Fields

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Chandra observations of solar-like pre-main sequence (PMS) stars in the Orion Flanking Fields (age ∼1 Myr) and NGC 2264 (∼3 Myr) are compared with the results of the COUP survey of similar objects in the ONC (∼0.5 Myr). The correlations between $\log \log L_x$ and mass found for PMS stars on convective tracks in these clusters are consistent with the relationships found for the ONC, indicating little change in the *median* values of either $\log \log L_x$ or $\log \log L_x / \log L_{\rm bol}$ during the first ∼3-5 Myr of evolution down convective tracks. The fraction of stars with extreme values of $\log L_x$, more than 10 times higher than the average for a given $\log L_{\rm bol}$ or with $\log \log L_x / \log L_{\rm bol}$ greater than the canonical saturation value of -2.9, is however larger by a factor of two in the younger ONC when compared with the Orion FF and NGC 2264.

PMS stars in NGC 2264 on radiative tracks have $\log L_x / \log L_{\rm bol}$ values that are systematically lower by a factor of ∼10

times than those found for stars of similar mass on convective tracks. The dramatic decrease in flux from convective to radiative phases of PMS evolution is likely related to major structural changes which influence the efficiency of magnetic field generation and thus the level of magnetic activity.

As in the ONC, we find that stars with measured periods have, on average, higher X-ray luminosities. However, there is a wide range in $\log L_x$ and $\log L_x / \log L_{\rm bol}$ for both periodic and non-periodic stars of similar mass. Among stars with measured periods, the level of X-ray emission does not correlate with the rotation rate.

For this data set, we find no statistically significant correlation between X-ray flux and (a) the presence or absence of circumstellar accretion disks, or (b) disk accretion rates as assessed from ultraviolet excesses.

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The COMPLETE Survey of Star-Forming Regions: Phase I Data

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We present an overview of data available for the Ophiuchus and Perseus molecular clouds from "Phase I" of the COMPLETE Survey of Star-Forming Regions. This survey provides a range of data complementary to the Spitzer Legacy Program "From Molecular Cores to Planet Forming Disks." Phase I includes: Extinction maps derived from 2MASS near-infrared data using the NICER algorithm; extinction and temperature maps derived from IRAS 60 and 100μm emission; HI maps of atomic gas; ^{12}CO and ^{13}CO maps of molecular gas; and submillimetre continuum images of emission from dust in dense cores. Not unexpectedly, the morphology of the regions appears quite different depending on the column-density tracer which is used, with IRAS tracing mainly warmer dust and CO being biased by chemical, excitation and optical depth effects. Histograms of column-density distribution are presented, showing that extinction as derived from 2MASS/NICER gives the closest match to a log-normal distribution as is predicted by numerical simulations. All the data presented in this paper, and links to more detailed publications on their implications are publically available at the COMPLETE website.

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http://www.cfa.harvard.edu/COMPLETE/

The COMPLETE Nature of the Warm Dust Ring in Perseus

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The Perseus molecular cloud complex is a $\sim$30 pc long chain of molecular clouds most well-known for the two star-

forming clusters NGC 1333 and IC 348 and the well-studied outflow source in B5. However, when studied at mid- to far-infrared wavelengths the region is dominated by a ∼10 pc diameter shell of warm dust, likely generated by an HII region caused by the early B-star HD 278942. Using a revised calibration technique the COMPLETE team has produced high-sensitivity temperature and column-density maps of the Perseus region from IRAS Sky Survey Atlas (ISSA) 60 and 100 μm data. In this paper, we combine the ISSA based dust-emission maps with other observations collected as part of the COMPLETE [**Co**ordinated **M**olecular **P**robe **L**ine, **E**xtinction and **T**hermal **E**mission; http://cfa-www.harvard.edu/COMPLETE] Survey, along with archival Hα and MSX observations. Molecular line observations from FCRAO and extinction maps constructed by applying the NICER method to the 2MASS catalog provide independent estimates of the "true" column-density of the shell. Hα emission in the region of the shell confirms that it is most likely an HII region located behind the cloud complex, and 8 μm data from MSX indicates that the shell may be interacting with the cloud. Finally, the two polarisation components seen towards background stars in the region by Goodman et al. (1990) can be explained by the association of the stronger component with the shell. If confirmed, this would be the first observation of a parsec-scale swept-up magnetic field.

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The Young Massive Stellar Cluster Associated With RCW 121

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We report near-infrared (NIR) broadband and narrowband photometric observations in the direction of the IRAS 17149-3916 source that reveal the presence of a young cluster of massive stars embedded in an H II region coincident with RCW 121. These observations, together with published radio data and *Midcourse Space Experiment* and *Spitzer* images, were used to determine some of the physical parameters of the region. We found 96 cluster member candidates in an area of about 1.5×2.0 arcmin^2, 30% of them showing excess emission in the near-IR. IRS 1, the strongest source in the cluster with an estimated spectral type of O5 V–O6 V zero-age main sequence based on the color-magnitude diagram, is probably the main ionizing source of the H II region detected at radio wavelengths. Using the integrated Brγ and the 5 GHz flux densities, we derived a mean visual extinction $A_V = 5.49^{+2.06}_{-1.32}$ mag. From the observed size of the Brγ extended emission, we calculated the emission measure $E = 4.5 \times 10^{24}$ cm^{-5} and the electron density $n_e = 2.6 \times 10^3$ cm^{-3}, characteristic of compact H II regions.

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VLA Observations of Carbon 91α Recombination Line Emission in W49 North

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We have detected C91α (8.5891 GHz) emission toward 4 ultra-compact H II regions (UCHs; W49G, J, L & C) in the W49 North massive star forming region with the Very Large Array (VLA) at $3''$ resolution. No carbon line emission was detected toward UCHs W49F, A, O, S and Q at this frequency to a 3σ level of 2 mJy. We also observed the same region in the C75α line (15.3 GHz) with no detection at a 3σ level of 6 mJy with a $1''.7$ beam. Detection of line emission toward these sources add supporting data to the earlier result of Roshi et al. (2005a) that many UCHs have an associated photo-dissociation region (PDR). Similarity of the LSR velocities of carbon recombination lines and H_2CO absorption toward UCHs in W49 North suggests that the PDRs reside in the dense interface zone surrounding these H II regions. Combining the observed carbon line parameters at 8.6 GHz with the upper limits on line emission at 15.3 GHz, we obtain constraints on the physical properties of the PDRs associated with W49G and J. The upper limit on the number density of hydrogen molecule obtained from carbon line models is $\sim 5 \times 10^6$ cm^{-3} .

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http://www.rri.res.in/∼anish/

Infrared detection of gas phase formaldehyde towards the high mass protostar W33A

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We report the detection of numerous absorption lines of the ν_1 band of gaseous formaldehyde (H_2CO) near 3.6 μm towards the high-mass protostar W33A. This is the first infrared detection of gaseous H_2CO in an interstellar cloud. An upper limit toward RAFGL 7009S is also reported. The column density of H_2CO detected at 3.6 μm toward W33A is much higher than that measured in large beam millimeter wave observations toward the same source, suggesting that it is concentrated close to the infrared continuum source. The mean temperature of the H_2CO, derived from LTE spectral modelling, is $\sim$ 100 K, which is close to the values found for most other gas phase species observed in absorption and is the expected temperature of the cloud at the dust mantle sublimation interface, implying a large jump in the abundance of gaseous H_2CO from the surrounding cold cloud to the warm gas. The ratio of gaseous and solid H_2CO column densities is about 0.03 for W33A and less than 0.02 for RAFGL 7009S. We discuss this detection in the context of the two most likely mechanisms for H_2CO formation: grain mantle evaporation, and gas phase reactions between species produced by photodissociation of grain mantle evaporants.

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[CII] 158μm Emission and Metallicity in PDRs

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We study the effects of a metallicity variation on the thermal balance and [CII] fine-structure line strengths in interstellar photon dominated regions (PDRs). We find that a reduction in the dust-to-gas ratio and the abundance of heavy elements in the gas phase changes the heat balance of the gas in PDRs. The surface temperature of PDRs decreases as the metallicity decreases except for high density ($n > 10^6$ cm^{-3}) clouds exposed to weak ($\chi < 100$) FUV fields where vibrational H_2-deexcitation heating dominates over photoelectric heating of the gas. We incorporate the metallicity dependence in our KOSMA-τ PDR model to study the metallicity dependence of [CII]/CO line ratios in low metallicity galaxies. We find that the main trend in the variation of the observed CII/CO ratio with metallicity is well reproduced by a single spherical clump, and does not necessarily require an ensemble of clumps as in the semi-analytical model presented by Bolatto et al. (1999).

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http://www.edpsciences.org/articles/aa/pdf/forthpdf/aa3845-05_forth.pdf

Stellar populations in the CFHTLS – I. New constraints on the IMF at low mass

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We present a stellar populations analysis of the first release of the CFHTLS (Canada-France-Hawai Telescope Legacy Survey) data. A detailed comparison between the Besançon model of the Galaxy and the first data release of the CFHTLS-Deep survey is performed by implementing the MEGACAM photometric system in this model using stellar atmosphere model libraries. The reliability of the theoretical libraries to reproduce the observed colours in the MEGACAM system is investigated. The locations of various stellar species like subdwarfs, white dwarfs, late-type and brown dwarfs, binary systems are identified. The contamination of the stellar sample by quasars and compact galaxies is quantified using spectroscopic data from the VIMOS-VLT Deep Survey (VVDS) as a function of i' magnitude and $r'-i'$ colour. A comparison between simulated counts using the standard IMF at low masses show that the number of very low mass dwarfs may have been underestimated in previous studies. These observations favour a power law IMF following $d(n)/dm \propto m^{-\alpha}$ with $\alpha = 2.5$ for $m < 0.25 M_{\odot}$ or $\alpha = 3.0$ for $m < 0.2 M_{\odot}$ for single stars. The resulting LF is in agreement with the local LF as measured from the 5 or 25 pc samples. It is in strong disagreement with the Zheng et al. (2001) LF measured from deep *HST* data. We show that this discrepancy can be understood as an indication of a different IMF at low masses at early epochs of the Galaxy compared to the local thin disc IMF.

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Hubble Space Telescope NICMOS Polarization Measurements of OMC-1

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We present 2 μm polarization measurements of positions in the BN region of the Orion Molecular Cloud (OMC-1) made with NICMOS Camera 2 ($0.2''$ resolution) on *Hubble Space Telescope*. Our goals are to seek the sources of heating for IRc2, 3, 4, and 7, identify possible young stellar objects (YSOs), and characterize the grain alignment in the dust clouds along the lines-of-sight to the stars. Our results are as follows: BN is $\sim 29\%$ polarized by dichroic absorption and appears to be the illuminating source for most of the nebulosity to its north and up to $\sim 5''$ to its south. Although the stars are probably all polarized by dichroic absorption, there are a number of compact, but non-point-source, objects that could be polarized by a combination of both dichroic absorption and local scattering of star light. We identify several candidate YSOs, including an approximately edge-on bipolar YSO $8.7''$ east of BN, and a deeply-embedded variable star. Additional strongly polarized sources are IRc2-B, IRc2-D, and IRc7, all of which are obviously self-luminous at mid-infrared wavelengths and may be YSOs. None of these is a reflection nebula illuminated by a star located near radio source I, as was previously suggested. Other IRc sources are clearly reflection nebulae: IRc3 appears to be illuminated by IRc2-B or a combination of the IRc2 sources, and IRc4 and IRc5 appear to be illuminated by an unseen star in the vicinity of radio source I, or by Star n or IRc2-A. Trends in the magnetic field direction are inferred from the polarization of the 26 stars that are bright enough to be seen as NICMOS point sources. Their polarization ranges from $\leq 1\%$ (all stars with this low polarization are optically visible) to $> 40\%$. The most polarized star has a polarization position angle different from its neighbors by $\sim 40°$, but in agreement with the grain alignment inferred from millimeter polarization measurements of the cold dust cloud in the southern part of OMC-1. The polarization position angle of another highly-polarized, probable star also requires a grain alignment and magnetic field orientation substantially different from the general magnetic field orientation of OMC-1.

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A Rich Population of X-ray Emitting Wolf-Rayet Stars in the Galactic Starburst Cluster Westerlund 1

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Recent optical and infrared studies have revealed that the young (age ∼3-5 Myr) heavily-reddened starburst cluster Westerlund 1 (Wd 1) contains at least 22 Wolf-Rayet (WR) stars, comprising the richest WR population of any galactic cluster. We present results of a sensitive Chandra X-ray observation of Wd 1 which detected 12 of the 22 known WR stars and the mysterious emission-line star W9. The fraction of detected WN stars is nearly identical to that of WC stars. The WN stars WR-A and WR-B as well as W9 are exceptionally luminous in X-rays and have similar hard heavily-absorbed X-ray spectra with strong Si XIII and S XV emission lines. The luminous high-temperature X-ray emission of these three stars is characteristic of colliding wind binary systems but their binary status remains to be determined. Spectral fits of the X-ray bright sources WR-A and W9 with isothermal plane-parallel shock models require high absorption column densities log NH = 22.56 (cm^{-2}) and yield characteristic shock temperatures $kT_s \approx$ 3 keV ($T_s \approx 35$ MK).

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A Large-Area Search for Low Mass Objects in Upper Scorpius I: The Photometric Campaign and New Brown Dwarfs

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We present a wide-field photometric survey covering ∼200 deg^2 toward the Upper Scorpius OB association. Data taken in the R and I bands with the Quest-2 camera on the Palomar 48-inch telescope were combined with the 2MASS JHK_S survey and used to select candidate pre-main sequence stars. Follow-up spectroscopy with the Palomar 200-inch telescope of 62 candidate late-type members identified 43 stars that have surface gravity signatures consistent with association membership. From the optical/near-infrared photometry and derived spectral types we construct an HR diagram for the new members and find 30 likely new brown dwarfs, nearly doubling the known substellar population of the Upper Scorpius OB association. Continuation of our spectroscopic campaign should reveal hundreds on new stellar and substellar members.

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A Census of the Carina Nebula. I: Cumulative Energy Input from Massive Stars

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The Carina Nebula (NGC 3372) is our richest nearby laboratory in which to study feedback through UV radiation and stellar winds from very massive stars during the formation of an OB association, at an early phase in the evolution of the surrounding proto-superbubble before supernova explosions have influenced the environment. This feedback is triggering successive generations of new star formation around the periphery of the nebula, while simultaneously evaporating the gas and dust reservoirs out of which young stars are trying to accrete material. This paper takes inventory of the combined effect from all the known massive stars that power the Carina Nebula through their total ionizing flux and integrated mechanical energy from their stellar winds. Carina is close enough and accessible enough that spectral types for individual stars are available, and many close binary and multiple systems have recently been spatially resolved, so that one can simply add them. Adopting values from the literature for corresponding spectral types, the present-day total ionizing photon luminosity produced by the 65 O stars and 3 WNL stars in Carina is $Q_H \simeq 10^{51}$ s^{-1}, the total bolometric luminosity of all stars earlier than B2 is 2.5×10^7 $L_\odot$, and the total mechanical

luminosity of stellar winds is $L_{SW} \simeq 10^5\ L_\odot$. The total Q_H was about 25% higher when η Carinae was on the main sequence, before it and its companion were surrounded by its obscuring dust shell; for the first 3 Myr, the net ionizing flux of the 70 O stars in Carina was about 150 times greater than in the Orion Nebula. About 400-500 $M_\odot$ has been contributed to the H II region by stellar wind mass loss during the past 3 Myr. Values for Q_H and L_{SW} are also given for the individual clusters Tr14, 15, and 16, and Bo10 and 11, which are more relevant on smaller spatial scales than the total values for the whole nebula.

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Water destruction by X-rays in young stellar objects

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We study the H_2O chemistry in star-forming environments under the influence of a central X-ray source and a central far ultraviolet (FUV) radiation field. The gas-phase water chemistry is modeled as a function of time, hydrogen density and X-ray flux. To cover a wide range of physical environments, densities between $n_{\rm H} = 10^4$–10^9 cm^{-3} and temperatures between $T = 10 - 1000$ K are studied. Three different regimes are found: For $T < 100$ K, the water abundance is of order $10^{-7} - 10^{-6}$ and can be somewhat enhanced or reduced due to X-rays, depending on time and density. For 100 K $\leq T \leq$ 250 K, H_2O is reduced from initial $x(H_2O) \approx 10^{-4}$ following ice evaporation to $x(H_2O) \approx 10^{-6}$ for $F_{\rm X} \geq 10^{-3}$ ergs s^{-1} cm^{-2} ($t = 10^4$ yrs) and for $F_{\rm X} \geq 10^{-4}$ ergs s^{-1} cm^{-2} ($t = 10^5$ yrs). At higher temperatures ($T \geq 250$ K) and hydrogen densities, water can persist with $x(H_2O) \approx 10^{-4}$ even for high X-ray fluxes. The X-ray and FUV models are applied to envelopes around low-mass Class 0 and I young stellar objects (YSOs). Water is destroyed in both Class 0 and I envelopes on relatively short timescales ($t \approx 5000$ yrs) for realistic X-ray fluxes, although the effect is less prominent in Class 0 envelopes due to the higher X-ray absorbing densities there. FUV photons from the central source are not effective in destroying water, unless the photons can escape through cavities. The average water abundance in Class I sources for $L_{\rm X} \geq 10^{27}$ ergs s^{-1} is predicted to be $x(H_2O) \leq 10^{-6}$.

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A KOSMA 7 deg^2 ^{13}CO 2–1 & ^{12}CO 3–2 survey of the Perseus cloud

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Context. Characterizing the spatial and velocity structure of molecular clouds is a first step towards a better understanding of interstellar turbulence and its link to star formation.

Aims. We present observations and structure analysis results for a large-scale (~ 7.10 deg^2) ^{13}CO J = 2–1 and ^{12}CO J = 3–2 survey towards the nearby Perseus molecular cloud observed with the KOSMA 3m telescope.

Methods. We study the spatial structure of line-integrated and velocity channel maps, measuring the Δ-variance as a function of size scale. We determine the spectral index β of the corresponding power spectrum and study its variation across the cloud and across the lines.

Results. We find that the spectra of all CO line-integrated maps of the whole complex show the same index, $\beta \approx 3.1$, for scales between about 0.2 and 3 pc, independent of isotopomer and rotational transition. A complementary 2MASS map of optical extinction shows a noticeably smaller index of 2.6. In contrast to the overall region, the CO maps of individual subregions show a significant variation of β. The ^{12}CO 3–2 data provide e.g. a spread of indices between

2.9 in L 1455 and 3.5 in NGC 1333. In general, active star forming regions show a larger power-law exponent. We find that the Δ-variance spectra of individual velocity channel maps are very sensitive to optical depth effects clearly indicating self-absorption in the densest regions. When studying the dependence of the channel-map spectra as a function of the velocity channel width, the expected systematic increase of the spectral index with channel width is only detected in the blue line wings. This could be explained by a filamentary, pillar-like structure which is left at low velocities while the overall molecular gas is swept up by a supernova shock wave.

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Equilibrium Star Cluster Formation

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We argue that rich star clusters take at least several local dynamical times to form, and so are quasi-equilibrium structures during their assembly. Observations supporting this conclusion include morphologies of star-forming clumps, momentum flux of protostellar outflows from forming clusters, age spreads of stars in the Orion Nebula Cluster (ONC) and other clusters, and the age of a dynamical ejection event from the ONC. We show that these long formation timescales are consistent with the expected star formation rate in turbulent gas, as recently evaluated by Krumholz & McKee. Finally, we discuss the implications of these timescales for star formation efficiencies, the disruption of gas by stellar feedback, mass segregation of stars, and the longevity of turbulence in molecular clumps.

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A multiwavelength study of the massive star forming region IRAS 06055+2039 (RAFGL 5179)

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We present a multiwavelength study of the massive star forming region associated with IRAS 06055+2039 which reveals an interesting scenario of this complex where regions are at different stages of evolution of star formation. Narrow band near-infrared (NIR) observations were carried out with UKIRT-UFTI in molecular hydrogen and Brγ lines to trace the shocked and ionized gases respectively. We have used 2MASS JHK_s data to study the nature of the embedded cluster associated with IRAS 06055+2039. We obtain a power-law slope of 0.43$\pm$0.09 for the K_s-band Luminosity Function (KLF) which is in good agreement with other young embedded clusters. We estimate an age of 2 – 3 Myr for this cluster. The radio emission from the ionized gas has been mapped at 610 and 1280 MHz using the Giant Metrewave Radio Telescope (GMRT), India. Apart from the diffuse emission, the high resolution 1280 MHz map also shows the presence of several discrete sources which possibly represent high density clumps. The morphology of shocked molecular hydrogen forms an arc towards the N-E of the central IRAS point source and envelopes the radio emission. Submillimetre emission using JCMT-SCUBA show the presence of a dense cloud core which is probably at an earlier evolutionary stage compared to the ionized region with shocked molecular gas lying in between the two. Emission from warm dust and the Unidentified Infrared Bands (UIBs) have been estimated using the mid-infrared (8 – 21 μm) data from the MSX survey. From the submillimetre emission at 450 and 850 μm the total mass of the cloud is estimated to be $\sim$ 7000 – 9000 $M_\odot$.

Accepted by Astronomy and Astrophysics

http://au.arxiv.org/abs/astro-ph/0601535

A Chandra/ACIS Study of 30 Doradus I. Superbubbles and Supernova Remnants

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We present an X-ray tour of diffuse emission in the 30 Doradus star-forming complex in the Large Magellanic Cloud using high-spatial-resolution X-ray images and spatially-resolved spectra obtained with the Advanced CCD Imaging Spectrometer aboard the *Chandra X-ray Observatory*. The dominant X-ray feature of the 30 Doradus nebula is the intricate network of diffuse emission generated by interacting stellar winds and supernovae working together to create vast superbubbles filled with hot plasma. We construct maps of the region showing variations in plasma temperature (T = 3–9 million degrees), absorption (N_H = 1–6$\times10^{21}$ cm^{-2}), and absorption-corrected X-ray surface brightness (S_X = 3–126$\times10^{31}$ ergs s^{-1} pc^{-2}). Enhanced images reveal the pulsar wind nebula in the composite supernova remnant N157B and the *Chandra* data show spectral evolution from non-thermal synchrotron emission in the N157B core to a thermal plasma in its outer regions. In a companion paper we show that R136, the central massive star cluster, is resolved at the arcsecond level into almost 100 X-ray sources. Through X-ray studies of 30 Doradus the complete life cycle of such a massive stellar cluster can be revealed.

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A Chandra/ACIS Study of 30 Doradus II. X-ray Point Sources in the Massive Star Cluster R136 and Beyond

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We have studied the X-ray point source population of the 30 Doradus star-forming complex in the Large Magellanic Cloud using high-spatial-resolution X-ray images and spatially-resolved spectra obtained with the Advanced CCD Imaging Spectrometer (ACIS) aboard the *Chandra X-ray Observatory*. Here we describe the X-ray sources in a $17' \times 17'$ field centered on R136, the massive star cluster at the center of the main 30 Dor nebula. We detect 20 of the 32 Wolf-Rayet stars in the ACIS field. R136 is resolved at the subarcsecond level into almost 100 X-ray sources, including many typical O3–O5 stars. The brightest stellar source in the field is the WN5h star Melnick 34 in the outskirts of R136; it appears to host a faint subcluster of its own. Two orders of magnitude of scatter in L_X/L_{bol} is seen among R136 O stars, suggesting that X-ray emission depends critically on the details of wind properties and binarity rather than reflecting the widely-reported characteristic value $L_X/L_{bol} \simeq 10^{-7}$. Through X-ray studies of 30 Doradus the complete life cycle of a massive stellar cluster can be revealed.

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Radio continuum and molecular line observations of four bright-rimmed clouds

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Aim: To search for evidence of triggered star formation within four bright-rimmed clouds, SFO 58, SFO 68, SFO 75 and SFO 76.
Method: We present the results of radio continuum and molecular line observations conducted using the Mopra millimetre-wave telescope and Australia Telescope Compact Array. We use the J=1–0 transitions of ^{12}CO, ^{13}CO and C^{18}O to trace the distribution of molecular material and to study its kinematics. The radio continuum data is used to trace the distribution of the ionised gas and to derive its parameters. Combining these observations with archival data allows us to build up a comprehensive picture of the current state of star formation within these clouds.
Results: These observations reveal the presence of a dense core ($n_{\rm H_2} > 10^4$ cm^{-3}) embedded within each cloud, and the presence of a layer of hot ionised gas coincided with their bright-rims. The ionised gas has electron densities significantly higher than the critical density (> 25 cm^{-3}) above which an ionised boundary layer can form and be maintained, strongly supporting the hypothesis that these clouds are being photoionised by the nearby OB star(s). Using a simple pressure-based argument, photoionisation is shown to have a profound effect on the stability of these cores, leaving SFO 58 and SFO 68 on the edge of gravitational stability, and is also likely to have rendered SFO 75 and SFO 76 unstable to gravitational collapse. From an evaluation of the pressure balance between the ionised and molecular gas, SFO 58 and SFO 68 are identified as being in a post-pressure balance state, while SFO 75 and SFO 76 are more likely to be in a pre-pressure balance state. We find secondary evidence for the presence of ongoing star formation within SFO 58 and SFO 68, such as molecular outflows, OH, H_2O and methanol masers, and identify a potential embedded UC HII region, but find no evidence for any ongoing star formation within SFO 75 and SFO 76.
Conclusions: Our results are consistent with the star formation within SFO 58 and SFO 68 having been triggered by the radiatively driven implosion of these clouds.

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http://www.ast.leeds.ac.uk/∼jsu/astro-ph_0601718.ps

Observational Properties of Protoplanetary Disk Gaps

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We study the effects of an annular gap induced by an embedded protoplanet on disk scattered light images and the infrared spectral energy distribution (SED). We find that the outer edge of a gap is brighter in the scattered light images than a similar location in a gap-free disk. The stellar radiation that would have been scattered by material within the gap is instead scattered by the disk wall at the outer edge of the gap, producing a bright ring surrounding the dark gap in the images. Given sufficient resolution, such gaps can be detected by the presence of this bright ring in scattered light images. A gap in a disk also changes the shape of the SED. Radiation that would have been absorbed by material in the gap is instead reprocessed by the outer gap wall. This leads to a decrease in the SED at wavelengths corresponding to the temperature at the radius of the missing gap material, and to a corresponding flux increase at longer wavelengths corresponding to the temperature of the outer wall. We note, however, that the presence of an annular gap does not change the bolometric IR flux; it simply redistributes the radiation previously produced by material within the gap to longer wavelengths. Although it will be difficult on the basis of the SED alone to distinguish between the presence of a gap and other physical effects, the level of changes can be sufficiently large to be measurable with current instruments (e.g., *Spitzer*).

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Reviving Dead Zones in accretion disks by Rossby vortices at their boundaries

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Models of the accretion disks of Young Stellar Objects show that they should not be ionized at a few AU from the star, and thus not subject to the MHD turbulence believed to cause accretion. This has been suggested to create a "Dead Zone" where accretion remains unexplained. Here we show that the existence of the Dead Zone self-consistently creates a density profile favorable to the Rossby Wave Instability of Lovelace et al. (1999, ApJ, 513, 805). This instability will create and sustain Rossby vortices in the disk which could lead to enhanced planet formation.

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A Search for Optical Outflows from Brown Dwarfs in the Chamaeleon I Molecular Cloud

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A deep [S II] $\lambda\lambda$ 6717/6731 wide-field HH object survey has been carried out toward the Chamaeleon I (Cha I) molecular cloud with a sky coverage of $1^o \times 2^o$ which embraces the entire Cha I molecular cloud. Totally eighteen HH objects have been detected in the Cha I cloud including the previously known objects HH 48-51. The newly discovered HH objects are named as HH 905-918. The exciting source of HH 48 is found to drive two outflows at roughly a right angle with each other. Abundant features are discovered in the vicinity of HH 50 which show that HH 50 is a giant bow shock pointing to the southwest. The possible exciting sources of the detected HH objects are discussed based on the morphology and locations of the HH objects and results of surveys at X-ray, optical, infrared, and millimeter wavelengths. The HH objects in Cha I are found to be concentrated in the northern and southern dense parts of the cloud. In the northern dense cloud, the HH objects are clustered in a region of highest gas density with a radius of $2.5'$. In contrast, the HH objects in the southern dense cloud are near evenly distributed over the dense cloud. This difference may reflect that star formation in the northern cloud tends to be more clustered than that in the southern cloud or the driving sources in the northern cloud are in general younger than those in the southern cloud. Although more than 40 brown dwarfs or brown dwarf candidates have been detected in Cha I in previous surveys, no compelling evidence for optical outflows from brown dwarfs has been found in our images at the detection limit of 2.3×10^{-20} W m^{-2} arcsec^{-2} (3σ) in the [S II] $\lambda\lambda$ 6717/6731 emission. The typical peak brightness of HH objects in Cha I is about 20 times above our detection limit. We conclude that the brightness of optical outflows from substellar objects should be about 20 times lower than that of outflows from young solar-type stars if all the HH objects detected in Cha I are driven by young stars. In three cases, i.e., HH 51, 908, and 909, however there are hints of a connection between HH objects and the nearby brown dwarfs or very low-mass stars.

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http://www.journals.uchicago.edu/ApJ/future.html

Ammonia cores in high mass star formation regions

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We observed a sample of 35 water masers not coincident with known HII regions and/or low mass young stellar objects (YSOs) with the Effelsberg 100 m telescope in the NH_3 (J,K) = (1,1), (2,2), (3,3) and (4,4) transitions. Sixteen sources were detected in the NH_3 emission. The detection rate is 46%. All these sixteen sources have NH_3 (1,1) and (2,2) emission, among which four sources have NH_3 (3,3) emission. Comparing with the IRAS and the 2MASS data, we analyzed the relationship between the detection rate and the infrared color, the dust temperature and the source distance.

All the detected sources were mapped and 17 cores were obtained (one source IRAS 20215+3725 has two cores). From the detected sources five cores do not coincide with radio continuum or IRAS and MSX point sources. Excluding one core that has no MSX data available, the remaining eleven cores are coincident with IRAS or MSX point sources.

The typical size and mass of the cores are 1.6 pc and 1.5×10^3 $M_\odot$, respectively. The average line widths of the NH_3 (1,1) and (2,2) are 1.54 and 1.73 km/s. The average kinetic temperature of the gas is about 19 K. These values are much larger than those of low mass cores.

The NH_3 cores that coincide with IRAS sources (referred to as Group I) have slightly larger line widths (1.65 and 1.75 km/s for the (1,1) and (2,2) lines, respectively) and larger masses (1.8×10^3 $M_\odot$) than the mean values of the sample. For this type of core the kinetic temperature correlates with the line width. The line width appears to correlate with the bolometric luminosity and the core size. Despite the average luminosity of 2.9×10^4 $L_\odot$, there is no detectable 6 cm emission. These are candidates for high mass protostars or precursors of UC HII regions.

The NH_3 cores with peaks offset from infrared sources (referred to as Group II) have an average size of 1.7 pc and an average line width of 1.50 km/s for the (1,1) line. The line width of the (1,1) emission is smaller than that of the group I. The average mass is 9.4×10^2 $M_\odot$. One possible explanation for the deviation is that the NH_3 peak and the infrared source correspond to different clumps. These cores are potential high mass star formation sites and may be at an earlier evolutionary stage than those with IRAS point sources. This type of core is seen in mapping observations, and can be easily missed by single-spectrum observations toward the IRAS position.

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Concentration and sorting of chondrules and CAIs in the late Solar Nebula

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The high concentration and sorting of chondrules, sub-mm sized spherules found in undifferentiated meteorites, is one of the great unsolved mysteries in planetology. Here we present a unifying explanation for these phenomena based on the assumption that chondrules were present when the Solar Nebula was optically thin but had a significant amount of gas. An immediate consequence is that chondrules feel a force known as photophoresis. Photophoresis is based on a temperature gradient over the surface of a particle resulting from absorption of radiation and non-uniform interaction with its gaseous environment. In comparison to well-known forces originating from starlight, i.e. radiation pressure, Poynting-Robertson drag, or the Yarkovski effect, photophoresis can be stronger by many orders of magnitude in gaseous environments. In the application discussed here photophoresis concentrates chondrules and CAIs, which are both found in chondrites, in the region of the asteroid belt. Chondrules from any place in the Solar Nebula will be dragged to the asteroid belt region, while smaller dust particles and their aggregates will be removed from this region at the same time. This leads to a high relative concentration of chondrules, sorted with respect to their thermal conductivity, density, and size, for building chondrite parent bodies. Furthermore, photophoresis prevents CAIs from being lost to the Sun.

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Bolocam Survey for 1.1 mm Dust Continuum Emission in the c2d Legacy Clouds. II. Ophiuchus

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We present a large-scale millimeter continuum map of the Ophiuchus molecular cloud. Nearly 11 square degrees, including all of the area in the cloud with visual extinction more than 3 magnitudes, was mapped at 1.1 mm with Bolocam on the Caltech Submillimeter Observatory (CSO). By design, the map also covers the region mapped in the infrared with the Spitzer Space Telescope. We detect 44 definite sources, and a few likely sources are also seen along a filament in the eastern streamer. The map indicates that dense cores in Ophiuchus are very clustered and often found in filaments within the cloud. Most sources are round, as measured at the half power point, but elongated when measured at lower contour levels, suggesting spherical sources lying within filaments. The masses, for an assumed dust temperature of 10 K, range from 0.24 to 3.9 solar masses, with a mean value of 0.96 solar masses. The total mass in distinct cores is 42 solar masses, 0.5 to 2% of the total cloud mass, and the total mass above 4 sigma is about 80 solar masses. The mean densities in the cores are quite high, with an average of 1.6×10^6 cm^{-3}, suggesting short free-fall times. The core mass distribution can be fitted with a power law with slope of 2.1 ± 0.3 for $M > 0.5$ solar masses, similar to that found in other regions, but slightly shallower than that of some determinations of the local IMF. In agreement with previous studies, our survey shows that dense cores account for a very small fraction of the cloud volume and total mass. They are nearly all confined to regions with visual extinction at least 9 mag, a lower threshold than found previously.

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Preprints available from http://peggysue.as.utexas.edu/SIRTF/ under Publications link. A version with lower quality figures is available at http://xxx.lanl.gov/abs/astro-ph/0602259

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).

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New Jobs

JETSET - Radiative hydrodynamics experiments on large scale lasers in astrophysical context.

A one year postdoctoral position has been opened in Paris Observatory (www.obspm.fr) to work on the modelling of radiative hydrodynamics high energy laser experiments of astrophysical interest , in the context of the European network Marie Curie RTN-JETSET (www.jetsets.org). The candidate should have experience in numerical modelisation and if possible expertise in multidimensional numerical simulation. Expertise in hydrodynamics, radiative transfert, plasma physics, astrophysics will be appreciated.

Applications must be received by June 30, 2006.

Interested people can read the dedicated CNRS web page :

$www.sg.cnrs.fr/drhchercheurs/Post\_doc\_2006/default.htm$

(click on "liste des offres", then SDU and SDU7), or directly at :

$www.k-projects.com/cnrs\_postdocs/public/departement\_details.php?IdDpt=9\&Dep=SDU\&NumOffre=7$.

where they can also find the application form (click on "dossier de candidature") .

Contacts: sylvie.cabrit@obspm.fr or chantal.stehle@obspm.fr

LECTURESHIP IN ASTRONOMY, JODRELL BANK CENTRE FOR ASTROPHYSICS, MANCHESTER, UK

To enhance its world-ranked research astrophysics programme, the University of Manchester seeks to fill a faculty position in astronomy. The position will be based within the Jodrell Bank Centre for Astrophysics and will be in the general area of molecular astrophysics, astrochemistry and/or submillimetre astronomy, or a closely related area. Associated research areas currently addressed by the group include the origin and evolution of stars, circumstellar material and dust, and astrochemistry. Suitably qualified candidates with observational and/or theoretical interests in one or more of these areas or related areas are encouraged to apply. With this appointment the group expects to strengthen its ability to exploit upcoming instruments and missions including SCUBA2, HARP-B, ALMA, JWST and Herschel.

Informal enquiries concerning this position can be made to Prof. Albert Zijlstra, email: Albert.Zijlstra@manchester.ac.uk, or to Dr. Gary Fuller, email: Gary.Fuller@manchester.ac.uk

Application forms and further details may be downloaded by visiting the website: www.manchester.ac.uk/vacancies.

Applicants should submit a completed University application form, a full curriculum vitae, a research plan, and the names of three referees and the Equal Opportunities Monitoring form. These should be marked Confidential-Staff Application and returned by 15 APRIL 2006 to Anne O'Neill, The University of Manchester, Faculty of Engineering and Physical Sciences, Sackville Street Building, Manchester, M60 1QD, UK

Formation and evolution of planetary systems

We are offering a 30 months (with a possible extension to 36 months) post doctoral fellowship at Laboratoire dAstrophysique de Grenoble (LAOG, http://www-laog.obs.ujf-grenoble.fr/) in France.

The successful applicant will join a group of astronomers: A.-M. Lagrange, J.-L. Beuzit, H. Beust, J.-C. Augereau, F. Galland, D. Mouillet, R. Reche within the FOST team (http://www-laog.obs.ujf-grenoble.fr/equipes/fost/). The main fields of interest of our group are planetary debris disks and extrasolar planets/brown dwarfs. We regularly obtain high angular and high contrast imaging data at the VLT (main targets are currently close-by associations and stars with planets), data from the SPITZER Space Telescope (c2d Legacy Program) and radial velocity data at the ESO-3.6m (HARPS) and OHP-2m (ELODIE, SOPHIE) telescopes. The group has been involved in the construction of the NAOS adaptive optics system for the VLT (Project Scientist: A.-M. Lagrange) and is currently involved in the forthcoming VLT-Planet Finder (Principal Investigator: J.-L. Beuzit; Project Scientist: D. Mouillet). Also, physical and dynamical modelling of debris disks (e.g. Beta Pictoris, HD141569, HR4796) and of multiple stellar systems are carried out (H. Beust, J.-C. Augereau). Strong collaborations are maintained since several years with G. Chauvin at ESO-Chile and M. Mayor and S. Udry at Geneva Observatory.

Demonstrated expertise in IR observational astronomy is essential. Previous experience with high angular resolution imaging is desirable. The successful applicant will participate to the research activities of the group for 50% of his/her time, preferably on faint companions (planets, brown dwarfs) to stars, or on planetary disks. The remaining 50% can be devoted to the candidate own research (preferably in a domain related to planet formation). By the starting date, the candidate should have obtained a PhD degree in astronomy. The position is available immediately but the start date is flexible and can be any time before October 1, 2006. The net salary will be approximately 21000 Euros per year. Support for research activities will be available in addition.

Interested candidates shall send a letter of interest, detailed CV, statement of research and three letters of reference to Dr. Anne-Marie Lagrange (anne-marie.lagrange@obs.ujf-grenoble.fr).

Closing date for application: April 15, 2006.

Postdoctoral Position on Chemistry in Proto-planetary Disks Observatory of Bordeaux, France

The CNRS (Centre National de la Recherche Scientifique, France) has opened a postdoctoral Position at L3AB (Observatory of Bordeaux), in France. At L3AB ("Laboratoire d'Astrodynamique, d'Astrophysique et d'Aéronomie de Bordeaux"), a long term goal is to investigate the physics and the chemistry of the inner disks around young stars where planetary formation is thought to occur, a region which will be accessible with the ALMA sub-millimeter interferometer. For this purpose, we started in 2004 a large program of observations of molecular disks around young stars using the IRAM array. This post-doc position is dedicated to the comparison of these observational data to chemical models of disks. The successful candidate, based at the observatory of Bordeaux, will have to improve an existing chemical code, suited for PDRs, for a direct application to the physics and chemistry of disks and to compare it to others. In particular he/she will have to investigate the influence of 1) distribution of the grain size and 2) the UV spectrum shape of TTauri and Herbig Ae stars on the molecular content of disks. The successful candidate should be an astro-chemist working in one of the following domain: Interstellar medium, star formation, proto-planetary disks. He/she should have experience in using and understanding chemical codes in one of the astrophysical domain given above. A good knowledge of Fortran programming is required. Understanding millimeter observations is a plus, but knowledge of millimeter interferometry is not necessary. The position is for 2 years and will start in September 2006. Deadline for the application is end of June 2006.

More information can be found on the CNRS WEB site at the following address:

`http://www.k-projects.com/cnrs_postdocs/public/departement_details.php?IdDpt=9&Dep=SDU&NumOffre=2&Langue=en`

where is also located the application form (click on "dossier de candidature").

Contact: Dr Anne Dutrey
(33) 5 57 77 61 57
anne.dutrey@obs.u-bordeaux1.fr – http://www.obs.u-bordeaux1.fr/

Postdoctoral or Ph.D. position in the Infrared Interferometry Group at the Max-Planck Institute for Radioastronomy

Applications are invited for a postdoctoral or Ph.D. position in the Infrared Interferometry Group of the Max-Planck Institute for Radio Astronomy in Bonn (see http://www.mpifr-bonn.mpg.de/div/ir-interferometry). Preference will be given to applicants with experience in one of the following areas: young stellar objects, active galactic nuclei, or radiative transfer modeling.

Successful applicants will be expected to participate in interferometric observations and their interpretations. The position offers excellent opportunities for high-resolution studies using the VLT Interferometer (in particular, its AMBER phase closure instrument). Since our group is a member of the international VLTI AMBER and the LBT LINC-NIRVANA consortia, we own a large amount of both VLTI and LBT Guaranteed Observing Time.

The appointment is initially for one year and is renewable for up to six years. Applicants should submit a curriculum vitae, list of publications, and brief description of research interests, and arrange for one letter of recommendation to be emailed to weigelt@mpifr-bonn.mpg.de. The review of applications will begin on 1 April 2006 and will continue until the position is filled. The Max-Planck Society is an equal opportunity employer and aims to employ more disabled people. Applications from disabled persons are therefore particularly welcome.

SUPA Advanced fellowship in young stars and planetary systems

University of St Andrews, Scotland.

We are seeking an experienced researcher to join our group as a four-year Advanced Fellow under the Scottish Universities Physics Alliance (SUPA) initiative. The position is to be in any of the following areas: exo-planet detection, planet formation, young stars and disks, planetary atmospheres, planetary exploration, origins of solar system life or theory of extrasolar life. This position is to directly support the SUPA theme program of astrobiology. Our areas of current research interests include exo-planets, circumstellar discs and planet formation, star formation, cool stars and stellar magnetospheres, AGN, galactic dynamics, galaxy populations and cosmology.

The appointee is expected to lead an independent research programme in one of the above areas and ideally to extend the skills already within the group (see http://star-www.st-and.ac.uk/astronomy). Applicants should show how aspects of their work relate to astrobiological themes such as the origins of stars, planets and life. In addition to undertaking world-class research, the position offers the opportunity to gain valuable experience in university lecturing. The appointee is expected to contribute 25 lecture-hours per year to our undergraduate and graduate teaching programme in astronomy. The primary requirements for the position is a PhD in any area of astrophysics, postdoctoral experience and an active and world-class research programme. Experience in undergraduate/graduate teaching is advantageous.

This is a 4-year appointment based at the University of St Andrews, in Scotland. The SUPA (http://www.supa.ac.uk) network links up six universities in Edinburgh, Glasgow and St Andrews, and is investing in 35 new science posts in physics and astronomy. The appointee will have the opportunity to play a leading role in this new initiative.

Informal enquiries to Prof Keith Horne, kdh1@st-and.ac.uk, +44 (0)1334-463322, School of Physics and Astronomy (http://star-www.st-and.ac.uk/astronomy).

Application forms and further particulars are available from Human Resources, University of St Andrews, College Gate, North Street, St Andrews, Fife KY16 9AJ, (tel: 01334 462571, by fax 01334 462570 or by e-mail Jobline@st-andrews.ac.uk and at http://www.st-andrews.ac.uk/hr/recruitment/vacancies. Applications to Human Resources should include the application form, cover letter, curriculum vitae, publications list, statement of research and three letters of reference.

Please quote ref: ME152/06

Closing Date: 1 June 2006

The University is committed to equality of opportunity.

Meetings

IAU Symposium No. 237 Triggered Star Formation in a Turbulent ISM Prague 14-18 August 2006

IAU symposium No. 237 on "Triggered star formation in a turbulent ISM" will be held during the General Assembly of the IAU in Prague.

For information, please, visit the web page

http://astro.cas.cz/iaus237

This is a call for contributed and poster papers. Please, submit your proposed titles and abstracts through

http://www.astronomy2006.com

where you may also register for the General Assembly.

Should you wish to apply for a travel grant, please submit your abstract before 9th April 2006. The applicants will be notified by the IAU before the end of April.

The early registration finishes 15th of May, which is also the deadline for early submission of abstracts. The SOC will set the status of early papers (oral or poster) before 15th June 2006.

The final deadline for abstract submission is 26th June 2006.

Contacts: Bruce G. Elmegreen (bge@watson.ibm.com) and Jan Palous (SOC co-chairs)

Physical Processes in Circumstellar Disks
Vidago, Portugal - 18-23 September 2006

This is the second announcement of the workshop on Physical Processes in Circumstellar disks around young stars.

Due to the interdisciplinary nature of the field the workshop was designed with a considerable time devoted to in depth reviews. Time is also available to ∼20 contributed talks. In order to maximize interaction ample time is available for discussions.

Registration
The registration and submission of abstracts for contributed oral/poster contributions is now open. The deadline for registration is the **20th of March 2006**. The webpage of the workshop is available at: http://www.astro.up.pt/disks2006

Contact: Paulo J.V. Garcia (pgarcia@astro.up.pt)

Desert Meteorites
Casablanca, Morocco - August 3-4, 2006

We would like to focus your attention to a workshop on "Desert Meteorites" in Casablanca, Morocco, on August 3-4, a few days before the Annual Meeting of the Meteoritical Society in Zürich, Switzerland. This is the first time such a workshop has been organized by scientists from a country where thousands of desert meteorites have been recovered. The Meteoritical Society attaches great importance to this workshop as it reflects efforts to provide a more solid basis for the recovery and collection of desert meteorites.

The website for the meeting is at **http://www.fsac.ac.ma/meteorite/index.html** and you can also download the first circular from the MetSoc website at http://meteoriticalsociety.org/meetings/casablanca_circular_2006.pdf.

The Western Workshop:

From Protostellar Disks to Planetary Systems

May 18-19, 2006

The University of Western Ontario
London, Ontario, Canada
http://www.astro.uwo.ca/∼disks/

The formation of stars and planetary systems are fundamental yet unresolved problems in astrophysics. Both processes depend crucially on the evolution of a gas/dust disk surrounding a young star. Rapid advances in our understanding of disk evolution are coming from direct observations of star-disk systems, modeling of star and planet formation, and studies of our own solar system through observations and meteoritic data.

It is the goal of this workshop to bring together researchers working on various aspects of disk evolution in order to exchange ideas, achieve deeper insights, and foster new collaborations. We are encouraging talks on current research. This workshop will be limited to 40 participants.

The deadline for pre-registration (required if a contributed talk is requested) is March 15, 2006, and the deadline for payment of registration fees is April 17, 2006.

Electronic mail: disks@astro.uwo.ca

Complex Molecules in Space
Present Status and Prospects with ALMA

May 8-11

Location: near Aarhus, Denmark

The website is **http://www.isa.au.dk/meetings/alma06/index.html**

The numbers of attendees is limited to about 60.

Poster submissions are welcome. Some poster submissions will be selected for short presentations.

Deadline for registration is 31st March

2nd Announcement

Science with Alma: A New Era for Astrophysics

13-16 November 2006 - Madrid, Spain

Information on the 2nd pan-ALMA meeting is available via

http://www.oan.es/alma2006/ (final slash is mandatory)

Currently under construction in the Andean Altiplano, Northern Chile, the Atacama Large Millimeter Array (ALMA) is an international radio interferometer with about 7000 m2 of collecting area comprised of 64 (50) 12-m antennas. Initially covering the most interesting spectral wavelength ranges from 3 to 0.3 mm, ALMA will be a revolutionary telescope providing astronomy with the first detailed view of the dark and youngest objects of the Universe.

The scientific preparations for ALMA are being extremely active since the birth of the project. The various science committees, groups of astronomers working for ALMA, and regional communities interested in the project meet regularly to exchange ideas about the scientific capabilities and first observations to be carried out with the interferometer. A first world-wide conference on "Science with the Atacama Large Millimeter Array" took place in Washington, D.C. (USA), on 6-8 October 1999.

The conference will be the second world-wide meeting on "Science with the Atacama Large Millimeter Array". This international ALMA conference is envisioned as a way for the astronomers interested on ALMA, not necessarily radioastronomers, to exchange views, to plan preparatory observations in view of the scientific exploitation of the interferometer, and to obtain the information needed to orient their scientific work to the best possible use of ALMA.

About 40 invited papers will be presented orally in morning and afternoon sessions, and there will be afternoon poster sessions. In addition we will also have around 20-35 short contributing papers. There will be no parallel sessions. Invited papers are of 30 minutes duration, including discussion. The proceedings will be published by Springer Verlag

Programme :

SECTION 1 : The project

SECTION 2 : Star Formation

SECTION 3 : Proto-Planets and substellar objects

SECTION 4 : Molecular Clouds

SECTION 5 : Solar System

SECTION 7 : Galaxies

SECTION 8: High redshift galaxies & Cosmology

Contributing talks

There will be space for 30 contributing talks of 15 minutes. Participants interested in presenting a contribution have to use the conference web page to give title and abstract. Deadline for contributing taks is 15 June 2006. Contributing talks will be published in the proceedings of the conference.

Registration and deadline

The Registration has now opened, via the Conference webpages (see above). Full Registration, including payment of Registration Fee and Conference Dinner, must be completed before the deadline of 15 June 2006 (early registration; 15 September final deadline for registration). The Registration Fee is kept to 250 Euros (early registration; 300Euros after 15 June 2006) and includes the Conference Dinner. Registration Fee is mandatory for all participants, invited speakers and SOC/LOC members. The methods of payment are detailed on the Webpage. For early registration the payment has to be done to an International Money Transfer Order. Please ensure that any bank transfer costs are taken into account, so that the full amount due will be received by the LOC. At the Symposium itself, the Registration Desk will open on Monday morning (08H00), 13 November 2006.

Grants

A limited number of Grants for PhD students will be available. The Grants can be used primarily for the registration fee of participant unable to provide these by themselves. The application procedure for these Grants is indicated on the Conference webpage and the deadline for applying is 15 June 2006.

The Early Phase of Star Formation

August 28 - September 1, 2006

Ringberg Castle, Bavaria, Germany

Organized by J. Steinacker & A. Bacmann

Scientific Advisory Committee: P. Andre, J. Alves, A. Bacmann, M. Bate, S. Basu, R. Chini, Th. Henning, R. Klessen, P. Myers, T. Ray, J. Steinacker, D. Wiebe,

Objectives of the conference: Despite of the flow of new high-resolution observations and advanced simulations of star forming regions, the main controling agents of the early phase star formation process remain highly debated.

Due to the complex interplay of gas and dust, magnetic fields, radiation, chemistry, and turbulence, advanced numerical and observational methods are currently used to analyze the problem. Many of these methods harbor hidden difficulties, traps, approximations, and assumptions. In the current science landscape, these are often unmentioned although overcoming them might be crucial for a progress in the understanding of the early phase of star formation.

The main objective of the EPoS 2006 meeting is to present recent results of research about the early phase of star formation while highlighting the underlying approximations and assumptions made in numerical and observational methods. Major emphasis should be given to suggestions on how to overcome the limitations of the approximations, assumptions, and reduction techniques.

The meeting focusses on the theoretical and observational aspects of the first phase of the stellar birth, addressing both low- and high-mass stars. Topics of particular interest for the conference are triggered star formation, clustered star formation, cores, chemistry, collapse, fragmentation, jets, competitive accretion, giant molecular clouds, binarity, magnetic fields, initial mass function, turbulence, and early phases of disks.

Castle Ringberg, overlooking the Tegernsee in the foothills of the Bavarian Alps, is a unique place for scientific meetings with its relaxed mountain atmosphere high above the daily business activities. Owned by the Max-Planck Society, this center of scientific communication features several conference rooms, a dining hall, accommodation for the participants as well as a terrace, swimming pool, and a garden. Wireless LAN is available.

Relevant information including deadlines, registration, program etc. can be found at

www.mpia.de/homes/stein/EPoS2006/

Deadline for Registration and Abstract Submission: **May 1 2006**

The number of participants is limited to about 60.

The 8th European VLBI Network Symposium

The 8th EVN Symposium will be hosted by Torun Radio Astronomy Observatory, Poland, 26-29 September 2006. As usual, the EVN Users Meeting will be one of the items on the agenda.

The symposium will have an informal character. It will consist of a number of invited reviews followed by oral contributions grouped in sessions on extragalactic objects, stars, instrumentation, and techniques. Space for presenting posters will also be provided.

The First Announcement is downloadable from the official website:

http://www.astro.uni.torun.pl/evn2006/

Contact: Andrzej Marecki (amr@astro.uni.torun.pl - Secretary of the SOC)

New Books

Cores to Clusters

Star Formation with Next generation Telescopes

Edited by M.S.N. Kumar, M. Tafalla, and P. Caselli

These are the proceedings of a workshop held at Centro de Astrofisica da Universidade do Porto in Portugal on 7–9 October, 2004. The book provides an overview of a number of topics in low- and high-mass star formation, and contains the following chapters based on the oral presentations, as well as several poster papers:

Physical Propertiesof Prestellar Cores *Malcolm Walmsley*
Impulsively Triggered Star Formation *Anthony P. Whitworth*
Starless Cores *Mario Tafalla*
Chemical Processes in Star Forming Regions *Paola Caselli*
Protostellar Jets: A High Angular Resolution Perspective *Francesca Bacciotti*
Non-Isothermal Gravoturbulent Fragmentation *Anne-Katharina Jappsen, Ralf S. Klessen, Richard B. Larson, Yuexing Li & Mordecai-Mark Mac Low*
The Birth of Massive Stars and Star Clusters *Jonathan C. Tan*
Precursors of UCHII Regions and the Evolution of Massive Outflows *Henrik Beuther & Debra Shepherd*
Observations of Accretion onto High Mass Stars *Eric R. Keto*
Disks around Massive (proto)Stars *Riccardo Cesaroni*
Embedded Clusters *Elizabeth A. Lada*
Massive Protostars and Small Protoclusters *Nanda M. S. Kumar*
Pre-main-sequence Evolution and Brown Dwarfs Beyond the Solar Vicinity *Andre Moitinho, C. J. Lada, N. Huélamo, J. F. Alves & A. A. Muench*
Brown Dwarfs *Rafael Rebolo*

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http://www.springer.com/sgw/cda/frontpage/0,11855,4-40157-22-51432762-0,00.html

Short Announcements

This is an announcement of the availability of the version 1.0 of the CASSIS Spectrum Analyzer Software. This software is offered, presently in a beta (but robust) version, to the general millimeter and submillimeter astronomical community by a team of scientist working at CESR/UPS-CNRS, Toulouse France. The first goal of CASSIS was to prepare the Herschel Submillimeter Observatory mission (see the main CASSIS web page : http://pc-126.cesr.fr/), but it can also be used to prepare observations with - or to analyze data from - any radio-telescope.

CASSIS (Centre d'Analyse Scientifique de Spectres Infrarouges et Sub-millimtriques) provides interactive software allowing the user to visualize and analyze spectra taken with radiotelescopes.

- It accepts data files generated by CLASS software (post summer 2005) or ASCII tables (CASSIS Format)

- Coupled with CDMS and JPL databases and LTE models, CASSIS is particularly useful to identify lines and to deduce physical parameters.

- The CASSIS interactive spectrum analyzer is available in a dual (server + applet) Standalone Java application.

- The CDS (Cassis Data System) provides the models from authors that must be cited in case of publications made using CASSIS (see CASSIS web site).

The site to download the version 1.0 of the CASSIS Spectrum Analyzer Software is :

http://pc-126.cesr.fr/trac.cgi/wiki/InstallationCassisStandalone

If the CASSIS interactive spectrum analyzer was helpful for your for scientific analysis in published articles or for conference presentations work, please make reference to CASSIS software and acknowledge also the providers of databases and models interfaced to CASSIS. This would help to maintain their support and encourage new additions. Here is a sample text :

"This research has made use of CASSIS, (http://pc-126.cesr.fr/). We have used the JPL and CDMS databases and the LTE model by C. Vastel."

We are presently working on an improvement of this version and should be able to provide a version 1.1 in the coming weeks. The users feed-back is expected to make this version 1.1 even better. Please, if you use this software send me an email for us to build up a CASSIS user's database, and feel free to send comments and bugs reports filling in the template at the following address :

http://pc-126.cesr.fr/trac.cgi/newticket

Best regards,

Emmanuel Caux, caux@cesr.fr CESR, BP 4346 31028 Toulouse Cedex 4, France Phone 33-561 556 689 Fax 33-561 556 701