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Abstracts of recently accepted papers

A Submillimetre Survey for Protostellar Accretion Discs using the JCMT-CSO Interferometer

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We present a submillimetre continuum survey for accretion discs around seven embedded protostars in the Perseus and Serpens molecular clouds. Observations were made at frequencies between 339 and 357 GHz using the James Clerk Maxwell Telescope-Caltech Submillimeter Observatory single baseline interferometer on Mauna Kea, Hawaii. All the objects in our survey show compact dust emission on scales $< 1''$, assumed to arise in a circumstellar accretion disc. We compare the properties of this compact component with evolutionary indicators, such as the ratio of compact to extended emission, and bolometric temperature. We find that discs of mass $\sim 0.01 M_\odot$ have formed by the Class 0 stage, and that similar mass discs are observed in Class I and Class II sources. A trend is observed whereby the ratio of compact to extended emission in our sources increases from Class 0 to Class II sources. For three of the objects in the survey, NGC1333 IRAS2:CR1 and SVS13 in Perseus, and FIRS1 in Serpens, the signal-to-noise ratio is sufficient to allow us to model the brightness distributions with elliptical Gaussian and power-law disc models. The Gaussian fits give semi-major half-power radii of approximately 90 to 140 AU, at the assumed distance of 350 pc to the Perseus and Serpens clouds.

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Preprints available at : http://www.mrao.cam.ac.uk/~dbrown/publications.html

A comparison of the rotational properties of T Tauri stars in Orion and Taurus

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We analyse the distribution of projected equatorial velocities ($vsini$) for a magnitude limited sample of stars in Taurus, in order to assess whether this sample can contain a population of fast rotators (missed in previous photometric monitoring campaigns) similar to those recently discovered in Orion by Stassun et al 1999. We find strong evidence, in line with the results of photometric monitoring campaigns in Taurus, that there is *no* such population of stars in Taurus that rotate at a large fraction of break-up velocity. We thus demonstrate that t he stellar rotation distributions in the two star forming regions are intrinsically different (with a statistical significance of this discrepancy in excess of 3σ), and discuss possible origins for this difference.

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Observations of a curving molecular outflow from V380 Ori-NE: further support for prompt entrainment in protostellar outflows

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CO J=3-2 and 4-3 observations of V380 Ori-NE reveal a highly-collimated bipolar molecular outflow associated with a jet traced here in H_2 1-0S(1) line emission. The source of the flow is also detected at 450 μm and 850 μm with SCUBA. The combined CO and near-IR observations offer compelling support for the prompt entrainment model of jet-driven molecular outflows. Not only are the H_2 shock fronts spatially coincident with peaks in the CO outflow lobes, but the slope of the mass-velocity distribution in the flow, measured here at intervals along both flow lobes, also clearly *decreases* just behind the advancing shock fronts (and towards the ends of the flow lobes), as one would expect if the high-to-low velocity mass fraction was enhanced by the entraining shocks.

We also find that both lobes of the CO outflow clearly deviate, by some 20°, from the H_2 jet direction near the source. Both lobes may be being deflected at the locations of the observed H_2 shock fronts, where they impact dense, ambient material. Alternatively, the almost point-symmetric CO flow pattern could be caused by precession at the source.

The submm data reveal the source of the outflow, V380 Ori-NE. The 450 μm and 850 μm maps show an elongated peak superimposed onto an extensive pedastal of weaker emission. The major axis of the source is orientated parallel with the inner flow axis. Indeed, weak 850 μm emission is detected along much of the bipolar outflow, particularly in the southern lobe and towards the southernmost CO intensity peak. The submm "continuum" data therefore probably trace warm dust and CO associated with the outflow. These data also confirm V380 Ori-NE's status as a Class I protostar.

Overall, the orientation, simplicity and symmetry of this outflow, combined with the remarkable strength of the high-velocity line-wing emission in comparison to the ambient emission, make this system a perfect laboratory for future detailed studies of bipolar molecular outflows and their association with collimated jets from young, deeply embedded protostars.

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Preprints available from http://www.jach.hawaii.edu/~cdavis/papers.html

Large Area Mapping at 850 Microns. I. Optimum Image Reconstruction From Chop Measurements

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We present results on the optimum reconstruction of chop data taken using the Submillimeter Common-User Bolometer Array (SCUBA) on the James Clerk Maxwell Telescope. Using an artificial data set with known noise properties, we analyze three techniques for constructing images of the sky from the chop data: Emerson Fourier deconvolution, matrix inversion, and maximum entropy reconstruction. We conclude that a matrix inversion formulation via an iterative procedure produces the best image reconstructions. We apply the three reconstruction techniques to produce maps of the calibration point source CRL 618 and the ρ Ophiuchus A core at 850 μm and use Wiener filtering to

remove the high frequency noise component from the matrix inversion method.

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Large Area Mapping at 850 Microns. II. Analysis of the Clump Distribution in the ρ Ophiuchi Molecular Cloud

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We present results from a survey of the central 700 arcmin^2 region of the ρ Ophiuchi molecular cloud at 850μm using the Submillimeter Common-User Bolometer Array (SCUBA) on the James Clerk Maxwell Telescope. Using the clump finding procedure developed by Williams *et al.* (1994), we identify 55 independent objects and compute size, flux, and degree of central concentration. Comparison with isothermal, pressure-confined, self-gravitating Bonnor-Ebert spheres implies that the clumps have internal temperatures of $10-30\,$K and surface pressures $P/k = 10^{6-7}\,$K/cm^3 consistent with the expected average pressure in the ρ Ophiuchi central region, $P/k \sim 2\times 10^7\,$K/cm^3. The clump masses span $0.02-6.3\,M_\odot$ assuming a dust temperature $T_d \sim 20\,$K and a dust emissivity $\kappa_{850} = 0.01\,$cm^{2}g^{-1}. The distribution of clump masses is well characterized by a broken power-law $N(M) \propto M^{-\alpha}$ with $\alpha = 1.0-1.5$ for $M > 0.6\,M_\odot$ and $\alpha = 0.5$ for $M \le 0.6\,M_\odot$, although significant incompleteness may affect the slope at the lower mass end. This mass function is in general agreement with the ρ Ophiuchi clump mass function derived at 1.3 mm by Motte *et al.* (1998). The two-point correlation function of the clump separations is measured and reveals clustering on size scales $r < 3\times 10^4$ AU with a radial power-law exponent $\gamma = 0.75$.

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Dust Distribution in Gas Disks. A Model for the Ring Around HR 4796A

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There have been several model analyses of the near and mid IR flux from the circumstellar ring around HR4796A. In one set of models, the 10 and 18 μm IR flux has been attributed to the reprocessing of stellar radiation by μm-size particles. Since these particles are being blown away, on a dynamical time-scale, by the radiation pressure of HR4796A, they must be continually replenished by the collisional fragments of larger particles. If the ring appearance persisted for the life span (8×10^6 yr) of HR4796A, a parent-particle reservoir with a total mass $> 5M_\oplus$ would be needed. In order to avoid being conspicuous at longer wavelengths, most of the mass must be contained in parent particles larger than $20-40$ cm. In other models, it has been suggested that the IR flux from the rings is emitted by sufficiently large particles that survive the radiative blow out by their host star. In a gas free ring, $10-20\mu m$-size particles would survive radiative blow out and a total of $10^{-3}M_\oplus$ would be adequate to account for the observed IR flux. But, in the vicinity of a young star, the possibility that the dust ring is embedded within a residual protostellar gas disk cannot be ruled out. In a gas-rich environment, larger sizes ($> 100\mu m$) are needed for the particles to survive the radiative blow out. The total dust mass required to account for the IR flux is $< 10^{-2}M_\oplus$. The combined influence of gas and stellar radiation may also account for the observed sharp inner boundary and rapidly fading outer boundary of the ring. The pressure gradient induced by a small (10%) amplitude variation in the surface density distribution of a low-mass gaseous disk would be sufficient to modify the rotation speed of the gas. The resulting hydrodynamic drag on modest-size ($> 100\mu$m) particles would be adequate to compensate for the turbulent stirring, radiative drag and radiation pressure such that they remain gravitationally bound to the system. The required surface density variation

of the gas may be induced by 1) the perturbation of a low-mass planet or the binary companion HR 4796B, 2) the photo evaporation of the disk, or 3) from the variations in the viscous angular momentum transport and mass diffusion rate in the disk. We show that the structure of the dust ring is preserved during and after the gas is being depleted such that similar rings may be common among early type stars.

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http://www.ucolick.org/ klahr/hr4796A.ps.gz

Molecular line study of evolution in protostellar cloud cores

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Two dense dark cloud cores representing different stages of dynamical evolution were observed in a number of molecular spectral lines. One of the cores, Cha-MMS1 in the Chamaeleon cloud I contains a Class 0 protostar, whereas the other, CrA C in the R Coronae Australis cloud, is pre-stellar. The molecules selected for this study are supposed to show significant abundance variations in the course of the chemical evolution.

We find that the cores have very different chemical compositions. Cha-MMS1 exhibits characteristics of so-called 'early-type' chemistry with high abundances of carbon-chain molecules such as HC_3N, CH_3CCH and c-C_3H_2. However, it also has a large N_2H^+ abundance, which is expected only to build up at later stages. In contrast, none of the carbon-chain molecules were detected in CrA C. On the other hand, CrA C has a higher SO abundance than Cha-MMS1, which according to chemistry models implies that it is chemically 'older' than Cha-MMS1. The most striking difference between the two cores is seen in the HC_3N/SO abundance ratio, which is at least three orders of magnitude higher in Cha-MMS1 than in CrA C. This result is somewhat surprising since starless cores are usually thought to be chemically younger than star-forming cores.

Because of the high N_2H^+ abundance, we suggest that Cha-MMS1 represents the 'late-time cyanopolyyne peak' that is predicted to occur when heavy molecules start to freeze onto grain surfaces ([Ruffle et al., 1997, MNRAS 291, 235]). This would also be a more natural explanation for the carbon-chain molecules than the 'early-time' picture in view of the fact that the core is presently collapsing to form a star. The abundances observed in CrA C can be explained either by pure gas-phase models at late stages of evolution, or by the 'SO peak' which follows the second cyanopolyyne peak ([Ruffle et al., 1999, MNRAS 306, 691]). Thus, the dynamical evolution in CrA C seems to have been very slow compared with that of Cha-MMS1, and we discuss possible reasons for this.

We detected two SO emission maxima around Cha-MMS1, which lie symmetrically on both sides of the core, approximately on the line connecting the centre of Cha-MMS1 and the position of Herbig-Haro object HH49/50. These SO peaks may signify the lobes of a bipolar outflow, and the observation supports the suggestion by [Reipurth et al., 1996, A&A 314, 258] that Cha-MMS1 is the central source of HH49/50.

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Star formation in the Cepheus Flare region II. A-type stars associated with IRAS sources

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In order to reveal the star forming history of the molecular cloud complex we studied the intermediate mass stellar population in the Cepheus Flare region. (Paper I was dealing with the distance and the young stellar object candidates of the region.) Correlating the *IRAS* Point Source Catalog and Faint Source Catalog positions with those of 1214 B8–A8 and 1760 F0–F5 type stars brighter than $V \approx 13$ mag and classified during an objective prism survey we identified 19 stars showing far-infrared excess emission in the Cepheus Flare region. In addition to the 16 stars whose

counterparts are given in the *IRAS* catalogues, we found three more stars with infrared excess not recognized before.

In order to identify the young medium-mass stars associated with the Cepheus Flare molecular clouds we observed the optical spectra of the IR-excess stars, and using published optical photometry and the *IRAS* data we examined their spectral energy distributions (SEDs) and *IRAS* two-colour diagram. The observations resulted in the discovery of a new Herbig Ae/Be star, BD +68°1118, coinciding with *IRAS* 21169+6842. More evolved HAe/Be stars may be SAO 19953, BD +67°1314, and BD +69°1231, whose Hα lines showed weak emission components. Possible β Pictoris or Vega type stars may be HD 203854, HD 212826, and HD 216486, whereas the far-infrared fluxes at the positions of BD +72°1018, HD 210806, and HD 217903 can be attributed to the heating of the interstellar environment. We used distances and radial velocities of the stars derived from the spectroscopy and published optical photometry as indicators of their relations to the clouds. Information on the environment of the observed stars deduced from the diffuse interstellar band at 6613 Å, is briefly discussed.

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The ISO-LWS map of the Serpens cloud core: I. The SEDs of the IR/SMM sources

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Iso-Lws mapping observations of the Serpens molecular cloud core are presented. The spectral range is $50 - 200\,\mu$m and the map size is $8' \times 8'$. These observations suffer from severe source confusion at Fir wavelengths and we employ a *Maximum Likelihood Method* for the spectro-spatial deconvolution. The strong and fairly isolated source SMM 1/FIRS 1 presented a test case, whose modelled spectral energy distribution (SED), within observational errors, is identical to the *observed* one. The model results for the other infrared and submillimetre sources are therefore likely to represent their correct SEDs. Simulations demonstrating the reliability and potential of the developed method support this view. It is found that some sources do not exhibit significant Fir emission and others are most likely not pointlike at long wavelengths. In contrast, the SEDs of a number of SMMs are well fit by modified single-temperature blackbodies over the entire accessible spectral range. For the majority of sources the peak of the SEDs is found within the spectral range of the Lws and derived temperatures are generally higher (≥ 30 K) than have been found by earlier deconvolution attempts using Iras data. SMM sizes are found to be only a few arcsec in diameter. In addition, the SMMs are generally optically thick even at Lws wavelengths, i.e. estimated $\lambda(\tau = 1)$ are in the range 160–270 μm. The Rayleigh-Jeans tails are less steep than expected for optically thin dust emission. This indicates that the SMMs are optically thick out to longer wavelengths than previously assumed, an assertion confirmed by self-consistent radiative transfer calculations. Models were calculated for five sources, for which sufficient data were available, viz. SMM 1, 2, 3, 4 and 9. These models are optically thick out to millimetre wavelengths (wavelength of unit optical depth 900 to 1 400 μm). Envelope masses for these SMMs are in the range 2–6 $M_\odot$, which is of course considerably more massive than estimates based on the optically thin assumption. The luminosities are in the range 10–70 $L_\odot$, suggesting the formation of low-mass to intermediate mass stars, so that the existence of such massive envelopes argues for extreme youth of the SMMs in the Serpens cloud core. Finally, we present, for the first time, the full infrared SEDs for the outburst source DEOS, both at high and low intensity states.

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Pre-Orion Cores in the Trifid Nebula

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The Trifid nebula is a young HII region undergoing a burst of star formation. In this article, we report on far-infrared and millimeter continuum and line observations of several massive and bright protostellar sources in the vicinity of the exciting star of the nebula, just behind the ionization front. These objects are probably young protostars (Class 0) and are associated with very massive cores ($M \sim 8 - 90\,M_{\odot}$) powering young energetic outflows. Analysis of the far-infrared emission in the $45 - 200\mu m$ range from ISO/LWS data shows that they are embedded in cold dense material. Inspection of their physical properties suggest that they are similar to the dust protostellar cores observed in Orion, although at an earlier evolutionary "Pre-Orion" stage. The cores are embedded in a compressed layer of dense gas. Based on comparison with the models, we find that the cores could have formed from the fragmentation of the layer and that the birth of the protostars was triggered by the expansion of the Trifid nebula.

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Mid-infrared imaging of the massive young star AFGL 2591: Probing the circumstellar environment of an outflow source

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Most, if not all, stars are now believed to produce energetic outflows during their formation. Yet, almost 20 years after the discovery of bipolar outflows from young stars, the origins of this violent phenomenon are not well understood. One of the difficulties of probing the outflow process, particularly in the case of massive embedded stars, is a deficit of high spatial resolution observations. Here, we present sub-arcsecond-resolution mid-infrared images of one massive young stellar object, AFGL 2591, and its immediate surroundings. Our images, at 11.7, 12.5 and 18.0 μm, reveal a knot of emission $\approx$6" SW of the star, which may be evidence for a recent ejection event or an embedded companion star. This knot is roughly coincident with a previously seen near-infrared reflection nebula and a radio source, and lies within the known large-scale CO outflow. We also find a new faint NW source which may be another embedded lower-luminosity star. The *IRAS* mid-infrared spectrum of AFGL 2591 shows a large silicate absorption feature at 10μm, implying that the primary source is surrounded by an optically thick dusty envelope. We discuss the interrelationship of these phenomena and suggest that mid-infrared imaging and spectroscopy provide powerful tools for probing massive star birth.

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Efficiencies of Low-Mass Star and Star Cluster Formation

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Using a quantitative model for bipolar outflows driven by hydromagnetic protostellar winds, we calculate the efficiency of star formation assuming that available gas is either converted into stars or ejected in outflows. We estimate the efficiency of a single star formation event in a protostellar core, finding $25\% - 70\%$ for cores with various possible degrees of flattening. The core mass function and the stellar initial mass function have similar slopes, because the efficiency is not sensitive to its parameters. We then consider the disruption of gas from a dense molecular clump in which a cluster of young stars is being born. In both cases, we present analytical formulae for the efficiencies that compare favorably against observations and, for clusters, against numerical simulations. We predict efficiencies in the range $30\% - 50\%$ for the regions that form clusters of low-mass stars. In our model, star formation and gas dispersal happen concurrently. We neglect the destructive effects of massive stars: our results are therefore upper limits to the efficiency in regions more massive than about 3000 $M_{\odot}$.

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A Photometric and Spectroscopic Study of the Herbig Ae/Be Star XY Per.

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The UBVR photometry of XY Per in 1985-1998 is presented. At this epoch, XY Per exhibited variability with an amplitude of $\approx 1^m$ in V. The photometric variability of XY Per can be divided into three components: (1) smooth year-to-year variations in mean brightness; (2) quasi-periodic variations with a characteristic time scale of 20-40 days and an amplitude of $0^m.3$; and (3) Algol-like minima with a duration of 15-20 days and an amplitude of $0^m.6$. The CLEAN algorithm is used to refine the quasi-period of light variations in the interval 1988-1995, $P = 22^d.7252$. The observed variability is assumed to be produced by two mechanisms: circumstellar absorption and nonstationary accretion. An ultraviolet excess was observed in the stellar radiation during the local minimum of 1991, which was associated with an eclipse of the star by a circumstellar formation. The probable reason why it emerged is that part of the eclipsing circumstellar formation fell into the accretion zone. A high-resolution spectrum in the wavelength range 3600-6700 Å contains both photospheric lines and circumstellar shell lines. The shell lines profiles suggest mass accretion onto the star at a velocity of 90-140 km s^{-1}. Of the Balmer lines, only $H\alpha$ is in emission. Its equivalent width is $EW(H\alpha)$ = -0.8 Å. The strongest Fe II lines, as well as Mg II 4481.33 Å and He I 5875.65 Å, have an emission component at the line center. The presence of emission components in lines with different excitation potentials suggests the presence of a hot gas shell around the star, which is heated very nonuniformly.

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Spatially Resolved Circumstellar Structure of Herbig Ae/Be Stars in the Near-Infrared

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We have conducted the first systematic study of Herbig Ae/Be stars using the technique of long baseline stellar interferometry in the near-infrared, with the objective of characterizing the distribution and properties of the circumstellar dust responsible for the excess near-infrared fluxes from these systems. The observations for this work have been conducted at the Infrared Optical Telescope Array (IOTA). The principal result of this paper is that the interferometer resolves the source of infrared excess in 11 of the 15 systems surveyed. A new binary, MWC 361-A, has been detected interferometrically for the first time.

The visibility data for all the sources has been interpreted within the context of four simple models which represent a range of plausible representations for the brightness distribution of the source of excess emission: a Gaussian, a narrow uniform ring, a flat blackbody disk with a single temperature power law, and an infrared companion. We find

that the characteristic sizes of the near-infrared emitting regions are larger than previously thought (0.5 − 5.9 AU, as given by the FWHM of the Gaussian intensity). A further major result of this paper is that the sizes measured, when combined with the observed spectral energy distributions, essentially rule out accretion disk models represented by blackbody disks with the canonical $T(r) \propto r^{-3/4}$ law. We also find that, within the range observed in this study, none of the sources (except the new binary) shows varying visibilities as the orientation of the interferometer baseline changes. This is the expected behaviour for sources which appear circularly symmetric on the sky, and for the sources with the largest baseline position angle coverage (AB Aur, MWC 1080-A) asymmetric brightness distributions (such as inclined disks or binaries) become highly unlikely.

Taken as an ensemble, with no clear evidence in favor of axi-symmetric structure, the observations favor the interpretation that the circumstellar dust is distributed in spherical envelopes (the Gaussian model) or thin shells (the ring model). This interpretation is also supported by the result that the measured sizes, combined with the excess near-infrared fluxes, imply emission of finite optical depth, as required by the fact that the central stars are optically visible. The measured sizes and brightnesses do not correlate strongly with the luminosity of the central star. Moreover, in two cases, the same excess is observed from circumstellar structures that differ in size by more than a factor of two, and surround essentially identical stars. Therefore, different physical mechanisms for the near-infrared emission may be at work in different cases, or alternatively, a single underlying mechanism with the property that the same infrared excess is produced on very different physical scales.

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Distribution of Cold dust in Orion A & B

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Large scale far-infrared (FIR) observations of the Orion complex at 205 and 138 μm are presented with an aim of studying the distribution of cold (<25 K) dust. The maps in these FIR bands extend over ∼3600 sq. arcmin and cover regions around OMC-1, 2, 3 in Orion A and NGC 2023 and NGC 2024 in Orion B. Some limited regions have also been mapped at 57 μm. A total of 15 sources in Orion A and 14 in Orion B (south) have been identified from our FIR maps. Dust temperature distribution in both Orion A and Orion B (south) have been determined reliably using the maps at 205 & 138 μm obtained from simultaneous observations using almost identical beams (1.′6 dia). These temperatures have been used to generate map of τ_{150}, the optical depth at 150 μm, for the Orion B region. The coldest source detected is in OMC-3 and has a temperature of $\sim$ 15 K. The diffuse FIR emission in the different sub-regions is found to vary between 25 % to 50 % of the total FIR emission from that sub-region.

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Young Stars Associated with the Reflection Nebula NGC 2626

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We have conducted a search for Hα emission-line stars within the field containing the reflection nebula NGC 2626 and the associated dark cloud DC 259.9−0.0. Thirty-two Hα stars, most of them new, have been identified. Magnitudes and colors for these stars are listed. Some are found to be variable and are possible T Tauri stars. Changes between 1991 and 1999 in the brightness and appearance of a small reflection nebula in the region are shown. These are caused by an unevenly obscured young stellar object which is the probable source of IRAS 08337−4028 and the Herbig-Haro object HH 132. The overall morphology of the small nebula is strikingly similar to that of the well studied HH 46–47 configuration, but the NGC 2626 region is at about twice the distance.

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Formation of an Infalling Disklike Envelope around a Protostar

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We examined the gravitational contraction of isothermal molecular cloud cores with slow rotation by means of two-dimensional numerical simulations. Applying a sink-cell method, we followed the evolution of the cloud cores up to the stages at which most of the matter accretes onto the central region (i.e., a protostar and a rotationally-supported circumstellar disk). We show that both an infalling disklike envelope and a rotationally-supported disk around the central star are natural outcome of the gravitational contraction of a *prolate* cloud core with slow rotation. The early evolution of the infalling envelopes resembles sheet models recently proposed by Hartmann and coworkers. In the infalling disklike envelope, the radial profiles of the density, radial velocity, and azimuthal velocity can be approximated by $\rho \propto r^{-1.5}$, $v_r \propto r^{-0.5}$, and $v_\varphi \propto r^{-1}$, respectively. The fate of the infalling envelopes is also discussed.

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An interesting episode of accretion activity in UX Orionis

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This paper presents observations of an episode of accretion activity in the pre-main–sequence star UX Ori. High-velocity, redshifted absorption is seen in several lines of H, Ca II, Na I and Fe II during an interval of 8 nights in the fall of 1996, with similar velocity and time evolution. A non-LTE analysis of the line optical depths shows that the infalling gas cannot be heavily hydrogen-depleted, as expected if produced by the evaporation of a solid body of chemical composition similar to solar system comets. On the contrary, the observations are consistent with gas of solar chemical composition at temperature $\sim$ 6000–7000 K.

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Spectrum and proper motion of a brown dwarf companion of the T Tauri star CoD$-33°7795$

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We present optical and infrared spectra as well as the proper motion of an H=12 mag object $2''$ off the $\sim$ 5 mag brighter spectroscopic binary star CoD$-33°7795$ (=TWA-5), a member of the TW Hya association of T Tauri stars at $\sim$ 55 pc. It was suggested as companion candidate by Lowrance et al. (1999) and Webb et al. (1999), but neither a spectrum nor the proper motion of the faint object were available before. Our spectra taken with FORS2 and ISAAC at the ESO-VLT reveal that the companion candidate has spectral type M8.5 to M9. It shows strong Hα emission and weak Na I absorption, both indicative of a young age. The faint object is clearly detected and resolved in our optical and infrared images, with a FWHM of $0.18''$ in the FORS2 image. The faint object's proper motion, based on two year epoch difference, is consistent with the proper motion of CoD$-33°7795$ by 5 Gaussian σ significance. From three different theoretical pre-main sequence models, we estimate the companion mass to be between $\sim$ 15 and

40 M_{jup}, assuming the distance and age of the primary. A slight offset between the VLT and HST images with an epoch difference of two years can be interpreted as orbital motion. The probability for chance alignment of such a late-type object that close to CoD−33°7795 with the correct proper motion is below $7 \cdot 10^{-9}$. Hence, the faint object is physically associated with CoD−33°7795, the 4th brown dwarf companion around a normal star confirmed by both spectrum and proper motion, the first around a pre-main sequence star.

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Protostellar Disk Instabilities and the Formation of Substellar Companions

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Recent numerical simulations of self-gravitating protostellar disks have suggested that gravitational instabilities can lead to the production of substellar companions. In these simulations, the disk is typically assumed to be locally isothermal, i.e., the initial, axisymmetric temperature in the disk remains everywhere unchanged. Such an idealized condition implies extremely efficient cooling for outwardly moving parcels of gas. While we have seen disk disruption in our own locally isothermal simulations of a small, massive protostellar disk, no long-lived companions formed as a result of the instabilities. Instead, thermal and tidal effects and the complex interactions of the disk material prevented permanent condensations from forming, despite the vigorous growth of spiral instabilities. In order to compare our results more directly with those of other authors, we here present three-dimensional evolutions of an older, larger, but less massive protostellar disk. We show that potentially long-lived condensations form only for the extreme of local isothermality, and then only when severe restrictions are placed on the natural tendency of the protostellar disk to expand in response to gravitational instabilities. A more realistic adiabatic evolution leads to vertical and radial expansion of the disk, but no clump formation. We conclude that isothermal disk calculations cannot demonstrate companion formation by disk fragmentation, but only suggest it at best. It will be necessary in future numerical work on this problem to treat the disk thermodynamics more realistically.

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Young stellar clusters and H_2 nebulosities in S233IR

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We present an infrared photometric study of the star formation region associated to IRAS 05358+3543, hereafter designated S233IR. Several manifestations of star formation activity are present in S233IR: masers, molecular outflow, GMC core, YSOs, young stellar clusters and an IRAS source. The paper includes photometric J, H, K and H_2 (2.12 μm) images and scanning Fabry-Perot observations to study H_2 kinematics. In the 3.6'×3.6' observed field, two distinct young stellar clusters separated by 0.5 pc are found, one being much redder than the other by $A_V \sim 7$ mag. A collection of PMS objects and several H_2 nebulosities associated to the younger and redder NE cluster are found. Two deeply embedded jet/counter-jet structures, produced by shocked H_2 gas, are detected near the core of the molecular outflow. Possible exciting source candidates of the molecular outflow and H_2 nebula are discussed. The velocity field of H_2 gas shows that the bulk of the emission occurs within -36.9 to 2.3 km/s. Individual spectra of H_2 nebulosities show peak velocities consistent with the rest velocity of the GMC and H_2O maser peak velocities. Luminosity function histograms are used to obtain a crude age estimate for cluster and field stars: ≤2 Myr for NE cluster, 3 Myr for SW cluster and 6 Myr for field (distributed population) stars; indicating at least two star formation stages and a distributed population of young stars. Finally, from PMS isochrones and NIR photometry, taking care of

completeness limits, we estimate stellar masses to study the IMF. A turnover for low-mass-stars is found for the SW cluster, while field stars show a Salpeter IMF.

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Preprints in postscript version s233ir-aa.ps via ftp to ftp.astroscu.unam.mx,
(enter as anonymous to /pub/temporal/irenecg)

New models of interstellar gas-grain chemistry. I. Surface diffusion rates

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In recent years it has become evident that large differences can exist between model results of grain-surface chemistry obtained from a rate equation approach and from a Monte Carlo technique. This dichotomy has led to the development of a modified rate equation method, in which a key element is the artificial slowing down of the diffusion rate of surface hydrogen atoms. Recent laboratory research into the surface diffusion rate of atomic hydrogen suggests that atomic hydrogen moves more slowly on grains than heretofore assumed. This research appears

to lessen the need for modifications to the rate equation method. Based on the new laboratory work, we have developed appropriate models of gas-phase and grain-surface chemistry in quiescent dense cloud cores to examine the chemical effects of slowing down the rate at which atomic H can scan over dust surfaces.

Furthermore, we have investigated the effect of slowing down the rate at which all species can move over grain surfaces.

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Velocity Structure in the Curved Jet S187:SCP 1 (H2):

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We describe the velocity structure of the curved outflow S187:SCP 1 (H2). Observations of the 2.12 μm molecular hydrogen emission were obtained using an IR Fabry-Perot interferometer with a spectral resolution of 24 km/s and a spatial resolution of 1.6". The covered region of 3.6'×3.6' contains the entire curved-jet and several H_2 nebulosities, such as the counter-jet candidate, SCP 3 and SCP 4. The kinematics show that the curved jet is centered around a radial velocity of -30 km/s with velocity components spanning 40 km/s. On the other hand, knots SCP 3 and 4 and the counter-jet candidate appear red-shifted at velocities -12 to 30 km/s. We discuss whether the observed velocity structure favors the side-wind model or precession interpretations of the jet curvature.

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Preprints in postscript version s187vel-rmaa.ps via ftp to ftp.astroscu.unam.mx,
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The Parker Instability in a Thick Gaseous Disk II: Numerical Simulations in 2D

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We present 2D, ideal–MHD numerical simulations of the Parker instability in a multi–component warm disk model. The calculations were done using two numerical codes with different algorithms, TVD and ZEUS-3D. The outcome of the numerical experiments performed with both codes is very similar, and confirms the results of the linear analysis for the undular mode derived by Kim et al. (2000): the most unstable wavelength is about 3 kpc and its growth timescale is between 30–50 Myr (the growth rate is sensitive to the position of the upper boundary of the numerical grid). Thus, the time and length scales of this multicomponent disk model are substantially larger than those derived for thin disk models. We use three different types of perturbations, random, symmetric, and antisymmetric, to trigger the instability. The antisymmetric mode is dominant, and determines the minimum time for the onset of the nonlinear regime. The instability generates dense condensations and the final peak column density value in the antisymmetric case, as also derived by Kim et al. (2000), is about a factor of 3 larger than its initial value. These wavelengths and density enhancement factors indicate that the instability alone cannot be the main formation mechanism of giant molecular clouds in the general interstellar medium. The role of the instability in the formation of large-scale corrugations along spiral arms is briefly discussed.

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Detection of HCO^+ towards Cygnus OB2 No.12

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HCO^+ has been detected for the first time towards the star Cygnus OB2 No.12 through emission of the 1–0 rotational transition at 89 GHz. The CO(J = 2–1) transition has been also observed. The observations are consistent with a model of dense regions embedded in a low density clump gas. If actually present, the dense component would have an aggregate size $L \leq 1300$ AU, in agreement with estimates of small-scale density fluctuations observed along diffuse lines of sight.

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Mid infrared emission of nearby Herbig Ae/Be stars

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We present mid IR spectro-photometric imaging of a sample of eight nearby ($D \leq 240$pc) Herbig Ae/Be stars. The spectra are dominated by photospheric emission (HR6000), featureless infrared excess emission (T Cha), broad silicate emission feature (HR5999) and the infrared emission bands (HD 97048, HD 97300, TY CrA, HD 176386). The spectrum of HD179218 shows both silicate emission and infrared emission bands (IEB). All stars of our sample where the spectrum is entirely dominated by IEB have an extended emission on scales of a few thousand AU ($\sim 10''$). We verify the derived source extension found with ISOCAM by multi–aperture photometry with ISOPHT and compare our ISOCAM spectral photometry with ISOSWS spectra.

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X-ray emission from young stars in the Tucanae association

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We report on X-ray emission from members of the recently discovered Tucanae association, a group of stars with youth signatures and similar space motion. The Tucanae association is the nearest known region of recent star formation (~ 45 pc) far from molecular clouds. We have made use of the *ROSAT* Data Archive and searched for X-rays from Tucanae stars in both *ROSAT* All-Sky Survey (RASS) and pointed observations. The RASS provides complete sky coverage. Thus all potential Tucanae members have been observed. The detection rate is 59%. Three stars from the Tucanae association were also observed in PSPC pointings.

We compare the X-ray luminosity function of the Tucanae association to that of other star forming regions and young star clusters. Since the X-ray luminosity is known to decline with stellar age this allows to constrain the age of the Tucanae stars. The X-ray luminosity function suggests an age of $\sim 10-30$ Myrs for this association. Strong variability observed in the X-ray lightcurves further supports the youth of these stars.

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http://www.xray.mpe.mpg.de/~stelzer/publications.html

Molecular Clouds Around a Run-away O Star, ζ Oph

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Molecular clouds around a run-away O star ζ Oph have been surveyed with NANTEN telescope and their streaming motion caused by ζ Oph has been detected. ζ Oph is the earliest (O9.5V) member of the Sco OB2 association and is a runaway star rapidly moving accompanied by an H II region S27. We detected 2 major filamentary cloud complexes; one complex including L156 (L156 complex) is lying across nearly the center of S27 and the other one (L204 complex) is located near the eastern edge of S27. Total masses of them traced by the ^{12}CO emission in the two complexes are 520 $M_\odot$ and 1110 $M_\odot$, respectively. Denser molecular cloud cores detected in C^{18}O are locally distributed on the near side of the L204 complex to ζ Oph, and lower density gas traced by ^{12}CO spreads toward the opposite side. Both complexes have radial velocity shifts that are correlated with the gas density. These spatial and velocity structures can be interpreted as follows; (1) the L156 complex is stuck on the expanding Strömgrem sphere and has been accelerated, (2) the molecular gas in L204 complex was compressed and has also been accelerated outward from the H II region by ζ Oph, resulting the radial velocity shifts of diffuse low-density gas relative to the dense cores embedded in the cloud.

These density and velocity structures indicate dynamical interaction between the H II region and the molecular clouds. The cloud complexes are divided into seven clouds by intensity distributions. In order to investigate the acceleration mechanism, we calculated momentum and kinetic energy for each cloud. They range from 60 to 800 $M_\odot$ km s^{-1} and from 0.9 to 21 $\times 10^{45}$ erg, respectively. We examined the effects of the stellar wind and photo evaporation by UV field of ζ Oph and found that the stellar wind can hardly input the momentum during the crossing time of the rapid movement of ζ Oph. UV radiation seems to be a more likely origin of the streaming gas motion.

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preprint available at
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Proper motions of pre-main sequence stars in southern star-forming regions

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We present proper motion measurements of pre-main sequence (PMS) stars associated with major star-forming regions of the southern hemisphere (Chamaeleon, Lupus, Upper Scorpius - Ophiuchus, Corona Australis), situated in the galactic longitude range $l = 290°$ to $l = 360°$. A list of PMS stars as complete as possible was established based on the Herbig and Bell catalogue and many new catalogues like the PDS survey, the catalogue of Herbig Ae/Be stars by Thé et al. (1994), X-rays surveys, etc. The measurements made use of public material (mainly AC2000 and USNO–A2.0 catalogues) as well as scans of SERC–J Schmidt plates with the MAMA measuring machine (Paris) and Valinhos CCD meridian circle observations (Brazil). We derived proper motions for 214 stars, with an accuracy of 5 to 10 mas/yr depending mainly on the difference of epochs between the position sources. The main characteristics of the sample are discussed. We show that systematic motions of groups of stars exist, which are not explained by the reflex solar motion.

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Abundance profiles of CH_3OH and H_2CO toward massive young stars as evolutionary tracers

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The chemical evolution of thirteen regions of massive star formation is studied through single-dish and interferometer line observations at submillimeter wavelengths. The wealth of CH_3OH and H_2CO lines covering a large range of excitation conditions allows us to calculate radial abundance profiles, using the physical structures of the sources derived earlier from submillimeter continuum and CS lines. The data indicate three types of abundance profiles: flat profiles at $CH_3OH/H_2 \sim 10^{-9}$ for the coldest sources, profiles with a jump in its abundance from $\sim 10^{-9}$ to $\sim 10^{-7}$ for the warmer sources, and flat profiles at $CH_3OH/H_2 \sim$ few 10^{-8} for the hot cores. The location of the jump at $T \sim 100$ K suggests that it is due to evaporation of grain mantles, followed by destruction in gas-phase reactions in the hot core stage. In contrast, the H_2CO data can be well fit with a constant abundance of a few $\times 10^{-9}$ throughout the envelope, providing limits on its grain surface formation. These results indicate that $T_{\rm rot}(CH_3OH)$ can be used as evolutionary indicator during the embedded phase of massive star formation, independent of source optical depth or orientation.

A model assuming grain surface chemistry running at the accretion rate of CO reproduces the observed abundances of solid CO, CO_2 and CH_3OH for a density in the pre-protostellar phase of $n_{\rm H} \gtrsim$ a few 10^4 cm^{-3}, lasting for $\lesssim 10^5$ yr.

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A Multi-Wavelength Study of Outflows in OMC-2/3

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We present new $v = 1$–0 $S(1)$ H_2, ^{12}CO $J = 2 \rightarrow 1$, and ^{12}CO $J = 3 \rightarrow 2$ observations of the star forming clouds

OMC-2 and OMC-3, one of the densest known groupings of outflows from low mass young stellar objects (YSOs) in the sky. High velocity ^{12}CO $J = 2 \rightarrow 1$ gas in this region suggests that previously discovered H_2 flows are driving and entraining molecular outflows. However the large number of sources and flows within the narrow molecular filament means it is difficult to make a firm association of molecular outflow gas with H_2 flows, except for in the case of the bipolar east-west H flow. A number of Herbig-Haro (HH) objects, including ones far to the west and east of the main ridge, are identified with H_2 knots. High resolution spectroscopy in the $v = 1$–0 $S(1)$ line of ten H_2 knots shows line profiles consistent with dual forward and reverse shocks. C-shock modelling suggest that asymmetries seen in suspected bow shocks could be evidence of varying magnetic field orientations throughout the cloud. One of the bow shocks in the H flow, YBD-5, can be successfully modelled by a 100 km s^{-1} C-shock propagating into a magnetized, 10^6 cm^{-3} medium, although the observations and limitations within the computer code itself do not entirely rule out J-shocks. Mass spectra of the H flow are broken power laws, which might be evidence for a jet which has two entrainment mechanisms for accelerating ambient molecular gas into the outflow. The H_2 luminosity in this flow is many times smaller than the CO mechanical luminosity, but this fact cannot rule out the possibility that a narrow highly collimated jet drives the molecular outflow, due to uncertainties in extinction, outflow dynamic times, cooling contributions from other lines, and the wind model used. Outflows from OMC-2/3 are likely to contribute to the turbulent pumping of gas within the molecular ridge north of the Orion Nebula. High velocity gas clumps north of the sources investigated here may represent evidence of additional undiscovered outflows from young stars.

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Preprint available for downloading at `http://casa.colorado.edu/~kachun/research.shtml`

HNCO in massive galactic dense cores

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We surveyed 81 dense molecular cores associated with regions of massive star formation and Sgr A in the $J_{\mathrm{K}_{-1}\mathrm{K}_1} = 5_{05} - 4_{04}$ and $10_{010} - 9_{09}$ lines of HNCO. Line emission was detected towards 57 objects. Selected subsamples were also observed in the $1_{01} - 0_{00}$, $4_{04} - 3_{03}$, $7_{07} - 6_{06}$, $15_{015} - 14_{014}$, $16_{016} - 15_{015}$ and $21_{021} - 20_{020}$ lines, covering a frequency range from 22 to 461 GHz. HNCO lines from the $K_{-1} = 2,3$ ladders were detected in several sources. Towards Orion-KL, $K_{-1} = 5$ transitions with upper state energies $E_{\mathrm{u}}/k \sim 1100$ and 1300 K could be observed.

Five HNCO cores were mapped. The sources remain spatially unresolved at 220 and 461 GHz ($10_{010} - 9_{09}$ and $21_{010} - 20_{020}$ transitions) with beam sizes of $24''$ and $18''$, respectively.

The detection of hyperfine structure in the $1_{01} - 0_{00}$ transition is consistent with optically thin emission under conditions of Local Thermodynamic Equilibrium (LTE). This is corroborated by a rotational diagram analysis of Orion-KL that indicates optically thin line emission also for transitions between higher excited states. At the same time a tentative detection of interstellar HN^{13}CO (the $10_{0,10} - 9_{0,9}$ line at 220 GHz toward G 310.12-0.20) suggests optically thick emission from some rotational transitions.

Typical HNCO abundances relative to H_2 as derived from a population diagram analysis are $\sim 10^{-9}$. The rotational temperatures reach ~ 500 K. The gas densities in regions of HNCO $K_{-1} = 0$ emission should be $n \gtrsim 10^6$ cm^{-3} and in regions of $K_{-1} > 0$ emission about an order of magnitude higher even for radiative excitation.

HNCO abundances are found to be enhanced in high-velocity gas. HNCO integrated line intensities correlate well with those of thermal SiO emission. This indicates a spatial coexistence of the two species and may hint at a common production mechanism, presumably based on shock chemistry.

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preprint available at http://zin.appl.sci-nnov.ru/~igor/papers/hnco.ps.gz and astro-ph/0007095

Dissertation Abstracts

A Far-Infrared and Submillimetre Continuum Study of Young Stellar Objects

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This thesis presents an investigation of the early stages of star formation using ground- and space-based observations of Young Stellar Objects (YSOs) in the far-infrared and in the submillimetre/millimetre regions of the spectrum. It represents an effort to make use of some of the latest available observational tools in this spectral domain to improve the observational constraints on some circumstellar parameters, and to look for trends that might be related to the evolutionary stage of the objects.

Spectral energy distributions (SEDs) covering the $50 - 190\ \mu$m range were obtained for a sample of five YSOs observed by the Infrared Space Observatory (ISO) and representing different stages of protostellar evolution. The SEDs were constructed by characterizing the continuum emission of the objects using data from the ISO Long Wavelength Spectrometer (LWS). A description of the instrument is given and the data reduction and calibration techniques are described in detail. A systematic study of the *detector shifting* problem is also presented. The ISO observations were complemented with IRAS data when available and with submillimetre observations done with the James Clerk Maxwell Telescope (JCMT). Data obtained with the single bolometer UKT14 were used together with 450 and 850 μm imaging data from SCUBA. The JCMT data reduction and calibration are described and the morphology of the objects is discussed. We also report high resolution ^{12}CO J = 3–2 observations of a compact molecular outflow around VLA1, the powering source of the HH 1–2 system, and the only object of our sample for which a molecular outflow had previously not been discovered. These observations show that this outflow is one of the weakest, youngest and most compact ever seen.

The continuum observations were modelled with a simple phenomenological model in order to characterize the circumstellar environment of the objects. The model consists of a spherically symmetric dusty envelope with power law density and temperature radial distributions. The role of each parameter in the model is illustrated and the uniqueness and degeneracy of the fits are discussed. An optically thick circumstellar disk embedded in the envelope was also included to account for the possible need for extra emission in the thermal infrared. We emphasise the importance of spatial information about the sources to distinguish between possible fits and to obtain reliable circumstellar parameters. The SCUBA images allowed to reveal the extension of the sources and to define their submillimetre intensity profiles. By comparing these profiles with those the model predicts, we were able to distinguish between multiple possible sets of parameters and select the ones that simultaneously fitted the SEDs and the intensity profiles. Envelope masses and bolometric and submillimetre luminosities are estimated for each object. Power law density distribution indices, p, are found in the range $1.1 - 2.0$. These are discussed in the light of current collapse theories. An anti-correlation between L_{submm}/L_{bol} and the submillimetre dust opacity index was found, and the use of this index as a possible age indicator is discussed.

Rotation of Young Low-Mass Stars in the Orion Nebula Cluster Flanking Fields

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We have photometrically monitored ~3600 young, low-mass stars in four $45' \times 45'$ fields in the outer Orion Nebula Cluster (ONC), surrounding but not including the Trapezium region. The ~300 periodic variables we find do not produce the expected bimodal distribution of rotation periods. There is no unambiguous correlation of period with $(I_{\rm C} - K_{\rm s})$, $(H - K_{\rm s})$, and $(U - V)$ color excesses or more indirect disk indicators; the slowest rotators are not necessarily the disk candidates, and the disk candidates are not necessarily the slow rotators, regardless of how one defines a disk candidate. To the extent that the small numbers allow, the disk candidates represent a constant fraction of the total sample to P=15d, beyond which there are no disk candidates, inconsistent with the hypothesis that the more slowly rotating stars are more likely to have disks. We find an intriguing relationship between specific angular momentum (j) and some excesses, namely $(H - K_{\rm s})$ excesses and the strongest $(U - V)$ excesses; whereas stars are found with j values ranging over $\sim 10^6 - 10^8$ km^{2}s^{-1}, disk candidates with these excesses are restricted to $10^{6.5} < j < 10^{7.5}$ km^{2}s^{-1}. A similar relationship is not found for the $(I_{\rm C} - K_{\rm s})$ disk candidates, nor in the less excessive $(U - V)$ candidates. There is no clear correlation between signal amplitude and period or log j. Other investigators have found differences in period distributions for stars more and less massive than 0.25 $M_{\odot}$; we find ambiguous evidence for differences in distributions of P and no difference in those of log j on either side of this boundary, although for stars more massive than ~0.6 $M_{\odot}$, values appear to cluster around $j = 10^7$ km^{2}s^{-1}. When comparing the log j distribution derived here to those for other clusters, we find that it is consistent with a population of stars draining angular momentum into disks. We conclude that disk locking may be operating, but it is not the complete solution to the problem of angular momentum distributions in young stars.

We find weak (1.5-2σ) evidence for a change in stellar structure, spot coverage, and/or disk characteristics for stars redder than $(V - I_{\rm C})$~2.5 (type ~M3, ~0.25 $M_{\odot}$). We find that at least ~10% of the stars have identical light curves (shape and phase) between the two seasons of our observations, suggesting that the lifetime of the photospheric disturbance causing periodic modulations in these stars is at least a year.

Astrochemical Studies of Galactic Star Formation

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This thesis characterizes and quantifies a key part of the chemical evolution associated with star formation towards nearby molecular clouds by analyzing the radiation from abundant molecules and their deuterium-substituted counterparts, or deuterated molecules. As clouds evolve to form stars, molecular spectra probe the dynamics. Deuterium fractionation ratios sample the variations in temperature, density and activity of protostellar systems and offer clues into their dynamics.

We present three projects to examine the scope and scale of deuterium fractionation of ammonia, NH_3, and formylium, HCO^+, in low mass star forming regions. Analysis of single aperture NH_2D and NH_3 spectra from prestellar and protostellar cores indicates the predominance of gas–phase reactions in the production of these species. Our survey suggests that these species deplete onto grain surfaces at late times in the evolution of molecular cores into protostars. Since the collapse of protostars is rapid, deuterium fractionation of ammonia is not likely to be affected substantially by grain chemistry. This should be the case for even more massive molecular clouds such as Orion Molecular Cloud I or Sgr B2. Thus, observed NH_2D/NH_3 values probe the cold gas-phase evolution of molecular clouds.

The relationship between gas dynamics and star formation are explored in our survey of DCO^+ and $H^{13}CO^+$. We extend previous analyses of the DCO^+/HCO^+ as a measure of the ionization fraction and magnetic field-neutral coupling of molecular clouds by examining high energy transitions. This method traces warmer, denser gas associated with near–protostellar regions and clustered star formation. Although we find that most DCO^+/HCO^+ values are consistent with previous studies, we also discover regions where DCO^+/HCO^+ is larger than predicted by the paradigm of ambipolar diffusion-regulated star formation.

Single aperture surveys examine the ambient gas on $\sim 10^5$ AU scales. However, only aperture synthesis studies directly probe material associated with forming protostars, on size scales of $< 10^3$ AU. Interferometer studies of NH_2D and NH_3 towards NGC1333 IRAS4 and the Serpens cloud indicate that deuterated molecules are not depleted as are more common isotopes such as CO and HCO^+. Thus, NH_2D probes the physical conditions of envelope gas surrounding a protostar.

New Jobs

Postdoctoral Research Assistant in Star Formation

Applications are invited for an Enterprise Ireland (the Irish Science and Technology agency) funded postdoctoral position to work in the field of star formation at the Dublin Institute for Advanced Studies. The successful applicant should have, or expect to shortly have, a PhD in astronomy/astrophysics and a background in observational techniques. He or she will join a small research group with an ongoing HST programme and access to world-class observing facilities through an arrangement with the UK's Particle Physics and Astronomy Research Council. Excellent computational resources are available on-site.

The post is available for a period of 2 years and the salary will be on the Research Assistant scale IR£21,311–IR£26,793 (7 points) per annum. Applications, including a CV, list of publications, and the names of 2 referees, should be sent by Thursday 31st August 2000 to The Secretary, Astrophysics Section, School of Cosmic Physics, Dublin Institute for Advanced Studies, 5 Merrion Square, Dublin 2.

Further details are available from Tom Ray, e-mail: tr@cp.dias.ie, telephone: +353 1 6621333, fax: +353 1 6621477.

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, not reviews nor conference notes), *Dissertation Abstracts* (presenting abstracts of new Ph.D dissertations), *Meetings* (announcing meetings broadly of interest to the star formation and interstellar medium community), *New Books* (giving details of books relevant for the same community), *New Jobs* (advertising jobs specifically aimed towards persons within our specialty), and *Short Announcements* (where you can inform or request information from the community).

Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter.

The Star Formation Newsletter is available on the World Wide Web at http://casa.colorado.edu/reipurth or at http://www.eso.org/gen-fac/pubs/starform/ .

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European Southern Observatory Workshop: First Announcement

The Origins of Stars and Planets: The VLT View

ESO Auditorium, Garching bei München, 24–27 April 2001

Understanding how stars and planets form in the cold interiors of molecular clouds presents one of the most formidable challenges of modern astrophysics. Many important observational clues concerning this fundamental process have been amassed during the last two decades, almost all associated with major technological developments. Which scientific breakthroughs can we predict and plan to achieve with the new generation of 8-metre class telescopes combined with state-of-the-art instrumentation? This workshop will bring together the star and planet formation community to discuss the unique opportunities offered by the ESO Very Large Telescope, including the four 8-metre unit telescopes, VLTI, VST, VISTA, and their extensive array of instruments. An important goal of the workshop will be to characterise the needs of the community regarding future VLT instrumentation. We will also look forward to future facilities with ESO involvement, in particular ALMA and OWL.

Topics to be covered:

- The structure of molecular clouds
- The physics of star formation: collapse, accretion, and outflows
- Chemical processes in star and planet formation
- Pre-main-sequence stellar evolution
- Origin and characterisation of the initial mass function in different environments
- Evolution of protoplanetary disks and the birth of planets
- The connection to the extragalactic domain

Scientific Organizing Committee:

J. Alves (co-chair), F. Bertoldi, F. Boulanger, C. Clarke, C. Cesarsky, E. van Dishoeck, F. Malbet, M. Mayor, R. Genzel, T. Henning, C. Lada, M. McCaughrean (co-chair), A. Moorwood, A. Natta, F. Paresce, B. Reipurth, M. Romaniello, E. Tolstoy

Local Organizing Committee:

J. Alves (chair), M. Romaniello, C. Stoffer

For more information: `http://www.eso.org/starplanet2001`