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Abstracts of recently accepted papers

A Mid-IR survey of L 1641-N with ISOCAM

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We present an analysis of the L 1641 outflow region using broad-band and narrow-band imaging data at mid-infrared wavelengths from ISOCAM. We detect a total of 34 sources in the 7.65′ x 8.40′ region covered by the broad-band filters. Four of these sources have no reported detection in previous studies of the region. We find that the source previously identified as the near-IR counter-part to the IRAS detected point-source (IRAS 05338-0624) is not the brightest source in the wavelength region of the IRAS 12 μm filter. We find instead that a nearby object (within the beam of IRAS and not detected at near-IR wavelengths) outshines all others sources in the area by a factor of ∼2. We submit that this source is likely to be the IRAS detected point source. A comparison of the near-IR (J-H vs H-K) and mid-IR (J-K vs [6.7 um]-[14 um]) color-color plots shows only four sources with excess emission at near-IR wavelengths, but at least 85% of all sources show excess emission at mid-IR wavelengths. The CVF spectra suggest a range of evolutionary status in the program stars ranging from embedded YSOs to the young disks. When combined with optical and near-IR age estimates, these results show active current star-formation in the region that has been on-going for at least 2 Myr.

Accepted by Astrophysical Journal

IRAC Colors of Young Stellar Objects

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We compare the infrared colors predicted by theoretical models of protostellar envelopes and protoplanetary disks with initial observations of young stellar objects made with the Infrared Array Camera (IRAC) on the Spitzer Space Telescope (Werner et al. 2004, Fazio et al. 2004). Disk and envelope models characterized by infall and/or accretion rates found in previous studies can quantitatively account for the range of IRAC colors found in four young embedded clusters: S 140, S 171, NGC 7129, and Cep C. The IRAC color-color diagram ($[3.6]-[4.5]$ *vs.* $[5.8]-[8.0]$) can be used to help to distinguish between young stars with only disk emission and protostars with circumstellar envelopes.

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Preprint available at http://xxx.lanl.gov/abs/astro-ph/0406003

Mid-Infrared and Submillimeter Observations of the Illuminating Source of McNeil's Variable Nebula

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We present post-outburst observations of the mid-infrared spectrum and submillimeter continuum of the illuminating source of the newly-discovered McNeil's Nebula in the L1630 region of Orion. The $12\,\mu$m flux of this source has increased by a factor of $\sim$25 after the outburst, whereas the submillimeter continuum remains at its pre-outburst level. The bolometric luminosity has increased by at least an order of magnitude, to $\sim 34\,L_\odot$, and is likely less than $90\,L_\odot$. The mid-infrared spectrum exhibits a strong and red continuum with no emission or absorption features. The infrared slope of the spectral energy distribution characterizes the illuminating source as a flat-spectrum protostar, in both its active and quiescent states. New CO spectral line observations show no evidence for a molecular outflow.

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Molecular Cloud Formation Behind Shock Waves

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Motivated by our previous paper, in which we argued for the formation of molecular clouds from large-scale flows in the diffuse galactic interstellar medium, we examine the formation of molecular gas behind shocks in atomic gas using a one-dimensional chemical/dynamical model. In our analysis we place particular emphasis on constraints placed on the dynamical evolution by the chemistry. The most important result of this study is to stress the importance of shielding the molecular gas from the destructive effects of UV radiation. For shock ram pressures comparable to or exceeding typical local interstellar medium pressures, self-shielding controls the formation time of molecular hydrogen but CO formation requires shielding of the interstellar radiation field by dust grains. We find that for typical parameters the molecular hydrogen fractional abundance can become significant well before CO forms. The timescale for (CO) molecular cloud formation is not set by the H_2 formation rate on grains, but rather by the timescale for accumulating a sufficient column density or extinction, $A_V > 0.7$.

The local ratio of atomic to molecular gas (4:1), coupled with short estimates for the lifetimes of molecular clouds (3-5 Myr), suggests that the timescales for accumulating molecular clouds from atomic material typically must be no longer than about 12-20 Myr. Based on the shielding requirement, this implies that the typical product of pre-shock density and velocity must be $nv > 20$ cm^{-3}kms^{-1}. In turn, depending upon the shock velocity, this implies shock ram pressures which are a few times the typical estimated local turbulent gas pressure, and comparable to the total pressures (gas plus magnetic plus cosmic rays). Coupled with the rapid formation of CO once shielding is sufficient, flow-driven formation of molecular clouds in the local interstellar medium can occur sufficiently rapidly to account for observations.

We also provide detailed predictions of atomic and molecular emission and absorption that track the formation of a molecular cloud from a purely atomic medium, with a view toward helping to verify cloud formation by shock waves. However, our predictions suggest that the detection of the pre-CO stages will be challenging. Finally, we provide an analytic solution for time-dependent H_2 formation which may be of use in numerical hydrodynamic calculations.

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or
`http://www.astro.lsa.umich.edu/~ebergin/`

Submillimeter Array multiline observations of the massive star-forming region IRAS 18089-1732

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Submillimeter Array (SMA) observations of the high-mass star-forming region IRAS 18089-1732 in the 1 mm and 850 μm band with 1 GHz bandwidth reveal a wealth of information. We present the observations of 34 lines from 16 different molecular species. Most molecular line maps show significant contributions from the outflow, and only few molecules are confined to the inner core. We present and discuss the molecular line observations and outline the unique capabilities of the SMA for future imaging line surveys at high spatial resolution.

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preprints available at: http://cfa-www.harvard.edu/ hbeuther/

Spitzer Space Telescope Spectroscopy of Ices toward Low Mass Embedded Protostars

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Sensitive 5-38 μm Spitzer Space Telescope (SST) and ground based 3-5 μm spectra of the embedded low mass protostars B5 IRS1 and HH46 IRS show deep ice absorption bands superposed on steeply rising mid-infrared continua. The ices likely originate in the circumstellar envelopes. The CO_2 bending mode at 15 μm is a particularly powerful tracer of the ice composition and processing history. Toward these protostars, this band shows little evidence for thermal processing at temperatures above 50 K. Signatures of lower temperature processing are present in the CO and OCN^- bands, however. The observed CO_2 profile indicates an intimate mixture with H_2O, but not necessarily with CH_3OH, in contrast to some high mass protostars. This is consistent with the low CH_3OH abundance derived from the ground based L band spectra. The CO_2/H_2O column density ratios are high in both B5 IRS1 and HH46 IRS ($\sim$ 35%). Clearly, the SST spectra are essential to study ice evolution in low mass protostellar environments, and to eventually determine the relation between interstellar and solar system ices.

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Mass Accretion Rates of Intermediate Mass T Tauri Stars

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We present Hubble Space Telescope ultraviolet spectra and supporting ground-based data for a sample of nine intermediate mass T Tauri stars (IMTTS, $1.5M_\odot - 4M_\odot$.) The targets belong to three star-forming regions: T Tau, SU Aur, and RY Tau in the Taurus clouds, EZ Ori, P2441, and V1044 Ori in the Ori OB1c association surrounding the Orion Nebula Cluster, and CO Ori, GW Ori, and GX Ori in the ring around λ Ori. The supporting ground-based observations include nearly simultaneous UBVR$_c$I$_c$ photometry, 6 Å resolution spectra covering the range 3900 Å - 7000 Å, optical echelle observations in the range 5800 Å - 8600 Å, and K-band near-infrared spectra. We use these data to determine improved spectral types and reddening corrections, and to obtain physical parameters of the targets. We find that an extinction law with a weak 2175 Å feature but high values of A_{UV}/A_V is required to explain the simultaneous optical-UV data; the reddening laws for two B-type stars located behind the Taurus clouds, HD 29647 and HD 283809, meet these properties. We argue that reddening laws with these characteristics may well be representative of cold dense molecular clouds. Spectral energy distributions and emission line profiles of the IMTTS are consistent with expectations from magnetospheric accretion models. We compare our simultaneous optical-UV data with predictions from accretion shock models to get accretion luminosities and mass accretion rates ($\dot{M}$) for the targets. We find that the average mass accretion rate for IMTTS is $\sim 3 \times 10^{-8} M_\odot\,\mathrm{yr}^{-1}$, a factor of ~ 5 higher than that for their low mass counterparts. The new data extends the correlation between $\dot{M}$ and stellar mass to the intermediate mass range. Since the IMTTS are evolutionary descendants of the Herbig Ae/Be stars, our results put limits to the mass accretion rates of their disks. We present luminosities of the UV lines of highly ionized metals and show they are well above the saturation limit for magnetically active cool stars, but correlate strongly with accretion luminosity, indicating that they are powered by accretion, in agreement with previous claims but using a sample in which reddening and accretion luminosities have been determined self-consistently. Finally, we find that the relation between accretion luminosity and Br γ luminosity found for low-mass T Tauri stars extends to the intermediate mass regime.

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http://cfa-www.harvard.edu/cfa/youngstars/

The effect of dust settling on the appearance of protoplanetary disks

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We analyze how the process of dust settling affects the spectral energy distribution and optical appearance of protoplanetary disks. Using simple analytic estimates on the one hand, and detailed 1+1-D models on the other hand, we show that, while the time scale for settling down to the equator may exceed the life time of the disk, it takes much less time for even small grains of 0.1 μm to settle down to a few pressure scale heights. This is often well below the original location of the disk's photosphere, and the disk therefore becomes effectively 'flatter'. If turbulent stirring is included, a steady state solution can be found, which is typically reached after a few $\times\, 10^5$ years. In this state, the downward settling motion of the dust is balanced by vertical stirring. Dependent on the strength of the turbulence, the shape of the disk in such a steady state can be either fully flaring, or flaring only up to a certain radius and self-shadowed beyond that radius. These geometries are similar to the geometries that were found for disks around Herbig Ae/Be stars in our previous papers (Dullemond 2002; Dullemond & Dominik A&A 2004, henceforth DD04). In those papers, however, the reason for a disk to turn self-shadowed was by loss of optical depth through dust grain growth. Here we

show that dust settling can achieve a similar effect without loss of vertical optical depth, although the self-shadowing in this case only affects the outer regions of the disk, while in DD04 the entire disk outside of the puffed-up inner rim was shadowed. In reality it is likely that both grain growth and grain settling act simultaneously. The spectral energy distributions of such self-shadowed — or partly self-shadowed — disks have a relatively weak far-infrared excess (in comparison to flaring disks). We show here that, when dust settling is the cause of self-shadowing, these self-shadowed regions of the disk are also very weak in resolved images of scattered light. A reduction in the brightness was already predicted in DD04, but we find that dust settling is far more efficient than grain growth at dimming the scattered light image of the disk. Settling is also efficient in steepening the spectral energy distribution at mid- to far-infrared wavelengths. From the calculations with compact grains it follows that, after about 10^6 years, most disks should be self-shadowed. The fact that some older disks are still observed with the characteristics of flaring disks therefore seems somewhat inconsistent with the time scales predicted by the settling model based on compact grains. This suggests that perhaps even the small grains ($\leq 0.1\mu$m) have a porous or fractal structure, slowing down the settling. Or it could mean that the different geometries of observed disks is merely a reflection of the turbulent state of these disks.

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Nature of two massive protostellar candidates: IRAS 21307+5049 and IRAS 22172+5549

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We present observations of continuum and molecular lines towards the protostar candidates IRAS 21307+5049 and IRAS 22172+5549. Single-dish maps in the CO (2–1), CII (2–1), HCO+ (1–0) lines and 850 μm continuum are compared with interferometric maps in the CO (1–0) line and 3 mm continuum, and with mid- and near-infrared images. Also, single-pointing spectra of the ace (6–5), (8–7) and (13–12) lines observed towards IRAS 21307+5049, and H_2 and [FeII] line emission observed towards IRAS 22172+5549, are presented. A plausible interpretation of our data based on the continuum maps and spectral energy distributions is that two components are present: a compact molecular core, responsible for the continuum emission at wavelengths longer than ~ 25 μm, and a cluster of stars located close to the center of the core, but not spatially coincident with it, responsible for the emission at shorter wavelengths. The core is approximately located at the center of the associated molecular outflow, detected for both sources in the CO (1–0) and (2–1) lines. The cores have masses of ~ 50 $M_\odot$, and luminosities of $\sim 10^3$ $L_\odot$. The outflows parameters are consistent with those typically found in high-mass young stellar objects. Our results support the hypothesis that in these sources the luminosity is dominated by accretion rather than by nuclear burning. We conclude that the sources embedded inside the cores are likely protostars with mass $\sim 5-8$ $M_\odot$.

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Discovery of four new massive and dense cold cores

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We report the identification, from a 1.2-mm dust continuum emission survey toward massive star forming regions, of four strong 1.2-mm sources without counterparts at mid-infrared (*Midcourse Space Experiment* [MSX]) and far-infrared (IRAS) wavelengths. They have radii in the range 0.2-0.3 pc, dust temperatures ≤ 17 K, masses in the range $4\times10^2-2\times10^3 M_\odot$ and densities of $\sim 2\times10^5$ cm^{-3}. We suggest that these objects are massive and dense cold cores that will eventually collapse to form high-mass stars.

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The NGC 7129 Young Stellar Cluster: A Combined *Spitzer*, MMT, and 2MASS Census of Disks, Protostars, and Outflows

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We present the analysis of seven band (1.2 to 8 μm) ground and space-based imaging of the NGC 7129 young stellar cluster from FLAMINGOS on MMT, 2MASS, and the Infrared Array Camera (IRAC) on the *Spitzer Space Telescope*. An analysis of the $H-[4.5]$ vs. $J-H$ colors reveals 84 objects with circumstellar disks. Of these, 42 are located within the cluster core, a 0.5 pc ($100''$) radius region of enhanced stellar surface density. From a luminosity and extinction limited sample of the stars within the cluster core boundary we have determined that 54% $\pm$ 14% have circumstellar disks. Finally, we report the detection of several resolved outflows in the IRAC 4.5 μm mosaic.

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Protostellar angular momentum evolution during gravoturbulent fragmentation

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Using hydrodynamic simulations we investigate the rotational properties and angular momentum evolution of prestellar and protostellar cores formed from gravoturbulent fragmentation of interstellar gas clouds. We find the specific angular momentum j of molecular cloud cores in the prestellar phase to be on average $\langle j \rangle = 7 \times 10^{20}\,\mathrm{cm^2\,s^{-1}}$ in our models. This is comparable to the observed values. A fraction of those cores is gravitationally unstable and goes into collapse to build up protostars and protostellar systems, which then have $\langle j \rangle = 8 \times 10^{19}\,\mathrm{cm^2\,s^{-1}}$. This is one order of magnitude lower than their parental cores and in agreement with observations of main-sequence binaries. The loss of specific angular momentum during collapse is mostly due to gravitational torques exerted by the ambient turbulent flow as well as by mutual protostellar encounters in a dense cluster environment. Magnetic torques are not included in our models, these would lead to even larger angular momentum transport.

The ratio of rotational to gravitational energy β in cloud cores that go into gravitational collapse turns out to be similar to the observed values. We find, β is roughly conserved during the main collapse phase. This leads to the correlation $j \propto M^{2/3}$, between specific angular momentum j and core mass M. Although the temporal evolution of the angular momentum of individual protostars or protostellar systems is complex and highly time variable, this correlation holds well in a statistical sense for a wide range of turbulent environmental parameters. In addition, high turbulent Mach numbers result in the formation of more numerous protostellar cores with, on average, lower mass. Therefore, models with larger Mach numbers result in cores with lower specific angular momentum. We find, however, no dependence on the spatial scale of the turbulence. Our models predict a close correlation between the angular momentum vectors of neighboring protostars during their initial accretion phase. Possible observational signatures are aligned disks and parallel outflows. The latter are indeed observed in some low-mass isolated Bok globules.

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KH 15D: A Spectroscopic Binary

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We present the results of a high-resolution spectroscopic monitoring program of the eclipsing pre–main-sequence star KH 15D that reveal it to be a single-line spectroscopic binary. We find that the best-fit Keplerian model has a period $P = 48.38$ days, which is nearly identical to the photometric period. Thus, we find the best explanation for the periodic dimming of KH 15D is that the binary motion carries the currently visible star alternately above and behind the edge of an obscuring cloud. The data are consistent with the models involving an inclined circumbinary disk, as recently proposed by Winn et al. (2004) and Chiang & Murray-Clay (2004). We show that the mass ratio expected from models of PMS evolution, together with the mass constraints for the visible star, restrict the orbital eccentricity to $0.68 \leq e \leq 0.80$ and the mass function to $0.125 \leq F_M / \sin^3 i \leq 0.5$ $M_\odot$.

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Imaging chemical differentiation around the low-mass protostar L483-mm

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This paper presents a millimeter wavelength aperture-synthesis study of the spatial variations of the chemistry in the envelope around the deeply embedded low-mass protostar L483-mm on ∼1000 AU (5″) scales. Lines of 8 molecular species including CN, $C^{18}O$, CS, $C^{34}S$, HCN, $H^{13}CN$, HCO^+ and N_2H^+ have been observed using the Owens Valley Radio Observatory Millimeter Array. Continuum emission at 2.7-3.4 millimeter is well-fit by an envelope model based on previously reported submillimeter continuum images down to the sensitivity of the interferometer without introducing a disk/compact source, in contrast to what is seen for other protostellar objects. A velocity gradient in dense material close to the central protostar is traced by HCN, CS and N_2H^+, and is perpendicular to the large-scale CO outflow, with a pattern consistent with rotation around a ∼1 $M_\odot$ central object. Velocity gradients in the propagation direction of the outflow suggest a clear interaction between the outflowing material and "quiescent" core. Significant differences are observed between the emission morphologies of various molecular species. The $C^{18}O$ interferometer observations are fit with a "drop" abundance profile where CO is frozen-out in a region of the envelope with temperatures lower than 40 K and densities higher than 1.5×10^5 cm^{-3}, which is also required to reproduce previously reported single-dish observations. The N_2H^+ emission strongly resembles that of NH_3 and is found to be absent toward the central continuum source. This is a direct consequence of the high CO abundances in the inner region as illustrated by a chemical model for the L483 envelope. The observed CN emission forms a spatial borderline between the outflowing and quiescent material probed by, respectively, HCO^+ and N_2H^+, and also shows intermediate velocities compared to these two species. A scenario is suggested in which CN is enhanced in the walls of an outflow cavity due to the impact of UV irradiation either from the central protostellar system or related to shocks caused by the outflow.

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Substellar objects in star formation regions: A deep near infrared study in the Serpens cloud

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We present near infrared (J, H and Ks) observations of a $5' \times 10'$ sample field in the Serpens Star Formation region obtained with SOFI at the NTT. These observations are sensitive enough to detect a 20 M_{Jup} brown dwarf through an extinction of $A_V \sim 16$ and are used to build an infrared census of this field in the cluster. From photometry and mass-luminosity models, we have developed a detailed methodology to extract quantitative parameters (distance modulus, extinction, spectral type, masses) for objects observed towards and inside the Serpens molecular cloud. An extinction map of the region is derived allowing us to disentangle cloud members from background field objects. Luminosities and masses for 14 low-mass stars and substellar object candidate members of the cluster are derived. Three of these objects have masses compatible with the brown dwarf regime and one of them (BD-Ser 1) was observed spectroscopically with ISAAC at the VLT, confirming its substellar status. Long-term photometric variability of BD-Ser 1 could be consistent with signs of accretion.

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Emission of CO, CI, and CII in W3 Main

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We used the KOSMA 3m telescope to map the core $7' \times 5'$ of the Galactic massive star forming region W3 Main in the two fine structure lines of atomic carbon and four mid-J transitions of CO and ^{13}CO. The maps are centered on the luminous infrared source IRS 5 for which we obtained ISO/LWS data comprising four high-J CO transitions, CII, and OI at 63 and 145 μm. In combination with a KAO map of integrated line intensities of CII (Howe et al. 1991), this data set allows to study the physical structure of the molecular cloud interface regions where the occurence of carbon is believed to change from C^+ to C^0, and to CO. The molecular gas in W3 Main is warmed by the far ultraviolet (FUV) field created by more than a dozen OB stars. Detailed modelling shows that most of the observed line intensity ratios and absolute intensities are consistent with a clumpy photon dominated region (PDR) of a few hundred unresolved clumps per 0.84 pc beam, filling between 3 and 9% of the volume, with a typical clump radius of 0.025 pc (2.2″), and typical mass of 0.44 $M_\odot$. The high-excitation lines of CO stem from a $100 - 200$ K layer, as also the CI lines. The bulk of the gas mass is however at lower temperatures.

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A Mushroom-shaped Structure from the Impact of a Cloud with the Galactic Disk

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We propose that the mushroom-shaped structure of the Galactic worm GW 123.4–1.5 is created by a cloud collision with the Galactic gas disk. A hydrodynamic simulation shows that a mushroom-shaped structure is created after the cloud crosses the Galactic midplane. The lifetime of the mushroom-shaped structure is of order the dynamical time scale of the disk, $\sim 10^7$ years. We find that the velocities across the cap of the mushroom-shaped structure in the simulation are consistent with the observed values. The simulation also predicts a structure on the opposite side of the Galactic plane which is created by the Kelvin-Helmholtz instability after the cloud passes through the disk.

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Preprint and color figures/movies available at `http://www.astro.uwo.ca/~kudoh/mushroom`. Preprint in b/w also at astro-ph/0405165.

Mid-infrared sizes of circumstellar disks around Herbig Ae/Be stars measured with MIDI on the VLTI

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We present the first long baseline mid-infrared interferometric observations of the circumstellar disks surrounding Herbig Ae/Be stars. The observations were obtained using the mid-infrared interferometric instrument MIDI at the European Southern Observatory (ESO) Very Large Telescope Interferometer VLTI on Cerro Paranal. The 102 m baseline given by the telescopes UT1 and UT3 was employed, which provides a maximum full spatial resolution of 20 milli-arcsec (mas) at a wavelength of 10 μm. The interferometric signal was spectrally dispersed at a resolution of 30, giving spectrally resolved visibility information from 8 μm to 13.5 μm. We observed seven nearby Herbig Ae/Be stars and resolved all objects. The warm dust disk of HD 100546 could even be resolved in single-telescope imaging. Characteristic dimensions of the emitting regions at 10 μm are found to be from 1 AU to 10 AU. The 10 μm sizes of our sample stars correlate with the slope of the 10-25 μm infrared spectrum in the sense that the reddest objects are the largest ones. Such a correlation would be consistent with a different geometry in terms of flaring or flat (self-shadowed) disks for sources with strong or moderate mid-infrared excess, respectively. We compare the observed spectrally resolved visibilities with predictions based on existing models of passive centrally irradiated hydrostatic disks made to fit the SEDs of the observed stars. We find broad qualitative agreement of the spectral shape of visibilities corresponding to these models with our observations. Quantitatively, there are discrepancies that show the need for a next step in modelling of circumstellar disks, satisfying both the spatial constraints such as now available from the MIDI observations and the flux constraints from the SEDs in a consistent way.

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Temporal evolution of magnetic molecular shocks I. Moving grid simulations

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We present time-dependent 1D simulations of multifluid magnetic shocks with chemistry resolved down to the mean free path. They are obtained with an adaptive moving grid implemented with an implicit scheme. We examine a broad range of parameters relevant to conditions in dense molecular clouds, with preshock densities 10^3 cm$^{-3} < n < 10^5$ cm^{-3}, velocities 10 kms^{-1} $< u <$ 40 kms^{-1}, and three different scalings for the transverse magnetic field : $B = 0, 0.1, 1$ μG$\times\sqrt{n/\mathrm{cm}^{-3}}$.

We first use this study to validate the results of Chièze, Pineau des Forêts & Flower (1998), in particular the long delays necessary to obtain steady C-type shocks, and we provide evolutionary time-scales for a much greater range of parameters.

We also present the first time-dependent models of dissociative shocks with a magnetic precursor, including the first models of stationary CJ shocks in molecular conditions. We find that the maximum speed for steady C-type shocks is reached *before* the occurrence of a sonic point in the neutral fluid, unlike previously thought. As a result, the maximum speed for C-shocks is lower than previously believed.

Finally, we find a large amplitude bouncing instability in J-type fronts near the H_2 dissociation limit ($u \simeq 25 - 30$ kms^{-1}), driven by H_2 dissociation/reformation. At higher speeds, we find an oscillatory behaviour of short period and small amplitude linked to collisional ionisation of H. Both instabilities are suppressed after some time when a magnetic field is present.

In a companion paper (Lesaffre *et al.* 2004, hereafter Paper II), we use the present simulations to validate a new semi-analytical construction method for young low-velocity magnetic shocks based on truncated steady-state models.

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Temporal evolution of magnetic molecular shocks II. Analytics of the steady state and semi-analytical construction of intermediate ages.

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In the first paper of this series (Lesaffre *et al.* 2004, hereafter Paper I), we computed time dependent simulations of multifluid shocks with chemistry and a transverse magnetic field frozen in the ions, using an adaptive moving grid.

In this paper, we present new analytical results on steady-state molecular shocks. Relationships between density and pressure in the neutral fluid are derived for the cold magnetic precursor, hot magnetic precursor, adiabatic shock front, and the following cooling layer. The compression ratio and temperature behind a fully dissociative adiabatic shock is also derived.

To prove that these results may even hold for intermediate ages, we design a test to characterise locally the validity of the steady state equations in a time-dependent shock simulation. Applying this tool to the results of Paper I, we show that most of these shocks (all the stable ones) are indeed in a quasi-steady state at all times, i.e. : a given snapshot is composed of one or more truncated steady shocks. Finally, we use this property to produce a construction method of any intermediate time of low velocity shocks ($u < 20$ kms^{-1}) with the only means of a steady-state code. In particular, this method allows to predict the occurrence of steady CJ-type shocks more accurately than previously proposed criteria.

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Methanol as a diagnostic tool of interstellar clouds: I. Model calculations and application to molecular clouds

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We present a detailed analysis of the diagnostic properties of methanol, (CH_3OH), in dense molecular clouds, made possible by the availability of new (CH_3OH-He) collisional rate coefficients. Using a spherical Large Velocity Gradient (LVG) model, the dependence on kinetic temperature and spatial density of various millimeter and submillimeter line bands is investigated over a range of physical parameters typical of high- and low-mass star-forming regions. We find CH_3OH to be a good tracer of high-density environments and sensitive to the kinetic temperature. Using our LVG model, we have also developed an innovative technique to handle the problem of deriving physical parameters from observed multi-line spectra of a molecule, based on the simultaneous fit of all the lines with a synthetic spectrum, finding the best physical parameters using numerical methods.

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Magnetically Regulated Star Formation in Turbulent Clouds

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We investigate numerically the combined effects of supersonic turbulence, strong magnetic fields and ambipolar diffusion on cloud evolution leading to star formation. We find that, in clouds that are initially magnetically subcritical, supersonic turbulence can speed up star formation, through enhanced ambipolar diffusion in shocks. The speedup overcomes a major objection to the standard scenario of low-mass star formation involving ambipolar diffusion, since the diffusion time scale at the average density of a molecular cloud is typically longer than the cloud life time. At the same time, the strong magnetic field can prevent the large-scale supersonic turbulence from converting most of the cloud mass into stars in one (short) turbulence crossing time, and thus alleviate the high efficiency problem associated with the turbulence-controlled picture for low-mass star formation. We propose that relatively rapid but inefficient star formation results from supersonic collisions of somewhat subcritical gas in strongly magnetized, turbulent clouds. The salient features of this shock-accelerated, ambipolar diffusion-regulated scenario are demonstrated with numerical experiments.

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High resolution imaging polarimetry of HL Tau and magnetic field structure

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We present high quality near infrared imaging polarimetry of HL Tau at 0.4 to 0.6 arcsec resolution, obtained with Subaru/CIAO and UKIRT/IRCAM. 3-D Monte Carlo modelling with aligned oblate grains is used to probe the structure of the circumstellar envelope and the magnetic field, as well as the dust properties. At J band the source shows a centrosymmetric pattern dominated by scattered light. In the H and K bands the central source becomes visible and its polarisation appears to be dominated by dichroic extinction, with a position angle inclined by $\approx 40°$ to the disc axis. The polarisation pattern of the environs on scales up to 200 AU is consistent with the same dichroic extinction signature superimposed on the centrosymmetric scattering pattern. These data can be modelled with a magnetic field which is twisted on scales from tens to hundreds of AU, or alternatively by a field which is globally misaligned with the disc axis. A unique solution to the field structure will require spatially resolved circular polarisation data. The best fit Monte Carlo model indicates a shallow near infrared extinction law. When combined with the observed high polarisation and non-negligible albedo these constraints can be fitted with a grain model involving dirty water ice mantles in which the largest particles have radii slightly in excess of 1 μm. The best fit model has an envelope structure which is slightly flattened on scales up to several hundred AU. Both lobes of the bipolar outflow cavity contain a substantial optical depth of dust (not just within the cavity walls). Curved, approximately parabolic, cavity walls fit the data better than a conical cavity. The small inner accretion disc observed at millimetre wavelengths is not seen at this spatial resolution.

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Constraining the Lifetime of Circumstellar Disks in the Terrestrial Planet Zone: A Mid-IR Survey of the 30-Myr-old Tucana-Horologium Association

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We have conducted an N-band survey of 14 young stars in the ∼30 Myr-old Tucana-Horologium Association to search for evidence of warm, circumstellar dust disks. Using the MIRAC-BLINC camera on the Magellan I (Baade) 6.5-m telescope, we find that none of the stars have a statistically significant N-band excess compared to the predicted stellar photospheric flux. Using three different sets of assumptions, this null result rules out the existence of the following around these post-T Tauri stars: (a) optically-thick disks with inner hole radii of $\leq$0.1 AU, (b) optically-thin disks with masses of $>10^{-6}$ $M_{\oplus}$ (in ∼1-μm-sized grains) within $\leq$10 AU of these stars, (c) scaled-up analogs of the solar system zodiacal dust cloud with >4000× the emitting area. Our survey was sensitive to dust disks in the terrestrial planet zone with fractional luminosity of $\log(L_{dust}/L_*) \sim 10^{-2.9}$, yet none were found. Combined with results from previous surveys, these data suggest that circumstellar dust disks become so optically-thin as to be undetectable at N-band before age ∼20 Myr. We also present N-band photometry for several members of other young associations and a subsample of targets that will be observed with *Spitzer Space Telescope* by the *Formation and Evolution of Planetary Systems* (FEPS) Legacy Science Program. Lastly, we present an absolute calibration of MIRAC-BLINC for four filters (L, N, 11.6, and Q_s) on the Cohen-Walker-Witteborn system.

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A Map of OMC-1 in CO $J = 9 \rightarrow 8$

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The distribution of $^{12}C^{16}O$ $J = 9 \rightarrow 8$ (1.037 THz) emission has been mapped in OMC-1 at 35 points with $84''$ resolution. This is the first map of this source in this transition and only the second velocity-resolved ground-based observation of a line in the terahertz frequency band. There is emission present at all points in the map, a region roughly $4'$ by $6'$ in size, with peak antenna temperature dropping only near the edges. Away from the Orion KL outflow, the velocity structure suggests that most of the emission comes from the OMC-1 photon-dominated region, with a typical linewidth of 3-6 km s^{-1}. Large velocity gradient modeling of the emission in $J = 9 \rightarrow 8$ and six lower transitions suggests that the lines originate in regions with temperatures around 120 K and densities of at least $10^{3.5}$ cm^{-3} near θ^1C Ori and at the Orion Bar, and from 70 K gas at around 10^4 cm^{-3} southeast and west of the bar. These observations are among the first made with the 0.8 m Smithsonian Astrophysical Observatory Receiver Lab Telescope, a new instrument designed to observe at frequencies above 1 THz from an extremely high and dry site in northern Chile.

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Initial Results from The Spitzer Young Stellar Cluster Survey

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We report initial results from IRAC observations of four young stellar clusters. These regions are part of a larger Spitzer survey of 31 young stellar groups and clusters within 1 kpc of the Sun. In each of the four clusters, there are between 39 and 85 objects with colors inconsistent with reddened stellar photospheres. We identify these objects as young stars with significant emission from circumstellar dust. Applying an analysis developed in a companion paper (Allen et al. 2004), we classify these objects as either pre-main sequence stars with disks (class II) or protostellar objects (class I). These show that the sites of recent star formation are distributed over multi-parsec size scales. In two clusters, Cepheus C and S140, we find protostars embedded in filamentary dark clouds seen against diffuse emission in the IRAC bands.

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Flared Disks and Silicate Emission in Young Brown Dwarfs

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We present mid-infrared photometry of three very young brown dwarfs located in the ρ Ophiuchi star-forming region

– GY5, GY11 and GY310 – obtained with the Subaru 8-meter telescope. All three sources were detected at 8.6 and 11.7μm, confirming the presence of significant mid-infrared excess arising from optically thick dusty disks. The spectral energy distributions of both GY310 and GY11 exhibit strong evidence of flared disks; flat disks can be ruled out for these two brown dwarfs. The data for GY5 show large scatter, and are marginally consistent with both flared and flat configurations. Inner holes a few substellar radii in size are indicated in all three cases (and especially in GY11), in agreement with magnetospheric accretion models. Finally, our 9.7μm flux for GY310 implies silicate emission from small grains on the disk surface (though the data do not completely preclude larger grains with no silicate feature). Our results demonstrate that disks around young substellar objects are analogous to those girdling classical T Tauri stars, and exhibit a similar range of disk geometries and dust properties.

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The 24-Micron View of Embedded Star Formation in NGC 7129

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We present observations of the star formation region NGC 7129 taken with the Multiband Imaging Photometer for *Spitzer* (MIPS). A significant population of sources, likely pre-main sequence members of the young stellar cluster, is revealed outside the central photoionization region. Combining with Infrared Array Camera (IRAC) and ground-based near-infrared images, we have obtained colors and spectral energy distributions for some 60 objects. The [3.6]-[4.5] vs. [8]-[24] color-color plane shows sources clustered at several different loci, which roughly correspond to the archetypal evolutionary sequence Class 0, I, II, and III. We obtain preliminary classifications for 36 objects, and find significant numbers of both Class I and II objects. Most of the pre-main sequence candidates are associated with the densest part of the molecular cloud surrounding the photoionization region, indicating active star formation over a broad area outside the central cluster. We discuss three Class II candidates that exhibit evidence of inner disk clearing, which would be some of the youngest known examples of a transition from accretion to optically thin quiescent disks.

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Accretion in Brown Dwarfs: an Infrared View

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This paper presents a study of the accretion properties of 19 very low mass objects ($M_\star \sim 0.01-0.1\ M_\odot$) in the regions Chamaeleon I and ρ Oph. For 8 objects we obtained high resolution Hα profiles and determined mass accretion rate $\dot{M}_{ac}$ and accretion luminosity L_{ac}. Paβ is detected in emission in 7 of the 10 ρ Oph objects, but only in one in Cha I. Using objects for which we have both a determination of L_{ac} from Hα and a Paβ detection, we show that the correlation between the Paβ luminosity and luminosity L_{ac}, found by Muzerolle et al. 1998 for T Tauri stars in Taurus, extends to objects with mass $\sim 0.03\ M_\odot$; L(Paβ) can be used to measure L_{ac} also in the substellar regime. The results were less conclusive for Brγ, which was detected only in 2 objects, neither of which had an Hα estimate of

$\dot{M}_{ac}$. Using the relation between L(Paβ) and L_{ac} we determined the accretion rate for all the objects in our sample (including those with no Hα spectrum), more than doubling the number of substellar objects with known $\dot{M}_{ac}$. When plotted as a function of the mass of the central object together with data from the literature, our results confirm the trend of lower $\dot{M}_{ac}$ for lower $M_\star$, although with a large spread. Some of the spread is probably due to an age effect; our very young objects in ρ Oph have on average an accretion rate at least one order of magnitude higher than objects of similar mass in older regions. As a side product, we found that the width of Hα measured at 10% peak intensity is not only a qualitative indicator of the accreting nature of very low mass objects, but can be used to obtain a quantitative, although not very accurate, estimate of $\dot{M}_{ac}$ over a large mass range, from T Tauri stars to brown dwarfs. Finally, we found that some of our objects show evidence of mass-loss in their optical spectra.

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Available at http://www.arcetri.astro.it/∼starform/publ2004.htm

An Aggregate of Young Stellar Disks in Lynds 1228 South

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Using the MIPS and IRAC instruments on the *Spitzer Space Telescope*, we have investigated an aggregate of at least 9 candidate bright young stellar objects in the southern region of the Lynds 1228 cloud in Cepheus. The spectral energy distributions (SEDs) encompass both infrared (IR) Class II and Class III types, and at least one object has no excess at wavelengths shorter than 24 μm. There are 5 known IRAS sources in the region. We find that the fluxes of these sources are generally overestimated by IRAS due to confusion, and one appears in both the IRAS Point Source and Faint Source catalogs. This small group of YSOs provides a good example of the power of Spitzer to resolve star-forming regions confused in the IRAS catalogs. The SEDs of these sources illustrate that there can be a diversity of disk evolutionary states within a coeval stellar aggregate.

Accepted by Ap.J.Supp. (Spitzer special issue)

Can be found in astro-ph and on the Spitzer Science Center website

Rotation of the pre-stellar core L1689B

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The search for the onset of star formation in pre-stellar cores has focussed on the identification of an infall signature in the molecular line profiles of tracer species. The classic infall signature is a double peaked line profile with an asymmetry in the strength of the peaks such that the blue peak is stronger. L1689B is a pre-stellar core and infall candidate but new JCMT HCO+ line profile data, presented here, confirms that both blue and red asymmetric line profiles are present in this source. Moreover, a dividing line can be drawn between the locations where each type of profile is found. It is argued that it is unlikely that the line profiles can be interpreted with simple models of infall or outflow and that rotation of the inner regions is the most likely explanation. A rotational model is developed in detail with a new 3D molecular line transport code and it is found that the best type of model is one in which the rotational velocity profile is in between solid body and Keplerian. It is firstly shown that red and blue asymmetric line profiles can be generated with a rotation model entirely in the absence of any infall motion. The model is then quantitively compared with the JCMT data and an iteration over a range of parameters is performed to minmize the difference between the data and model. The results indicate that rotation can dominate the line profile shape even before the

onset of infall.

Accepted by MNRAS

http://arxiv.org/abs/astro-ph/0405469

The Bias of Molecular Clump Identification Programs: the Example of the Carina Molecular Clouds

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A large scale ^{12}CO J=1→0 molecular line map of the Carina molecular cloud complex was obtained with the Mopra radiotelescope in order to investigate its spatial and kinematic structure. The data show a complex velocity structure in two distinct cloud regions - the northern and southern Carina clouds. Two different clump identification methods (GAUSSCLUMPS and CLUMPFIND) were applied to the data. Though both algorithms find a similar clump mass spectral index (1.95 and 1.8, respectively), the properties of the clumps (mass, size, virial equilibrium) differ significantly. We discuss possible explanations for this discrepancy and question the validity of the Larson relations which could be an artifact of the limited spatial resolution and dynamic range of the observations.

Accepted by PASA (Publications of the Astronomical Society of Australia)

Preprints available at http://www.publish.csiro.au/nid/139/aid/110.htm

Low Mass Stars and Accretion at the Ages of Planet Formation in the CepOB2 Region

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We present the first identification of low mass (spectral types K-M) stars in the young clusters Tr 37 and NGC 7160, members of the CepOB2 association. This is part of a program to follow the evolution of protoplanetary accretion disks through the ages thought to be crucial to understanding disk dissipation and planet formation (∼3-10 Myr). Combining optical photometry and optical spectroscopy, we have identified ∼40 members in Tr 37, and ∼15 in NGC 7160, using several independent tests for determining the membership (optical colors, optical variability, $H\alpha$ emission, and Lithium 6707 Å absorption). We confirm previous age estimates of 1-5 Myr for Tr 37 and 10 Myr for NGC 7160. We find active accretion in some of the stars in Tr 37, with average accretion rates of $\sim 10^{-8} M_{\odot} yr^{-1}$, derived from their U-band excesses. These results expand the existing samples of accreting stars, and are consistent with the models of viscous accretion disk evolution. No signs of active accretion have been detected so far in the older cluster NGC 7160, suggesting that disk accretion ends before the age of 10 Myr. These results are consistent with those from other populations and are a clear sign of disk evolution within the CepOB2 region.

We also investigate the spatial asymmetries in Tr 37 and the possible presence of younger populations triggered by Tr 37 itself, and we outline an efficient method to detect and study the rest of the clusters members and their characteristics.

Accepted by Astron. J.

http://cfa-www.harvard.edu/cfa/youngstars/

Thermal-IR Detection of Optical Outflow Sources in OMC1 South

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We present the first thermal-infrared imaging photometry for several embedded sources in the OMC1 South cloud core in the Orion nebula, and propose that some of these drive optical Herbig-Haro jets emerging from the region. Thermal-infrared images at 8.8 and 11.7 μm obtained at Gemini South show a handful of sources in OMC1-S with no visual-wavelength counterparts, although a few can be seen in recent near-infrared data. For the three brightest mid-infrared sources, we also present 18.75 μm photometry obtained with the Keck telescope. The most prominent blueshifted outflows in the Orion nebula at visual wavelengths such as HH 202, HH 203/204, HH 529, and HH 269 all originate from OMC1-S. The brightest infrared source in OMC1-S at 11.7 μm is located at the base of the prominent jet that powers HH 202 and is likely to be the sought-after driver of this outflow. The second brightest infrared source is located at the base of the HH 529 jet. We consider the possibility that HH 203/204 and HH 269 trace parts of a single bent outflow from the third-brightest infrared source. While there may be some lingering ambiguity about which infrared stars drive specific jets, there is now a sufficient number of embedded sources to plausibly account for the multiple outflows from OMC1-S.

Accepted by ApJ Letters

First Look at the Fomalhaut Debris Disk with the Spitzer Space Telescope[1]

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We present *Spitzer Space Telescope* early release observations of Fomalhaut, a nearby A star with dusty circumstellar debris. The disk is spatially resolved at 24, 70, and 160 μm using the Multiband Imaging Photometer for Spitzer (MIPS) instrument. While the disk orientation and outer radius is comparable to values measured in the submillimeter, the disk inner radius cannot be precisely defined: the central hole in the submillimeter ring is at least partially filled in with emission from warm dust seen in IRS 17.5-34 μm spectra and MIPS 24 μm images. The disk surface brightness becomes increasingly asymmetric toward shorter wavelengths, with the SSE ansa always brighter than the NNW one. This asymmetry may reflect perturbations on the disk by an unseen interior planet.

Accepted by Astrophysical Journal Supplement, Spitzer Special Issue

A preprint can be downloaded from http://ssc.spitzer.caltech.edu/pubs/journal2004.html

Multiple Outflows in the LkHα 234 Region

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We report results of radio continuum (1.3 and 3.6 cm) and H_2O maser line observations, carried out with the Very Large Array (VLA) in its A configuration, toward the star-forming region LkHα 234. We detected five radio continuum sources (VLA 1, VLA 2, VLA 3A, VLA 3B, and LkHα 234) in a region of $\simeq 5''$ ($\simeq$ 5000 AU), of which three were previously unknown (VLA 1, VLA 2 and VLA 3B). VLA 3A and VLA 3B seem to form a close ($\simeq$ 220 AU) binary system. Their elongated morphologies and positive spectral indices suggest that both, VLA 3A and VLA 3B, could be thermal radio jets. In addition, we detected three clusters of water masers, which are spatially associated with VLA 1, VLA 2 and VLA 3B. Based on the analysis of the distribution of the water masers and the characteristics of the continuum emission, we favor the new radio continuum source VLA 2 as the exciting source of the large-scale CO/[SII] outflow observed in the region. Moreover, we find that the multiple outflows observed in the region share a similar orientation. Finally, our data confirm that there is no evidence indicating that the Herbig Be star LkHα 234 is driving any of the outflows in the region.

Accepted by Astrophysical J.

Evaporation of ices near massive stars: models based on laboratory TPD data

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Hot cores and their precursors contain an integrated record of the physics of the collapse process in the chemistry of the ices deposited during that collapse. In this paper, we present results from a new model of the chemistry near high mass stars in which the desorption of each species in the ice mixture is described as indicated by new experimental results obtained under conditions similar to those hot cores. Our models show that provided there is a monotonic increase in the temperature of the gas and dust surrounding the protostar, the changes in the chemical evolution of each species due to differential desorption are important. The species H_2S, SO, SO_2, OCS, H_2CS, CS, NS, CH_3OH, $HCOOCH_3$, CH_2CO, C_2H_5OH show a strong time dependence that may be a useful signature of time evolution in the warm-up phase as the star moves on to the Main Sequence. This preliminary study demonstrates the consequences of incorporating reliable TPD data into chemical models.

Accepted by MNRAS

http://arXiv.org/abs/astro-ph/0406054

A GLIMPSE of Star Formation in the Giant H II Region RCW 49

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GLIMPSE imaging using the Infrared Array Camera (IRAC) on the *Spitzer Space Telescope* indicates that star formation is ongoing in the RCW 49 giant H II region. A photometric comparison of the sources in RCW 49 to a similar area to its north finds that at least 300 stars brighter than 13th magnitude in band [3.6] have infrared excesses inconsistent with reddening due to foreground extinction. These are likely young stellar objects (YSOs) more massive than 2.5 $M_{\odot}$ suggesting that thousands more low-mass stars are forming in this cloud. Some of the YSOs are massive (B stars) and therefore very young, suggesting that a new generation of star formation is occurring, possibly triggered by stellar winds and shocks generated by the older (2-3 Myr) central massive cluster. filamentary, containing both large evacuated regions and dense has proven to be ideally suited for distinguishing young stars from field stars, and the GLIMPSE survey of the Galactic Plane will likely find thousands of new star formation regions.

Accepted by ApJS, Spitzer edition

Preprints available at
http://www.astro.wisc.edu/glimpse/glimpsepubs.html

Mie Scattering by Ensembles of Particles with Very Large Size Parameters

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We present a computer program for the simulation of Mie scattering in case of arbitrarily large size parameters. The elements of the scattering matrix, efficiency factors as well as the corresponding cross sections, the albedo and the scattering asymmetry parameter are calculated. Single particles as well as particle ensembles consisting of several components and particle size distributions can be considered.

Accepted by Computer Physics Communications

astro-ph/0406118

Abstracts of recently accepted major reviews

Outflow, Infall, and Rotation in High-mass Star Forming Regions

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According to theory, stars more massive than ~ 8 $M_{\odot}$ must form while still accreting material from the surrounding parental cloud: at this stage radiation pressure should reverse the infall thus preventing further growth of the stellar mass. After illustrating the two models proposed to solve this problem ("accretion" and "coalescence"), we review the observational evidence pro/contra such models, focusing on the kinematics of the molecular gas where the massive (proto)stars are embedded as the best tool to shed light on the formation mechanism. Special attention is devoted to the phenomena of infall, outflow, and rotation, concluding that the recent detection of rotating disks in massive young stellar objects is the best evidence so far in favour of the accretion model.

Accepted by Ap&SS

http://www.arcetri.astro.it/∼starform/publ2004.htm

Dissertation Abstracts

Study of envelopes and protoplanetary discs around young stars

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Ph.D dissertation directed by: Benjamín Montesinos

Ph.D degree awarded: March 2004

An analysis of multiwavelength data of young pre-main sequence (PMS) and main sequence (MS) stars with IR excesses is presented. This work is conducted in the context of the EXPORT international consortium, which has the overall aim of studying observationally the evolution of the circumstellar (CS) discs around PMS stars towards the "debris" discs around MS Vega-type stars. Most of the observations analysed in this work were obtained by the EXPORT team during the 1998 International Time of the Canary Islands observatories.

The data of a sample of 70 stars is homogeneously processed and presented as a catalogue of observations of stars with IR excesses and different evolutionary stages. The first step for the characterization of the sample is the spectral type reclassification of the stars with optical spectra taken by EXPORT. The second step is the construction of complete Spectral Energy Distributions (SEDs) with simultaneous optical and near-IR photometry from EXPORT plus fluxes from the UV to the centimetre wavelength range taken from satellite archives and from the literature. For many stars in the sample, we present the most complete SEDs to date. We compute the fractional IR excesses for the stars in the catalogue and pinpoint the objects in which the presence of hidden binaries or background IR emission may be distorting the shape of the SEDs. Four groups of similar SEDs were found in the sample, pointing to similar CS discs. Moreover, we found similarities between stars with well-known CS discs and objects not previously observed in high spatial resolution. The stellar parameters of the PMS stars are determined by putting them in an HR diagram, confirming their PMS nature. No clear trend in the IR excess is observed with the stellar age for the PMS stars in the catalogue.

To analyse the SEDs of the PMS objects, we use physical self-consistent irradiated accretion disc models by D'Alessio et al. We create a library with $\sim$ 3000 model SEDs for different physical parameters of the central stars and the CS discs. This catalogue will be offered to the scientific community through a web page to allow for a physical characterization of CS discs around PMS stars.

We present a detailed study of the stellar parameters, distances and SEDs of HD 34282 and HD 141569, two A-type PMS stars with CS discs imaged in millimetre and optical wavelegths, respectively, which appeared below the MS in the HR diagram. The SED of HD 34282 is compatible with a large CS disc while that of HD 141569 points to an evolved disc in a intermediate phase towards a Vega-type "debris" disc. We find that both stars are metal-deficient and solve the problem of their positions in the HR diagram. The SEDs are fitted with physical disc models and the possible evolutionary connection between both objects is studied.

More information about the EXPORT consortium can be found at `http://www.laeff.esa.es/EXPORT`.

The complete pdf file can be downloaded from `http://www.laeff.esa.es/users/bruno/thesis_merin.pdf`.

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Meetings

Cores to Clusters

Star formation with the Next Generation Telescopes

A workshop to be held at Centro de Astrofisica da Universidade do Porto during 7–9 October, 2004

http://www.astro.up.pt/c2c/

Electronic mail: c2c@astro.up.pt

Towards the second half of this decade several major telescope facilities operating in the infrared submillimeter and millimeter wave bands will become operational. These missions are expected to throw much light on our understanding of the the star formation phenomenon, which is addressed as one of the primary science goals in these wave bands. "Cores to Clusters" is a workshop to be held at Centro de Astrofisica da Universidade do Porto during 7 - 9 October, 2004 to discuss current and future issues in star formation physics in the light of these Next Generation Telescopes.

Organising Committee: J. Alves (ESO), P. Caselli (Arcetri), M. S. N. Kumar (CAUP, Convenor), M. T. Lago (CAUP), M. Tafalla (OAN)

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://www.ifa.hawaii.edu/∼reipurth or at http://www.eso.org/gen-fac/pubs/starform/ .

Short Announcements

The following Perspective article just appeared in Science:

The Cradle of the Solar System

J. Jeff Hester[1], Steven J. Desch[1], Kevin R. Healy[1] and Laurie A. Leshin[2]

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The majority of low-mass stars form in H II region environments like those surrounding the Orion Nebula and M16. Recent work on the origins of short-lived radionuclides in meteorites, especially the confirmation of live ^{60}Fe in the early Solar System, provides compelling evidence that our own Sun and Solar System formed in just such an environment. We develop a scenario for low-mass star formation in H II region environments that begins when a shock driven in advance of an ionization front compresses preexisting density irregularities in a molecular cloud, initiating gravitational collapse. A short time (typically $\sim 10^5$ years) later, the advancing ionization front overruns a forming star. As the YSO is uncovered by the ionization front it passes through a short-lived ($\sim 10^4$ year) phase during which the remainder of the collapsed core is photoevaporated. This is the EGG phase, seen most clearly in *HST* images of M16. As the EGG is dispersed the star and disk inside are exposed directly to ultraviolet radiation. The EGG evolves into an evaporating disk – a proplyd – such as those seen most clearly in *HST* images of Orion. Within about 10^4 years proplyds are also evaporated down to a size of ~ 30 AU, leaving a young star surrounded by a protoplanetary disk. The star is now like the majority of low-mass protostars seen in H II region interiors, which are associated with neither EGGs nor proplyds. Subsequent evolution of protostars and their disks takes place within the ionized volume of H II regions where the disks are directly exposed to ultraviolet radiation from massive stars and to the effects of the supernovae that occur when those massive stars reach the ends of their brief lives. Our Sun, for example, was adrift in the interior of an H II region when an exciting star went supernova, injecting newly synthesized elements including short-lived radionuclides such as ^{60}Fe into the Sun's preexisting protoplanetary disk. In this paper we draw on existing astrophysical and meteoritic evidence (including *HST* images of the Trifid Nebula) to develop and support this unified and predictive scenario for the formation of Sun-like stars in H II region environments. This scenario has numerous implications for both astrophysics and planetary science, and provides a context linking studies of star formation, meteorites, and planets.

Science, Volume 304, p. 1116

The article is available at

http://www.sciencemag.org/cgi/content/full/304/5674/1116

or

http://eagle.la.asu.edu/hester/papers/science_perspective.pdf