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Abstracts of recently accepted papers

Search for cool circumstellar matter in the Ursae Majoris group with ISO

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We observed the mid- and far-infrared spectral energy distributions of 9 A-type stars from the 300 Myrs old Ursae Majoris group using the ISO satellite and the UKIRT telescope. We found that only 1 out of the 9 stars shows clear signature of circumstellar dust, and we derived an upper limit of 0.05 M_{moon} for the dust mass around the other stars. Our results suggest that the relatively high incidence of Vega-like disks observed among A-type field stars in the solar neighbourhood by IRAS cannot be extrapolated to the rest of the Milky Way. The Vega phenomenon appears to be the exception rather than the rule.

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Constraints on the Formation and Evolution of Circumstellar Disks in Rotating Magnetized Cloud Cores

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We use magnetic collapse models to place some constraints on the formation and angular momentum evolution of circumstellar disks which are embedded in magnetized cloud cores. Previous models have shown that the early evolution of a magnetized cloud core is governed by ambipolar diffusion and magnetic braking, and that the core takes the form of a nonequilibrium flattened envelope which ultimately collapses dynamically to form a protostar. In this paper, we focus on the inner centrifugally-supported disk, which is formed only after a central protostar exists, and grows by dynamical accretion from the flattened envelope. We estimate a centrifugal radius for the collapse of mass shells within a rotating, magnetized cloud core. The centrifugal radius of the inner disk is related to its mass through the two important parameters characterizing the background medium: the background rotation rate $\Omega_{\rm b}$ and the background magnetic field strength $B_{\rm ref}$. We also revisit the issue of how rapidly mass is deposited onto the disk (the mass accretion rate) and use several recent models to comment upon the likely outcome in magnetized cores. Our model predicts that a significant centrifugal disk (much larger than a stellar radius) will be present in the very early (Class 0) stage of protostellar evolution. Additionally, we derive an upper limit for the disk radius as it evolves due to internal torques, under the assumption that the star-disk system conserves its mass and angular momentum even while most of the mass is transferred to a central star.

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Preprints available through http://www.cita.utoronto.ca/∼basu/

On the Thermal Stability of Irradiation dominated Pre-main Sequence Disks

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The dusty disks of many young stars are probably heated mostly by absorption of light from the central star. This stellar irradiation can control the vertical structure of the disk, particularly in the outer regions. Because the irradiation heating is sensitive to the disk structure – the disk vertical thickness and the tilt of the disk photosphere relative to the star – the possibility of an unstable feedback is present. To study this problem, we present calculations of the evolution of perturbations in vertically-isothermal disks. We find that such disks are generally stable. In outer disk regions of T Tauri stars, linear analysis indicates that the radiative cooling time is so short that temperature perturbations will be damped faster than the disk structure can respond. Using our results for steady "alpha" viscosity disks, we estimate that this is true for distances larger than 2 AU $(\dot{M}/10^{-8}\mathrm{M}_\odot\,\mathrm{yr}^{-1})^{7/9}(\alpha/0.01)^{-7/9}$ for typical T Tauri stars. Inside this radius, if the disk surface tilt ("flaring") is still significant, numerical finite-amplitude calculations show that temperature pertubations will travel inwards as they damp. We find that disk self-shadowing has a small effect on the results, because the perturbation is damped on a timescale shorter than the time in which the shadowed disk region can respond. Our results help justify steady, smooth treatments of the effects of irradiation on the disks of young stellar objects.

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

X-ray spectroscopy of the weak-lined T Tauri star HD 283572

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We have analyzed the existing X-ray spectroscopic data for the Weak-Line T Tauri star (WTTS) HD 283572, from the ROSAT, ASCA and SAX satellites. All the data sets are well fit with an absorbed two-temperature model based on collisional ionization equilibrium. Together with the *Einstein* data discussed in the literature, these data sets afford a 16.5 years time span, allowing to study the short- and long-term spectroscopic and photometric variability characteristics of the X-ray emission from WTT stars. The X-ray luminosity of HD 283572 appears to vary by factors of $\simeq 2$ on time scales of tens of kiloseconds, within a single observations, while its average X-ray luminosity has varied by a factor of $\simeq 2.5$ (peak-to-peak) along the 16.5 yr studied here. The SAX observation also shows evidence for a short flare, with an enhancement of the X-ray luminosity by a factor of $\simeq 4$.

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The Ultracompact HII Region G45.45+0.06

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We present new imaging data on the ultracompact HII region G45.45+0.06 at near- and mid-infrared wavelengths. High-resolution data were taken in the H and K' bands using ESO's adaptive optics system ADONIS. The resulting images with a generic resolution of $0\farcs4$ for the first time allow the resolution of the object into several single point-like sources. Additionally, we present images obtained in the mid-infrared at 3.5, 10, and 12 μm. A Brγ image was obtained to serve as a measure for the extinction towards this region. We derive the physical properties of the point sources and show that some of them are young, massive stars. By combining our data with earlier VLA maps, we measure the extinction towards the region and discuss the history of the object. Finally, we conclude that G45.45+0.06 is a young OB cluster similar to the KL/BN Region in Orion and that sequential star formation is the reason for its present morphology.

Accepted by A&A

A dust ring around epsilon Eridani: analogue to the young Solar System

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Dust emission around the nearby star ϵ Eridani has been imaged using a new submillimetre camera (SCUBA at the JCMT). At 850 μm wavelength a ring of dust is seen, peaking at 60 AU from the star and with much lower emission inside 30 AU. The mass of the ring is at least ~ 0.01 $M_\oplus$ in dust, while an upper limit of 0.4 $M_\oplus$ in molecular gas is imposed by CO observations. The total mass is comparable to the estimated amount of material, 0.04–0.3 $M_\oplus$, in comets orbiting the Solar System.

The most probable origin of the the ring structure is that it is a young analogue to the Kuiper Belt in our Solar System, and that the central region has been partially cleared by the formation of grains into planetesimals. Dust clearing around ϵ Eri is seen within the radius of Neptune's orbit, and the peak emission at 35–75 AU lies within the estimated Kuiper Belt zone of 30–100 AU radius. ϵ Eri is a main-sequence star of type K2V (0.8 $M_\odot$) with an estimated age of 0.5–1.0 Gyr, so this interpretation is consistent with the early history of the Solar System where heavy bombardment occurred up to ≈ 0.6 Gyr. An unexpected discovery is substructure within the ring, and these asymmetries could be due to perturbations by planets.

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A survey of molecular line emission towards ultracompact HII regions

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We have used the JCMT to survey molecular line emission towards 14 ultracompact HII regions (G5.89, G9.62, G10.30, G10.47, G12.21, G13.87, G29.96, G31.41, G34.26, G43.89, G45.12, G45.45, G45.47, and G75.78). For each source, we observed up to ten 1 GHz bands between 200 and 350 GHz, covering lines of more than 30 species including multiple transitions of CO isotopes, CH_3OH, CH_3CCH, CH_3CN and $HCOOCH_3$, and sulphuretted molecules. The number of transitions detected varied by a factor of 20 between sources, which were chosen following observations of high-excitation ammonia (Cesaroni et al. 1994a) and methyl cyanide (Olmi et al. 1993). In half our sample (the line-poor sources), only $C^{17}O$, $C^{18}O$, SO, $C^{34}S$ and CH_3OH were detected. In the line-rich sources, we detected over 150 lines, including high excitation lines of CH_3CN, $HCOOCH_3$, C_2H_5CN ,CH_3OH, and CH_3CCH. We have calculated the physical conditions of the molecular gas. To reproduce the emission from the line-rich sources requires both a hot, dense compact core and an ambient cloud consisting of less dense, cooler gas. The hot cores, which are less than 0.1 pc in size, reach densities of at least 10^8 cm^{-3} and temperatures of more than 80 K. The line-poor sources can be modelled without a hot core by a 20–30 K, 10^5 cm^{-3} cloud. We find no correlation between the size of the HII region and the current physical conditions in the molecular environment. A comparison with chemical models

(Millar et al. 1997) confirms that grain surface chemistry is important in hot cores.

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Sulphur chemistry and evolution in hot cores

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We compare the results of our JCMT spectral line survey of molecular gas towards ultracompact HII regions with the predictions of models of sulphur chemistry in hot cores. We investigate the range of evolutionary models that are consistent with the observed physical conditions and chemical abundances, and see to what extent it is possible to constrain core ages by comparing abundances with the predictions of chemical models. The observed abundance ratios vary little from source to source, suggesting that all the sources are at a similar evolutionary stage. The models are capable of predicting the observed abundances of H_2S, SO, SO_2, and CS. The models fail to predict the amount of OCS observed, suggesting that an alternative formation route is required. An initial H_2S abundance from grain mantle evaporation of $\sim 10^{-7}$ is preferred.

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Millimetre study of star formation in southern globules

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The paper presents the results of a dedicated millimetre continuum and molecular line (CO and CS) search for cold and dense (protostellar) cores and molecular outflows in 35 southern Bok globules (Dec.$<-30^o$). Only globules which are associated with cold *IRAS* point sources (FIR colour temperatures below 35 K) were selected for this study.

We could demonstrate that globules are often loosely associated with molecular cloud complexes from which they probably formed. Based on such associations, we determined reliable distances for most of the globules of our sample. It turned out that half of the selected globules are located in the local spiral arm at distances between 170 and 400 pc. The most prominent features in the spatial distribution of these globules are the Lindblad ring and the Vela-Gum complex. A group of 14 globules is located at larger distances (0.7 – 4 kpc) in the Carina arm. The objects in the far Carina arm ($d > 2$ kpc) are clearly different from "classical" Bok globules being more massive and more luminous.

Out of the 35 globules observed, all globules were detected in the ^{12}CO(2–1) line (detection rate 100%, $3\,\sigma$ detection limit 0.3 K), 24 globules were detected in the CS(2–1) line (69%, detection limit 0.2 K), and 18 globules were detected in the 1.3 mm continuum emission (51%, detection limit 40 mJy/beam). In 12 globules (34%), CO line wings indicating the presence of molecular outflows have been found, of which 8 outflows were previously unkown. The colours of the embedded *IRAS* point sources, the strength of the millimetre dust continuum emission, the CS line temperatures as well as the presence of molecular outflows are all well correlated with each other. Based on these results and on the *IRAS* colour-colour diagram, we can clearly distinguish two groups of sources: Objects with active protostellar cores ("Class 0" and "I") and globules with less dense and less centrally peaked cores (pre-protostellar cores and globules which may not form stars at all).

The objects with active protostellar cores are characterized by centrally condensed cores (typical beam-averaged density of $\approx 10^6$cm^{-3}) and molecular outflows. The mass spectrum dN/dM of the circum-protostellar envelopes can be fitted with a single slope of -1.8 between 0.15 and 2 M$_\odot$ and a mean mass of 0.6 M$_\odot$. Two objects in our sample clearly resemble the properties of "Class 0" protostars while the majority of the star-forming cores probably already passed the main accretion phase. Five of the colder and less-condensed objects are proposed to be pre-protostellar

cores.

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A Near Infrared Study of the NS 14 Bipolar Nebula

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In this fifth paper of a series on high-mass star formation, we continue our study with the bipolar nebula NS 14. We have imaged this nebula at J (1.23 μm), H (1.65 μm), and K (2.23 μm) broadband near infrared (NIR) wavelengths. We have also obtained 3.29 μm dust feature emission and $Br\gamma$ (n = 7→4, 2.166 μm) hydrogen recombination line emission images of this region. The broadband reflection nebulosity, surrounding a central 'Trapezium' of stars, forms a bipolar structure that is also seen in the 3.29μm dust feature emission. This dust feature emission exhibits limb brightening; therefore, small dust grains in the central regions of the bipolar structure have been evacuated. The $Br\gamma$ line emission consists of a compact component $\leq 2''$ in size and a more extended component $\sim 5'' \times 7''$ or larger in size. A study of the stellar population of the cluster, centered on the nebular emission, has also been made.

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http://kutath.phast.umass.edu/ ehwd/papers/papers.html)

350 μm Continuum Imaging of the Orion A Molecular Cloud with SHARC

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We have used the SHARC bolometer camera at the Caltech Submillimeter Observatory to map the distribution of the broad-band 350 μm continuum emission toward the Orion A Molecular Cloud. A comparison of the 350 μm flux densities in OMC-1 with previous 1100 μm measurements indicates a strong spatial variation of the grain emissivity exponent, β. The lowest value of the exponent ($\beta \simeq 1.75$) is found toward the Orion Bar photon dominated region (PDR), while the highest value ($\beta \simeq 2.5$) is found toward the Ridge north of IRc 2. This variation is consistent with the destruction of grain mantles by the UV photons from the Trapezium cluster. The observed spatial variation of β in OMC-1 suggests that the long-wavelength grain emissivity may also vary significantly in GMC cores on small linear scales ($\lesssim$0.5 pc), affecting H_2 column density and mass estimates. The 350 μm continuum emission in the Orion Bar region correlates well with the CO (6–5) peak brightness temperature and is shifted by $\sim 10''$ from the molecular component traced by the ^{13}CO (6–5) emission. This indicates that the 350 μm dust emission in this region originates predominantly in the outer high-temperature PDR layers. Several filamentary structures previously detected in molecular tracers are also seen in our map at flux levels comparable to those seen the Bar. Over 30 compact dust sources are detected in the OMC-2 and OMC-3 clouds, including a dozen sources not previously known. The average 350/1300 μm flux ratio based on our data and previous observations of this region (63 ± 19) indicates low dust temperatures (17 ± 4 K, assuming $\beta = 2$) for most of the sources. The brightest 350 μm source in OMC-3 has a low 350/1300 μm ratio (∼23), indicating a very low dust temperature (∼10 K), or a significant opacity at 350 μm (∼2.5). This source appears to be a deeply embedded and cold young protostar. A comparison of the mass estimate for the OMC-2/3 filament based on the 350 μm continuum emission with previous $C^{18}O$ mass estimates indicates a relatively high grain emissivity $Q(350) = 4 \times 10^{-4}$ in this region.

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ISO LWS Observations of a Cold GMC Core near the Galactic Center

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We have used the Long Wavelength Spectrometer aboard of the Infrared Space Observatory in the grating mode to map the far-infrared continuum emission between 45 and 175 μm toward the massive Giant Molecular Cloud core GCM0.25+0.11 located near the Galactic center. Gray-body models of the observed far-infrared spectral energy distribution indicate that the bulk of the dust in the diffuse component along the line of sight toward GCM0.25+0.11 has a mean temperature of ~26 K and a 100 μm optical depth of ~0.17. GCM0.25+0.11 is observed in emission at far-infrared wavelengths ($\gtrsim$100 μm). However at mid-infrared wavelengths ($\lesssim$70 μm) the core is seen in absorption against the general Galactic center background. This indicates that GCM0.25+0.11 is located in front of the bulk of the dust responsible for the diffuse FIR emission, most likely a few hundred pc from the Galactic center. By subtracting the spectrum of the diffuse component from the spectrum observed toward GCM0.25+0.11, we have been able to extract the intrinsic spectrum of this GMC core. Gray-body fits to the resulting far-infrared spectrum combined with our previous submillimeter measurements (350–800 μm) give a low temperature (~18 K) for the bulk of the dust in the GCM0.25+0.11 core. In addition, the grain emissivity in this core is a very steep function of frequency ($\nu^{2.8}$). The high grain emissivity exponent is consistent with the presence of dust grains covered with thick ice mantles. We have complemented our ISO data with CO (2–1) and HCO^+ (3–2) observations carried out with the Caltech Submillimeter Observatory. The molecular emission shows a large velocity gradient across the southern part of the core indicative of streaming motions of the gas or of the presence of multiple, spatially overlapping velocity components. The observed gas kinematics may indicate that the GCM0.25+0.11 core is in the process of being disrupted by the strong tidal forces caused by the high mass concentration in the Galactic center region. This might explain why GCM0.25+0.11 shows no evidence for ongoing high-mass star formation in spite of its large molecular mass. However, the mean H_2 density of GCM0.25+0.11 is well above the tidal stability limit for a galactocentric distance of a few hundred pc implied by our infrared observations. An alternative explanation is that we are witnessing the very early stage of a cloud-cloud collision that may result in a future star formation episode.

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IRAS 23385+6053: A Prototype Massive Class 0 Object

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IRAS 23385+6053 is a Young Stellar Object with luminosity $\sim 1.6 \times 10^4$ $L_\odot$ at a kinematic distance of 4.9 kpc. This candidate precursor of an ultracompact HII region is associated with a millimeter source detected at the JCMT but is undetected at centimeter wavelengths with the VLA. We observed this source with the OVRO millimeter array at 3.4 mm in the continuum, $HCO^+(1 \rightarrow 0)$, $H^{13}CO^+(1 \rightarrow 0)$ and SiO(v=0, $2 \rightarrow 1$) line emission, and with CAM aboard ISO at 6.75μm and 15μm. The IRAS source is coincident with a 3.4 mm compact ($r_{core} \simeq 0.048$ pc) and massive ($M \simeq 370$ $M_\odot$) core, which is undetected at 15μm to a 3σ level of 6 mJy; this is compatible with the derived H_2 column density of $\sim 2 \times 10^{24}$cm^{-2} and the estimated visual extinction A_V ~2000 mag. We find $L_{submm}/L_{bol} \sim 3 \times 10^{-3}$ and $M_{env}/M_\star \gg 1$, typical of Class 0 objects. The source is also associated with a compact outflow characterized by a size $\lesssim r_{core}$, a dynamical timescale of $\lesssim 7 \times 10^3$ years, and a mass loss rate $\dot{M} \gtrsim 10^{-3} M_\odot\,yr^{-1}$. The axis of the outflow is oriented nearly perpendicular to the plane of the sky, ruling out the possibility that the non-detection at 15 μm is the result of a geometric effect. All these properties suggest that IRAS 23385+6053 is the first example of a *bona fide* massive Class 0 object.

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http://spider.ipac.caltech.edu/staff/molinari/mol160_prep.ps (USA)
http://www.arcetri.astro.it/science/SF (Italy)

Carbon Monoxide Observations of the HH 135/136 Complex

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We report CO (J=2-1) and ^{13}CO (J=2-1) observations of the HH 135 and 136 complex, which has been mapped with the SEST radio telescope. The ^{13}CO (J=2-1) emission does not peak at the IRAS position but about 16" away from it, probably due to a displacement of the density peak caused by radiation-driven implosion. The mass estimate of the cloud core associated with the HH complex is some 150 $M_\odot$. The position-velocity diagram of the CO (J=2-1) line emission reveals high velocity wings in the vicinity of the power source IRAS 11101-5829. The redshifted and blueshifted CO wing emission overlaps spatially and show only a slight indication of bipolarity. This can be explained by a combination of a wide opening angle of the molecular outflow and the large beam size compared to its extent. In order to explain the complicated velocity structure reported for the optical outflow (Ogura and Walsh 1992), we propose a model in which the jetlike outflow from IRAS 11101-5829 is collisionally deflected by the cloud core. This view appears to be supported by the slight misalignment of HH 136 knots and a possible temperature enhancement around the suspected point of impact.

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SVS 16: The most X-ray luminous young stellar object

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We present new infrared and X-ray data on the optically invisible infrared source SVS 16 in the NGC 1333 star forming region. We show that SVS 16 is a binary with a separation of 1″. The infrared spectrum displays photospheric atomic and CO absorption lines, and thus shows that SVS 16 is a highly obscured ($A_V \sim 26$ mag) low mass young stellar object. Our infrared data allow us to derive basic stellar parameters of SVS 16. We find that the binary system probably consists of two M-type pre-main sequence stars, which seem to be younger than a few 10^5 yrs.

Our new ROSAT PSPC data confirm the previous detection with the ROSAT HRI and show that SVS 16 has an extremely high quiescent X-ray luminosity of about 2×10^{32} erg/sec in the $0.1 - 2.4$ keV band, making it the young stellar object with the brightest quiescent X-ray emission ever detected. We discuss the origin of the strong X-ray emission.

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http://www.astro.uni-wuerzburg.de/~preib/SVS16.html

Hierarchical Model for the Evolution of Cloud Complexes

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The structure of cloud complexes appears to be well described by a tree structure (i.e., a simplified "stick man") representation when the image is partitioned into "clouds". In this representation, the parent-child relationships are assigned according to containment. Based on this picture, a hierarchical model for the evolution of Cloud Complexes, including star formation, is constructed. The model follows the mass evolution of each sub-structure by computing its mass exchange with its parent and children. The parent-child mass exchange (evaporation or condensation) depends on the radiation density at the interphase. At the end of the "lineage", stars may be born or die; so that there is a non-stationary mass flow in the hierarchical structure. For a variety of parameter sets the system follow the same series of steps to transform diffuse gas into stars, and the regulation of the mass flux in the tree by previously formed stars dominates the evolution of the star formation. For the set of parameters used here as a reference model, the system tends to produce IMFs that have a maximum at too high mass ($\sim 2M_{\odot}$), and also the characteristic times for evolution seem too long. We show that these undesired properties can be improved by adjusting the model parameters. The model requires further physics (e.g. allowing for multiple stellar systems and clump collisions) before a definitive comparison with observations can be made. Instead, the emphasis here is to illustrate some general properties of this kind of complex nonlinear model for the star formation process. Notwithstanding the simplifications involved, the model reveals an essential feature that will likely remain if additional physical processes are included. That is: the detailed behavior of the system is very sensitive to the variations on the initial and external conditions, suggesting that a "universal" IMF is very unlikely. When an ensemble of IMFs corresponding to a variety of initial or external conditions is examined, the slope of the IMF at high masses shows variations comparable to the range derived from observational data. These facts suggest that the considered physical processes (phase transitions regulated by the radiation field) may play a role in the global evolution of molecular complexes.

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Clustering Properties of Stars in Simulations of Wind-Driven Star Formation

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Several recent observational studies have shown that the clustering of young stars in local star-forming regions, and of Cepheids in the LMC, can be described by a power law two-point correlation function. We show by numerical simulations that the observed range in power law slopes can be accounted for by a model in which stellar winds drive expanding shells that are subjected to nonlinear fluid advection and interactions with other shells, and in which star formation occurs when a threshold shell column density is exceeded. The models predict how the power law slope should depend on the maximum age of the stellar sample and the average star formation rate, although a number of effects preclude a comparison with currently-available data. We also show how stellar migration flattens the power law slope below a scale that depends on the velocity dispersion and age of the sample, an effect which may explain the secondary breaks in the observed correlation functions of some regions at large separations. Problems with using the correlation function as a descriptor of clustering structure for statistically inhomogeneous data sets are discussed.

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http://xxx.lanl.gov/

On the Density Probability Function of Galactic Gas. I. Numerical Simulations and the Significance of the Polytropic Index

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We investigate the form of the one-point probability density function (pdf) for the density field of the interstellar medium using numerical simulations that successively reduce the number of physical processes included. Two-dimensional simulations of self-gravitating supersonic MHD turbulence, of supersonic self-gravitating hydrodynamic turbulence, and of decaying Burgers turbulence, produce in all cases filamentary density structures and evidence for a power-law density pdf at large densities with logarithmic slope between -1.7 and -2.3. This suggests that a power-law shape of the pdf and the general filamentary morphology are the signature of the nonlinear advection operator.

These results do not support previous claims that the pdf is lognormal. A series of 1D simulations of forced supersonic polytropic turbulence is used to resolve the discrepancy. They suggest that the pdf is lognormal only for effective polytropic indices $\gamma = 1$ (or nearly lognormal for $\gamma \neq 1$ if the Mach number is sufficiently small), while power laws develop for densities larger than the mean if $\gamma < 1$. We evaluate the polytropic index for conditions relevant to the cool interstellar medium using published cooling functions and different heating sources, finding that a lognormal pdf should probably occur at densities around 10^3, and is possible at larger densities, depending strongly on the role of gas-grain heating and cooling.

Several applications are examined. First, we question a recent derivation of the IMF from the density pdf by Padoan, Nordlund & Jones because a) the pdf does not contain spatial information, and b) their derivation produces the most massive stars in the *voids* of the density distribution. Second, we illustrate how a distribution of ambient densities can alter the predicted form of the size distribution of expanding shells. Finally, a brief comparison is made with the density pdfs found in cosmological simulations.

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The Dynamic Decay of Young Few-Body Stellar Systems. I. The Effect of a Mass Spectrum for N = 3, 4, and 5

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We investigate the dynamic decay of nonhierarchical few-body systems, with an emphasis on applications to young stellar multiples formed by fragmenting cloud collapse. A chain regularization scheme is used to integrate orbits for 300 or more crossing times in order to guarantee that most systems are fully decayed. In this paper, we consider cases where the number N of point-mass stars is three, four, or five; and we explore effects of the stellar mass spectrum on the outcome in the low angular momentum limit. A novel classification scheme is introduced to identify the remnant decay products, including singles, binaries, and bound hierarchical multiples. The ensemble of final system configurations is then analysed to determine mass and escape speed distributions, and to characterize properties of the binary and triple stars formed during the decay. Some statistical features of the endstates can be understood analytically using well-known principles of few-body dynamics. Our results suggest observable signatures in and around star forming regions which would be expected if multiply fragmenting collapse is a common mode of star formation.

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Studies of Ultracompact HII Regions – II. High Resolution Radio Continuum and Methanol Maser Survey

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High spatial resolution radio continuum and 6.67 GHz methanol spectral line data are presented for methanol masers previously detected by Walsh et al. (1997). Methanol maser and/or radio continuum emission is found in 364 cases towards *IRAS* selected regions. Of those sources with methanol maser emission, relative positions have been obtained to an accuracy of typically 0.05 arcsec, with absolute positions accurate to around 1 arcsec. Maps of selected sources are provided. The intensity of the maser emission does not seem to depend on the presence of a continuum source. The coincidence of water and methanol maser positions in some regions suggests there is overlap in the requirements for methanol and water maser emission to be observable. However, there is a striking difference between the general proximity of methanol and water masers to both cometary and irregularly shaped UC HII regions, indicating that, in

other cases, there must be differing environments conducive to stimulating their emission. We show that the methanol maser is most likely present before an observable UC HII region is formed around a massive star and is quickly destroyed as the UC HII region evolves. There are 36 out of 97 maser sites that are linearly extended. The hypothesis that the maser emission is found in a circumstellar disk is not inconsistent with these 36 maser sites, but is unlikely. It cannot however account for all other maser sites. An alternative model which uses shocks to create the masing spots can more readily reproduce the maser spot distributions.

Accepted by MNRAS

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A Survey for Inward Motions in the Dense Gas around Young Stellar Clusters

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We report the results of a spectroscopic search for inward motions of the dense gas around 19 young stellar clusters. Single point observations of CS(2–1) and N_2H^+(1–0) were made using the Haystack 37 m telescope at 21″ resolution, and CS(2–1) and $C^{34}S$(2–1) maps were made using the FCRAO 14 m telescope at 50″ resolution. Strong, spatially extended, CS self-absorption is seen in Mon OB1-D, IRAS 20050+2720, and Cepheus A indicating that these sources are good candidates for followup observations of kinematic structure. In Cepheus A, in particular, we identify a region that shows inward motions over a region $\gtrsim 0.2$ pc in extent which suggests that models of core collapse should take into account the turbulent motions in these sources. We use the normalized velocity difference, $\delta v = [v(\mathrm{thick}) - v(\mathrm{thin})]/\Delta v(\mathrm{thin})$, between the optically thick (CS) and thin (N_2H^+ or $C^{34}S$) lines to quantify the relative motions between the forward and central layers of dense gas. The average value of this velocity difference is not significantly different from zero for either dataset and there is no correlation with the source bolometric temperature as determined from IRAS flux measurements. Thus this cluster sample has no significant excess of sources with inward motions, unlike the samples of individual YSOs recently reported by Gregerson et al. (1997) and Mardones et al. (1997). The lower incidence of high absolute values of δv in our sample can be attributed to a lower optical depth in the CS line due to the greater distance, and therefore poorer linear resolution, of the sources here, and to the higher kinetic and excitation temperatures in these more massive, cluster forming, environments.

Accepted by the Astrophysical Journal

Preprint available at: http://cfa–www.harvard.edu/∼jpw/papers.html

A Rotating Disk around A High-mass Young Star

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We report the discovery of a disk around a young high-mass star IRAS 20126+4104. In the NH_3 (1,1) and (2,2) lines, we detected a flattened disk-like structure ($6'' \times 3''$ or 10000×5000 AU) roughly perpendicular to a bipolar molecular outflow. Along the major axis of the disk exists a velocity gradient. The disk rotates faster toward the center. Our findings provide direct verification that disks exist during the formation of high-mass stars.

Accepted by ApJ *Letters*

Preprint: *http://cfa-www.harvard.edu/~ qzhang.*

New Books

Star Formation - Near and Far

Seventh Astrophysics Conference, College Park, Maryland

Editors Stephen S. Holt and Lee G. Mundy

The book is divided into the following 10 sections:

1. **Introduction to star formation**
2. **Close-up views of star formation**
3. **Circumstellar disks**
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6. **Multiple star systems**
7. **Galactic star formation**
8. **Star formation history in spirals**
9. **Star formation history in ellipticals**
10. **Star formation history in irregulars and dwarf spheroidals**

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Current issues in star formation *J. Silk*
The fourth day of creation: The search for a history of star formation *V. Trimble*
Early star formation *P.C. Myers*
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Observations of circumstellar disks and infall *L.G. Mundy*
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Formation of low mass stars and brown dwarfs *D.N.C. Lin*
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Mergers, interactions, and the fueling of starbursts *J.E. Hibbard*
Starbursts and cosmogony *T.M. Heckman*
Accretion in pre-main sequence binaries *R.D. Mathieu*
Star formation in clusters *C.J. Clarke*
The initial mass function: now and then *H.B. Richer & G.G. Fahlman*
Observations of the extragalactic initial mass function and modes of star formation *S.R. Heap*
Controlling factors for global star formation *E.D. Skillman*
Cosmic star formation history *P. Madau*
Star formation history of elliptical galaxies from low-redshift evidence *G. Worthey*
Star formation history in irregular galaxies *D. Hatzidimitriou*
The star formation histories of dwarf spheroidal galaxies *T.A. Smecker-Hane*
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Accretion Processes in Astrophysical Systems - Some like it hot!

Eight Astrophysics Conference College Park, Maryland

Editors Stephen S. Holt & Timothy R. Kallman

The book contains the following 7 sections:

1. **Introductory overviews**
2. **Physical processes (theory)**
3. **Global disk structure (theory)**
4. **Active galactic nuclei**
5. **Neutron stars and galactic black holes**
6. **Cataclysmic variables**
7. **Stars**

The following is a selection among the principal articles:

Astrophysical accretion: The approach to the irrationality horizon *V. Trimble*
Hot accretion flows - Key issues *R. Narayan*
Introduction to the theory of black hole accretion disks *M.A. Abramowicz*
The connection between jets and accretion discs *R.D. Blandford*
Dynamics on the edge : Star-disk interaction *J.M. Stone*
Turbulent transport in accretion disks *S.A. Balbus & J.F. Hawley*
Modeling X/γ-ray spectra of galactic black holes and Seyferts *J. Poutanen*
Numerical models of accretion disks *C.F. Gammie*
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The Star Formation Newsletter is available on the World Wide Web, where you can access it via the ESO Portal (http://http.hq.eso.org/eso-homepage.html). You can also access it through the University of Massachusetts Astronomy World Wide Web server, the URL for its home page is http://www-astro.phast.umass.edu/

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12–14 October, 1998

Hosted by the Max-Planck-Institut für Astronomie Heidelberg, Germany.

The aim of this meeting is to bring together scientists working in the fields of star and planet formation to gather and discuss their latest research and potential collaborations. The meeting is primarily aimed at European scientists, however, scientists from outside Europe are also very welcome to attend.

Topics to be covered include:

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Jets, outflows and accretion discs.
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Scientific Program:
The scientific programme will include 12 invited talks, one from each of the ESFON Core Institutions, 16 - 20 short talks by individual participants, and poster papers. The invited talks will review the latest results and current research programs at the Core Institutions in the fields of star and planet formation. The short talks will be selected from abstracts submitted with the registration forms. The deadline for submitting an abstract which will be considered for a short talk is September 15, 1998.

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