THE STAR FORMATION NEWSLETTER

An electronic publication dedicated to early stellar evolution and molecular clouds

No. 169 — 23 November 2006 Editor: Bo Reipurth (reipurth@ifa.hawaii.edu)

Abstracts of recently accepted papers

Characterizing Young Brown Dwarfs using Low Resolution Near-IR Spectra

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We present near-infrared (1.0–2.4 μm) spectra confirming the youth and cool effective temperatures of 6 brown dwarfs and low mass stars with circumstellar disks toward the Chamaeleon II and Ophiuchus star forming regions. The spectrum of one of our objects indicates that it has a spectral type of ~L1, making it one of the latest spectral type young brown dwarfs identified to date. Comparing spectra of young brown dwarfs, field dwarfs, and giant stars, we define a 1.49–1.56 μm H_2O index capable of determining spectral type to ±1 sub-type, independent of gravity. We have also defined an index based on the 1.14 μm sodium feature that is sensitive to gravity, but only weakly dependent on spectral type for field dwarfs. Our 1.14 μm Na index can be used to distinguish young cluster members ($\tau < 5$ Myr) from young field dwarfs, both of which may have the triangular H-band continuum shape which persists for at least tens of Myr. Using T_{eff}'s determined from the spectral types of our objects along with luminosities derived from near and mid-infrared photometry, we place our objects on the H-R diagram and overlay evolutionary models to estimate the masses and ages of our young sources. Three of our sources have inferred ages ($\tau \simeq$10–30 Myr) significantly older than the median stellar age of their parent clouds (1–3 Myr). For these three objects, we derive masses ~3 times greater than expected for 1–3 Myr old brown dwarfs with the bolometric luminosities of our sources. The large discrepancies in the inferred masses and ages determined using two separate, yet reasonable methods, emphasize the need for caution when deriving or exploiting brown dwarf mass and age estimates.

Accepted by ApJ

http://arxiv.org/abs/astro-ph/0611408

XMM-Newton survey of two upper Scorpius regions

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Aims. We studied X-ray emission from young stars by analyzing the deep XMM-Newton observations of two regions of the Upper Scorpius association with an age of 5 Myr.

Methods. Based on near infrared and optical photometry we identified 22 Upper Scorpius photometric members among the 224 detected X-ray sources. We derived coronal properties of Upper Scorpius stars by performing X-ray spectral and timing analyses. The study of four strong and isolated stellar flares allowed us to derive the length of the flaring loops.

Results. Among the 22 Upper Scorpius stars, 13 were identified as Upper Scorpius photometric members for the first time. The sample includes 7 weak-line T Tauri stars and 1 classical T Tauri star, while the nature of the remaining sources is unknown. Except for the intermediate mass star HD 142578, all the detected USco sources are low-mass stars of spectral types ranging from G to late M. The X-ray emission spectrum of the most intense Upper Scorpius sources indicates metal depleted plasma with temperature of $\sim$ 10 MK, resembling the typical coronal emission of active main sequence stars. At least 59% of the detected members of the association have variable X-ray emission, and the flaring coronal structures appear shorter than or comparable to the stellar radii already at the Upper Scorpius age. We also found indications of increasing plasma metallicity (up to a factor 20) during strong flares. We identified a new galaxy cluster among the 224 X-ray source detected: the X-ray spectrum of its intra cluster medium indicates a redshift of $\sim 0.41 \pm 0.02$.

Published by Astronomy & Astrophysics (Vol. 459, p. 199)

Pre-main sequence stars in the Lagoon Nebula (M8)

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We report the discovery of new pre-main sequence (PMS) stars in the Lagoon Nebula (M8) at a distance of 1.25 kpc, based on intermediate resolution spectra obtained with the Boller & Chivens spectrograph at the 6.5-m Magellan I telescope (Las Campanas Observatory, Chile). According to the spectral types, the presence of emission lines and the lithium 6708Å absorption line, we are able to identify 27 classical T Tauri stars, 7 weak-lined T Tauri stars and 3 PMS emission objects with spectral type G, which we include in a separated stellar class denominated "PMS Fe/Ge class". Using near-infrared photometry either from 2MASS or from our own previous work we derive effective temperatures and luminosities for these stars and locate them in the Hertzsprung-Russell diagram, in order to estimate their masses and ages. We find that almost all of our sample stars are younger than 3×10^6 years and span over a range of masses between 0.8 and 2.5 $M_\odot$. A cross-correlation between our spectroscopic data and the X-ray sources detected with the Chandra ACIS instrument is also presented.

Accepted by Monthly Notices of the Royal Astronomical Society

http://arXiv.org/abs/astro-ph/0611150

Remarks on Rapid vs. Slow Star Formation

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We discuss problems with some observational estimates indicating long protostellar core lifetimes and large stellar age spreads in molecular clouds. We also point out some additional observational constraints which suggest that protostellar cores do not have long lifetimes before collapsing. For external galaxies, we argue that the widths of spiral arms does not imply a long star-formation process, since the formation of massive stars will disrupt molecular clouds, move material around, compress it in other regions which produce new star-forming clouds. Thus, it seems unavoidable that this cyclical process will result in an extended period of enhanced star formation, which does not represent the survival time of any individual molecular cloud. We argue that the rapid star formation indicated observationally is

also easier to understand theoretically than the traditional scenario of slow quasi-static contraction with ambipolar diffusion.

Accepted by Rev. Mex. Astron. Astrophys.

http://arxiv.org/abs/astro-ph/0605268

Deep Imaging Surveys of Star-forming Clouds. IV. The Meek and the Mighty: Outflows from Young Stars in Chamaeleon I

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We present a survey of shocks and outflows in the Chamaeleon I star-forming complex using Hα, [S II], and SDSS i' images obtained from the ground, an i' image obtained with the Hubble Space Telescope, and 4.5μm images obtained with the Infrared Array Camera (IRAC) on the Spitzer Space Telescope. We find new Herbig-Haro (HH) objects and extensions to the previously cataloged shocks that trace parts of at least 20 distinct outflows from young stars. Some HH objects mark the presence of giant outflows, the largest of which is powered by Cha-MMS1 and associated with HH 49/50 near the Ced 110 region. Other large flows are powered by Cha-MMS2 in the Ced 112 region and the IRN in the Ced 111 region. Although some shocks exhibit infrared emission in the IRAC bands, most notably HH 49/50 (the "tornado"), most outflows in the Cha I clouds are not detected in the Spitzer IRAC bands. This result is consistent with the general lack of extensive 2.12μm H_2 emission from Cha I.

Published by The Astronomical Journal (Vol. 132, p. 1923)

Gas-Phase Study of Coronene Cation Reactivity of Interstellar Relevance

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Recent research suggests that cations of polycyclic aromatic hydrocarbons (PAHs) may be responsible for the observed diffuse interstellar bands. Determining the reaction rate constants and reactivity trends of these ions with species relevant to the interstellar medium will help lead the search for specific diffuse interstellar band carriers and develop pathways for their transformation. This Letter presents the gas-phase ion-neutral reaction rate constants of a specific PAH cation, the parent molecular cation of coronene ($C_{24}H_{12}^+$), with H atom, N atom, O atom, and H_2, and discusses the reactivity trends of PAH cations of increasing size with these small interstellar species. This study examines the kinetics of the largest PAH cation to date. These experiments were carried out using a flowing afterglow-selected ion flow tube coupled to a quadrupole mass spectrometer. The reaction rate constants of the coronene cation with H atom, O atom, N atom, and H_2 have been measured to be 1.4×10^{-10}, 1.3×10^{-10}, $< 1 \times 10^{-12}$, and $< 5 \times 10^{-13}$ cm^3 s^{-1}, respectively.

Published by The Astrophysical Journal Letters (Vol. 651, p. L129)

Infrared Spectroscopy of the Ultra Low Mass Binary Oph 162225-240515

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Binary properties are an important diagnostic of the star and brown dwarf formation processes. While wide binaries appear to be rare in the sub-stellar regime, recent observations have revealed Ophiuchus 162225-240515 (2MASS J16222521-2405139) as a likely young ultra-low-mass binary with an apparent separation of ≈240 AU. Here, we present low-resolution near-infrared spectra of the pair from NTT/SOFI ($R \sim 600$) and VLT/ISAAC ($R \sim 1400$), covering the 1.0–2.5 μm spectral region. By comparing to model atmospheres from Chabrier & Baraffe and Burrows et al., we confirm the surface temperatures to be $T_{\rm A} = (2350 \pm 150)$ K and $T_{\rm B} = (2100 \pm 100)$ K for the two components of the binary, consistent with earlier estimates from optical spectra. Using gravity sensitive K I features, we find the surface gravity to be significantly lower than field dwarfs of the same spectral type, providing the best evidence so far that these objects are indeed young. However, we find that models are not sufficiently reliable to infer accurate ages/masses from surface gravity. Instead, we derive masses of $M_{\rm A} = 13^{+8}_{-4}\,{\rm M_J}$ and $M_{\rm B} = 10^{+5}_{-4}\,{\rm M_J}$ for the two objects using the well-constrained temperatures and assuming an age of 1–10 Myr, consistent with the full range of ages reported for the Oph region.

Accepted by ApJ Letters

http://arxiv.org/astro-ph/0610601

Structure and dynamics of the class I young stellar object L1489 IRS

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We investigate the velocity transition in the low-mass protostar L1489 IRS, which is known to be embedded in a flattened, disc-like structure that shows both infall and rotation. We construct a model for L1489 IRS consisting of an flattened envelope and a velocity field that can vary from pure infall to pure rotation. We obtain best-fit parameters by comparison to 24 molecular transitions from the literature, and using a molecular excitation code and a Voronoi optimisation algorithm. We test the model against existing millimeter interferometric observations, near-infrared scattered light imaging, and 12CO ro-vibrational lines.We find that L1489 IRS is well described by a central stellar mass of $1.3 M_\odot$ surrounded by a $0.10 M_\odot$ flattened envelope with approximate scale height $h \approx 0.57R$, inclined at 74°. The velocity field is strongly dominated by rotation, with the velocity vector making an angle of 15° with the azimuthal direction. Reproducing low-excitation transitions requires that the emission and absorption by the starless core 1' (8400 AU) east of L1489 IRS is included properly, implying that L1489 IRS is located partially behind this core. We speculate that L1489 IRS was originally formed closer to the center of this core, but has migrated to its current position over the past few times 10^5 yr, consistent with their radial velocity difference of 0.4 kms-1. This suggests that L1489 IRS' unusual appearance may be result of its migration, and that it would appear as a 'normal' embedded protostar if it were still surrounded by an extended cloud core. Conversely, we hypothesize that the inner envelopes of embedded protostars resemble the rotating structure seen around L1489 IRS.

Accepted by A&A

http://arxiv.org/abs/astro-ph/0610672

Observations of chemical differentiation in clumpy molecular clouds

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We have extensively mapped a sample of dense molecular clouds in HC_3N, CH_3OH, SO and $C^{18}O$. We demonstrate that a high degree of chemical differentiation is present in all of the observed clouds. We analyse the molecular maps for each cloud, demonstrating a systematic chemical differentiation across the sample, which we relate to the evolutionary state of the cloud. We relate our observations to the cloud physical, kinematical and evolutionary properties, and also compare them to the predictions of simple chemical models. The implications of this work for understanding the origin of the clumpy structures and chemical differentiation observed in dense clouds are discussed.

Accepted by Faraday Discuss., 2006, 63 - 82

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The magnetic field of the pre-main sequence Herbig Ae star HD 190073

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The general context of this paper is the study of magnetic fields in the pre-main sequence intermediate mass Herbig Ae/Be stars. Magnetic fields are likely to play an important role in pre-main sequence evolution at these masses, in particular in controlling the gains and losses of stellar angular momentum. The particular aim of this paper is to announce the detection of a structured magnetic field in the Herbig Ae star HD 190073, and to discuss various scenarii for the geometry of the star, its environment and its magnetic field. We have used the ESPaDOnS spectropolarimeter at CFHT in 2005 and 2006 to obtain high-resolution and signal-to-noise circular polarization spectra which demonstrate unambiguously the presence of a magnetic field in the photosphere of this star. Nine circular polarization spectra were obtained, each one showing a clear Zeeman signature. This signature is suggestive of a magnetic field structured on large scales. The signature, which corresponds to a longitudinal magnetic field of 74 ± 10 G, does not vary detectably on a one-year timeframe, **indicating either an azimuthally symmetric field**, a zero inclination angle between the rotation axis and the line of sight, or a very long rotation period. The optical spectrum of HD 190073 exhibits a large number of emission lines. We discuss the formation of these emission lines in the framework of a model involving a turbulent heated region at the base of the stellar wind, possibly powered by magnetic accretion. This magnetic detection brings an important element for our understanding of stellar magnetism at intermediate masses.

Accepted by Astronomy & Astrophysics

http://arxiv.org/format/astro-ph/0610499

A High-Latitude Molecular Structure in Pegasus-Pisces

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We detected CO emission from a shell-like or ringlike dust structure approximately 20° across centered near Galactic coordinates ($l = 105°$, $b = -45°$). This region was also observed in CO by Yamamoto et al. A total of 106 positions along the ridge of the feature were observed in the CO(1-0) and (2-1) transitions with the Arizona Radio Observatory 12 m millimeter-wave radio telescope at Kitt Peak, Arizona. Emission was detected from 65 lines of sight, plus three with two distinct velocity components. Although the dust emission shows a marked ringlike morphology, the kinematic information from the CO spectra is more ambiguous. The best χ^2 fits for two models, an expanding spherical shell and an expanding ring of molecular gas embedded in a sheet of neutral gas, suggest that, at best, only part of the

CO emission is associated with an expanding structure. The remaining CO detections are projected onto a stream of neutral hydrogen where CO unrelated to the shell may also have formed. However, if at least part of the CO emission is associated with an expanding shell or ring of molecular gas, the structure has an expansion velocity of 3.8 km s^{-1}, a molecular mass of 1200-1300 $M_{\odot}$, and an age of $\sim 1 \times 10^7$ yr.

Published by The Astronomical Journal (Vol. 132, p. 1964)

654 GHz Continuum and $C^{18}O$ $(6-5)$ Observations of G240.31+0.07 with the Submillimeter Array

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We report a dual-band observation at 223 and 654 GHz (460 μm) toward an ultracompact (UC) H II region, G240.31+0.07, with the Submillimeter Array. With a beam size of $1''.5 \times 0''.8$, the dust continuum emission is resolved into two clumps, with clump A coincident well with an H_2O maser and the UC H II region. The newly discovered clump, B, about $1''.3$ ($\simeq 8.3 \times 10^3$ AU) to the southwest of clump A, is also associated with H_2O masers and may be a more recent star-forming site. The continuum flux densities imply an opacity spectral index of $\beta = 1.5 \pm 0.3$, suggestive of a value lower than the canonical 2.0 found in the interstellar medium and in cold, massive cores. The presence of hot ($\simeq 100$ K) molecular gas is derived by the brightness ratio of two H_2CO lines in the 223 GHz band. A radial velocity difference of 2.5 ± 0.4 km s^{-1} is found between the two clumps in $C^{18}O$ $(6-5)$ emission. The total (nebular and stellar) mass of roughly 58 $M_{\odot}$ in the central region is close to, but not by far larger than, the minimum mass required for the two clumps to be gravitationally bound for binary rotation. Our continuum data do not suggest a large amount of matter associated with the H_2 knots that were previously proposed to arise from a massive disk or envelope.

Accepted by The Astrophysical Journal Letters

http://xxx.lanl.gov/abs/astro-ph/0611366

Clumpy and fractal shocks, and the generation of a velocity dispersion in molecular clouds

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We present an alternative explanation for the nature of turbulence in molecular clouds. Often associated with classical models of turbulence, we instead interpret the observed gas dynamics as random motions, induced when clumpy gas is subject to a shock. From simulations of shocks, we show that a supersonic velocity dispersion occurs in the shocked gas provided the initial distribution of gas is sufficiently non-uniform. We investigate the velocity size-scale relation $\sigma \propto r^{\alpha}$ for simulations of clumpy and fractal gas, and show that clumpy shocks can produce realistic velocity size-scale relations with mean $\alpha \sim 0.5$. For a fractal distribution, with a fractal dimension of 2.2 similar to what is observed in the ISM, we find $\sigma \propto r^{0.4}$. The form of the velocity size-scale relation can be understood as due to mass loading, i.e. the post-shock velocity of the gas is determined by the amount of mass encountered as the gas enters the shock. We support this hypothesis with analytical calculations of the velocity dispersion relation for different initial distributions. A prediction of this model is that the line-of sight velocity dispersion

should depend on the angle at which the shocked gas is viewed.

Accepted by MNRAS

astro-ph/0610720

Spectrally Dispersed K-Band Interferometric Observations of Herbig Ae/Be Sources: Inner Disk Temperature Profiles

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We use spectrally dispersed near-IR interferometry data to constrain the temperature profiles of sub-AU-sized regions of 11 Herbig Ae/Be sources. We find that a single-temperature ring does not reproduce the data well. Rather, models incorporating radial temperature gradients are preferred. These gradients may arise in a dusty disk, or may reflect separate gas and dust components with different temperatures and spatial distributions. Comparison of our models with broadband spectral energy distributions suggests the latter explanation. The data support the view that the near-IR emission of Herbig Ae/Be sources arises from hot circumstellar dust and gas in sub-AU-sized disk regions. Intriguingly, our derived temperature gradients appear systematically steeper for disks around higher mass stars. It is not clear, however, whether this reflects trends in relative dust/gas contributions or gradients within individual components.

Accepted by ApJ

http://xxx.lanl.gov/abs/astro-ph/0611447

Spectrally Dispersed K-Band Interferometric Observations of Herbig Ae/Be Sources: Inner Disk Temperature Profiles

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Accepted by ApJ

http://xxx.lanl.gov/abs/astro-ph/0611447

Enhanced Cosmic Ray Flux and Ionization for Star Formation in Molecular Clouds Interacting with Supernova Remnants

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Molecular clouds interacting with supernova remnants may be subject to a greatly enhanced irradiation by cosmic rays produced at the shocked interface between the ejecta and the molecular gas. Over the past decade, broad-band observations have provided important clues about these relativistic particles and indicate that they may dominate over the locally observed cosmic-ray population by a significant amount. In this paper, we estimate the enhancement and find that the cosmic ray energy density can be up to ∼1000 times larger in the molecular cloud than in the field. This enhancement can last for a few Myr and leads to a corresponding increase in the ionization fraction, which has important consequences for star formation. Ionization fractions in molecular cloud cores determine, in part, the rate of ambipolar diffusion, an important process in core formation and pre-collapse evolution. Ionization fractions in newly formed circumstellar disks affect the magneto-rotational instability mechanism, which in turn affects the rate of disk accretion. As estimated here, the increased ionization acts to increase the ambipolar diffusion time by a factor of ~ 30 and thereby suppresses star formation. In contrast, the increased ionization fraction reduces the sizes of dead zones in accretion disks (by up to an order of magnitude) and thus increases disk accretion rates (by a comparable factor).

Accepted by Astrophysical Journal Letters

astro-ph/0611023

Spectral properties of X-ray bright variable sources in the Taurus Molecular Cloud

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Aims. We analyze 19 bright variable X-ray sources detected in the *XMM-Newton Extended Survey of the Taurus Molecular Cloud* (XEST), in order to characterize the variations with time of their coronal properties and to derive informations on the X-ray emitting structures.
Methods. We performed time-resolved spectroscopy of the EPIC PN and MOS spectra of the XEST sources, using a model with one or two thermal components, and we used the time evolution of the temperatures and emission measures during the decay phase of flares to derive the size of the flaring loops.
Results. The light curves of the selected sources show different types of variability: flares, long-lasting decay or rise through the whole observation, slow modulation or complex flare-like variability. Spectral analysis shows typical quiescent plasma temperatures of $\sim 5-10$ MK and $\sim 15-35$ MK; the cool component generally remains constant, while the observed flux changes are due to variations of the hot component. During flares the plasma reaches temperatures up to 100 MK and luminosities up to $\sim 10^{31}$ erg s^{-1}. Loop sizes inferred from flare analysis are generally smaller than or comparable to the stellar radius.

Accepted by A&A, to appear in a special section/issue dedicated to the XMM-Newton Extended Survey of the Taurus Molecular Cloud (XEST)

http://www.issibern.ch/teams/Taurus/papers.html or http://www.astropa.unipa.it/~francio/papers.html

A Multiwavelength Study of Young Massive Star-forming Regions. I. The Ionized Gas Content

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We present multifrequency radio continuum observations, made with ATCA, of a sample of 15 southern hemisphere luminous IRAS point sources, all with colors typical of compact H II regions and associated with CS (2-1) emission. The sources were observed at 1.4, 2.5, 4.8, and 8.6 GHz with angular resolutions of about 7″, 4″, 2″, and 1″, respectively. Radio emission was detected toward 14 objects. Nine IRAS objects are associated with single regions of ionized gas with simple morphologies; three are associated with two regions of ionized gas, each of which also shows simple morphologies, and two are associated with regions of ionized gas that have complex structure. The H II regions with simple morphologies have linear diameters in the range 0.011-0.9 pc and electron densities in the range 10^3-10^5 cm^{-3} and are excited by stars with luminosities in the range 9×10^3-2×10^5 $L_\odot$. We find that the H II regions in our sample, most of which lie at the center of massive and dense molecular cores with H_2 densities of $\sim 4 \times 10^5$ cm^{-3} and line widths of ~ 3 km s^{-1}, are excited by stars with an output of UV photons of typically $\leq 3 \times 10^{48}$ s^{-1}. Under these conditions the regions of ionized gas reach pressure equilibrium with the dense molecular surroundings in only $\sim 5 \times 10^3$ yr. We conclude that the main mechanism of confinement of the compact H II regions in our sample is provided by the high density and large turbulent pressure of the surrounding molecular gas; therefore, their age can be much longer than their dynamical timescale. If the objects in our sample are representative of the Galactic IRAS sources with colors of compact H II regions, then the problem with the large rate of massive star formation in the Galaxy might be solved.

Published by The Astrophysical Journal (Vol. 651, p. 914)

Velocity Structure in the Orion Nebula. I. Spectral Mapping in Low-Ionization Lines

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High-dispersion echelle spectroscopy in optical forbidden lines of O^0, S^+, and S^{2+} is used to construct velocity-resolved images and electron density maps of the inner region of the Orion nebula with a resolution of 10 km s^{-1} $\times 3'' \times 2''$. Among the objects and regions newly discovered in this study are (1) the Diffuse Blue Layer: an extended layer of moderately blue-shifted, low-density, low-ionization emission in the southeast region of the nebula; (2) the Red Bay: a region to the east of the Trapezium where the usual correlation between velocity and ionization potential is very weak, and where the emitting layer is very thick; and (3) HH 873: a new redshifted jet to the southwest of the Trapezium.

Accepted by Astronomical Journal

http://www.ifront.org/wiki/Spectral_Mapping_Paper_I or http://arxiv.org/abs/astro-ph/0611417

Associations of water and methanol masers at milli-arcsec angular resolution in two high-mass YSOs

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Most previous high-angular (< 0.1 arcsec) resolution studies of molecular masers in high-mass star forming regions (SFRs) have concentrated mainly on either water or methanol masers. While high-angular resolution observations have clarified that water masers originate from shocks associated with protostellar jets, different environments have been proposed in several sources to explain the origin of methanol masers. Tha aim of the paper is to investigate the nature of the methanol maser birthplace in SFRs and the association between the water and methanol maser emission in the same young stellar object. We have conducted phase-reference Very Long Baseline Interferometry (VLBI) observations of water and methanol masers toward two high-mass SFRs, Sh 2-255 IR and AFGL 5142. In Sh 2-255 IR water masers are aligned along a direction close to the orientation of the molecular outflow observed on angular scales of 1-10 arcsec, tracing possibly the disk-wind emerging from the disk atmosphere. In AFGL 5142 water masers trace expansion at the base of a protostellar jet, whilst methanol masers are more probably tracing infalling than outflowing gas. The results for AFGL 5142 suggest that water and methanol masers trace different kinematic structures in the circumstellar gas.

Accepted by Astronomy and Astrophysics

http://fr.arxiv.org/abs/astro-ph/0610482

HST/NICMOS Observations of NGC 1333: The Ratio of Stars to Sub-Stellar Objects

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We present an analysis of NICMOS photometry and low-resolution grism spectroscopy of low-mass stars and sub-stellar objects in the young star-forming region NGC 1333. Our goal is to constrain the ratio of low-mass stars to sub-stellar objects down to 20 M_{Jup} in the cluster as well as constrain the cluster IMF down to 30 M_{Jup} in combination with a previous survey of NGC 1333 by Wilking et al. Our survey covers 4 fields of 51.2" x 51.2", centered on brown dwarf candidates previously identified in Wilking et al. We extend previous work based on the use of a water vapor index for spectral typing to wavelengths accessible with NICMOS on the HST. Spectral types were derived for the 14 brightest objects in our fields, ranging from ≤M0 - M8, which at the age of the cluster (0.3 Myr) corresponds to a range in mass of ≥0.25 - 0.02 $M_\odot$. In addition to the spectra, we present an analysis of the color-magnitude diagram using pre-main sequence evolutionary models of D'Antona & Mazzitelli. Using an extinction-limited sample, we derive the ratio of low-mass stars to brown dwarfs. Comparisons of the observed ratio to that expected from the field IMF of Chabrier indicate that the two results are consistent. We combine our data with that of Wilking et al. to compute the ratio of intermediate-mass stars (0.1 - 1.0 $M_\odot$) to low-mass objects (0.03 - 0.1 $M_\odot$) in the cluster. We also report the discovery of a faint companion to the previously confirmed brown dwarf ASR 28, as well as a possible outflow surrounding ASR 16. If the faint companion is confirmed as a cluster member, it would have a mass of $\approx$ 5 M_{Jup} (mass ratio 0.15) at a projected distance of 350 AU, similar to 2MASS 1207-3923 B.

Accepted by Astronomical Journal

http://arxiv.org/abs/astro-ph/0611501

Trapping of the HII and Photodissociation Region in a Radially Stratified Molecular Cloud

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Aims: We study the expansion of the ionization and dissociation fronts (DFs) in a radially stratified molecular cloud, whose density distribution is represented as $n(r) \propto r^{-w}$. We focus on cases with $w \leq 1.5$, when the ionization front is "trapped" in the cloud and expands with the preceding shock front. The simultaneous evolution of the outer photodissociation region (PDR) is examined in detail.
Methods: First, we analytically probe the time evolution of the column densities of the shell and envelope outside the HII region, which are key physical quantities for the shielding of dissociating photons. Next, we perform numerical calculations, and study how the thermal/chemical structure of the outer PDR changes with different density gradients. We apply our numerical model to the Galactic HII region, Sharpless 219 (Sh219).
Results: The time evolution of the column densities of the shell and outer envelope depends on w, and qualitatively changes across $w = 1$. In the cloud with $w < 1$, the shell column density increases as the HII region expands. The DFs are finally trapped in the shell, and the molecular gas gradually accumulates in the shell. The molecular shell and envelope surround the HII region. With $w > 1$, on the other hand, the shell column density initially increases, but finally decreases. The column density of the outer envelope also quickly decreases as the HII region swells up. It becomes easier and easier for the dissociating photons to penetrate the shell and envelope. The PDR broadly extends around the trapped HII region. A model with $w = 1.5$ successfully explains the observational properties of Sh219. Our model suggests that a density-bounded PDR surrounds the photon-bounded HII region in Sh219.

Accepted by A&A

astro-ph/0610615

A study of the magnetic field in the photospheric and circumstellar components of Herbig Ae stars

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We intend to investigate separately the photospheric and circumstellar (CS) magnetic field components in seven Herbig Ae stars.

The study is based on low-resolution ($R \sim 2000$ and 4000) spectropolarimetric data collected from 2003 to 2005 at the Very Large Telescope (ESO, Chile) with the multi-mode instrument FORS1.

We show that the spectropolarimetric results strongly depend on the level of CS contribution to the stellar spectra. We have improved the determination accuracy of magnetic fields up to the 7σ level in the two Herbig Ae stars HD 139614 and HD 144432, observed in 2005 when these objects were at a low level state of their CS activity. We have established that at a higher level state of CS activity the polarisation signatures are related mainly to the CS matter. The presence of CS polarisation signatures formed in the stellar wind supports the assumption that the magnetic centrifuge is a principal mechanism of wind acceleration.

We conclude that the most effective way to investigate the magnetism of Herbig Ae stars is to monitor their spectropolarimetric behaviour at different states of CS activity. Obviously, higher resolution spectropolarimetric observations would extend the sample of spectral lines to be used for the measurements of magnetic fields at different levels in the stellar atmosphere and CS envelope. Such observations will give a more complete insight into the magnetic topology in Herbig Ae stars.

Accepted by A&A

http://arxiv.org/abs/astro-ph/0610439

On the Origin of HD 149026b

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The high density of the recently discovered close-in extrasolar planet HD 149026b suggests the presence of a huge core in its interior, which challenges planet formation theory. We first derive constraints on the total mass of heavy elements in the planet and find its preferred value is 50-80 $M_\oplus$. We then explore the possibility of the formation of HD 149026b through subcritical core accretion as envisioned for Uranus and Neptune, and find the subcritical accretion scenario is very unlikely in the case of HD 149026b for at least two reasons: (1) subcritical planets are such that the ratio of their core mass to their total mass is above ~ 0.7, in contradiction with constraints for all but the most extreme interior models of HD 149026b and (2) high accretion rates and large isolation mass required for the formation of a subcritical > 50 $M_\oplus$ core are possible only at specific orbital distances in a disk with a surface density of dust equal to at least 30 times that of the minimum-mass solar nebula. These facts point toward two main routes for the formation of HD 149026b: (i) gas accretion limited by a slow viscous inflow in an evaporating disk or (ii) a significant modification of the planetary composition after gas accretion ended. Illustrating the second route, we show that collision between two gas giants leads to a substantial loss of the gas component and thus may make the planet highly enriched in heavy elements. Alternatively, the planet may be supplied with heavy elements by planetesimals through secular perturbations. In both the giant impact and the secular perturbation scenarios, we expect an outer giant planet to be present. Observational studies by imaging, astrometry, and long-term interferometry of this system

are needed to better narrow down the ensemble of possibilities.

Published by The Astrophysical Journal Letters (Vol. 650, p. 1150)

Current Star Formation in the Perseus Molecular Cloud: Constraints from Unbiased Submillimeter and Mid-Infrared Surveys

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We present a census of the population of deeply embedded young stellar objects (YSOs) in the Perseus molecular cloud complex based on a combination of Spitzer Space Telescope mid-infrared data from the “Cores to Disks” (c2d) legacy team and JCMT/SCUBA submillimeter maps from the COMPLETE team. The mid-infrared sources detected at 24 μm and having $[3.6]-[4.5]>1$ are located close to the center of the SCUBA cores, typically within $15''$ of their peaks. The narrowness of the spatial distribution of mid-infrared sources around the peaks of the SCUBA cores suggests that no significant dispersal of the newly formed YSOs has occurred. This argues against the suggestion that motions of protostars regulate the time scales over which significant (Bondi-Hoyle) accretion can occur. The YSOs are found to have red $[3.6]-[4.5]$ and $[8.0]-[24]$ colors, but not comparable red $[5.8]-[8.0]$ colors. The most deeply embedded YSOs are found in regions with high extinction, $A_V \geq 5$, similar to the extinction threshold observed for the SCUBA cores. All the SCUBA cores with high concentrations have embedded YSOs, but not all cores with low concentrations are starless. From the above considerations a relatively unbiased sample of 49 deeply embedded YSOs is constructed. Embedded YSOs are found in 40 of the 72 SCUBA cores with only three cores harboring multiple embedded YSOs within $15''$. The equal number of SCUBA cores with and without embedded YSOs suggests that the time scale for the evolution through the dense prestellar stages, where the cores are recognized in the submillimeter maps and have central densities of $5\times10^4-1\times10^5$ cm^{-3}, is similar to the time scale for the embedded protostellar stages. The current star formation efficiency of cores is estimated to be approximately 10–15%. In contrast, the star formation efficiency averaged over the cloud life time and compared to the total cloud mass is only a few percent, reflecting also the efficiency in assembling cloud material into the dense cores actually forming stars.

Accepted by ApJ

astro-ph/0610381

The initial conditions of isolated star formation - VII. Spitzer mapping of pre-stellar cores

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We have retrieved *Spitzer* archive data of pre-stellar cores taken with the Multiband Imaging Photometer for *Spitzer* (MIPS) at a wavelength of 160 μm. Seventeen images, containing eighteen cores, were constructed. Flux densities were measured for each core, and background estimates were made. Mean off-source backgrounds were found to be 48$\pm$10 MJy/sr in Taurus and 140$\pm$55 MJy/sr in Ophiuchus. Consistency was found between the MIPS 170μm and ISOPHOT 160μm calibration. Fourteen cores were detected both by MIPS and our previous submillimetre surveys. Spectral Energy Distributions (SEDs) were made for each core, using additional 24- and 70-μm data from the *Spitzer* data archive, as well as previous infra-red and submillimetre data. Previous temperature estimates were refined, and new temperature estimates were made where no *Infrared Space Observatory* (*ISO*) data exist. A temperature range of 8–18K was found for the cores, with most lying in the range 10–13K. We discount recent claims that a large number of pre-stellar cores may have been misclassified and in fact contain low luminosity protostars detectable only by *Spitzer*.

We find no new protostars in our sample other than that previously reported in L1521F. It is shown that this has a negligible effect on pre-stellar lifetime estimates.

Accepted by MNRAS

http://xxx.lanl.gov/abs/astro-ph/0611165

The Stellar Mass Spectrum in Warm and Dusty Gas: Deviations from Salpeter in the Galactic Centre and in Circum-Nuclear Starburst Regions

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Understanding the origin of stellar masses is a key problem in astrophysics. In the solar neighborhood, the mass distribution of stars follows a seemingly universal pattern. In the centre of the Milky Way, however, there are indications for strong deviations and the same may be true for the nuclei of distant starburst galaxies. Here we present the first numerical hydrodynamical calculations of stars formed in a molecular region with chemical and thermodynamic properties similar to those of warm and dusty circum-nuclear starburst regions. The resulting IMF is top-heavy with a peak at $\sim 15\ M_{\odot}$, a sharp turn-down below $\sim 7\ M_{\odot}$ and a power-law decline at high masses. We find a natural explanation for our results in terms of the temperature dependence of the Jeans mass, with collapse occuring at a temperature of ~ 100 K and an H_2 density of a few $\times 10^5$ cm^{-3}, and discuss possible implications for galaxy formation and evolution.

Accepted by Monthly Notices of the Royal Astronomical Society

On the Diversity of Giant Planets - Simulating the Evolution of Solids in Protoplanetary Disks

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We describe a model designed to track simultaneously the evolution of gas and solids in protoplanetary disks from an early stage, when all solids are in the dust form, to the stage when most solids are in the form of a planetesimal swarm. The model is computationally efficient and allows for a global, comprehensive approach to the evolution of solid particles due to gas-solid coupling, coagulation, sedimentation, and evaporation/condensation. We have used it to calculate the co-evolution of gas and solids starting from a comprehensive domain of initial conditions. Then based on the core accretion - gas capture scenario, we have estimated the planet-bearing capability of the environment defined by the final planetesimal swarm and the still evolving gaseous component of the disk. We describe how the disk's capability of formation of giant planets depends on the initial mass and size of a protoplanetary disk, its thermal structure, mass of the central star and properties of the material forming solid grains.

Accepted by Planetary and Space Science

Radiation-Hydrodynamic Simulations of Collapse and Fragmentation in Massive Protostellar Cores

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We simulate the early stages of the evolution of turbulent, virialized, high-mass protostellar cores, with primary attention to how cores fragment, and whether they form a small or large number of protostars. Our simulations use the Orion adaptive mesh refinement code to follow the collapse from ~ 0.1 pc scales to ~ 10 AU scales, for durations that cover the main fragmentation phase, using three-dimensional gravito-radiation hydrodynamics. We find that for a wide range of initial conditions radiation feedback from accreting protostars inhibits the formation of fragments, so that the vast majority of the collapsed mass accretes onto one or a few objects. Most of the fragmentation that does occur takes place in massive, self-shielding disks. These are driven to gravitational instability by rapid accretion, producing rapid mass and angular momentum transport that allows most of the gas to accrete onto the central star rather than forming fragments. In contrast, a control run using the same initial conditions but an isothermal equation of state produces much more fragmentation, both in and out of the disk. We conclude that massive cores with observed properties are not likely to fragment into many stars, so that, at least at high masses, the core mass function probably determines the stellar initial mass function. Our results also demonstrate that simulations of massive star forming regions that do not include radiative transfer, and instead rely on a barotropic equation of state or optically thin heating and cooling curves, are likely to produce misleading results.

Accepted by ApJ

http://www.astro.princeton.edu/∼krumholz/recent.html

Modeling T Tauri Winds from He I 10830 Profiles

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The high opacity of He I 10830 makes it an exceptionally sensitive probe of the inner wind geometry of accreting T Tauri stars. In this line blueshifted absorption below the continuum results from simple scattering of stellar photons, a situation which is readily modeled without definite knowledge of the physical conditions and recourse to multi-level radiative transfer. We present theoretical line profiles for scattering in two possible wind geometries, a disk wind and a wind emerging radially from the star, and compare them to observed He I 10830 profiles from a survey of classical T Tauri stars. The comparison indicates that subcontinuum blueshifted absorption is characteristic of disk winds in $\sim 30\%$ of the stars and of stellar winds in $\sim 40\%$. We further conclude that for many stars the emission profile of helium likely arises in stellar winds, increasing the fraction of accreting stars inferred to have accretion-powered stellar winds to $\sim 60\%$. Stars with the highest disk accretion rates are more likely to have stellar wind than disk wind signatures and less likely to have redshifted absorption from magnetospheric funnel flows. This suggests the possibility that when accretion rates are high, disks can extend closer to the star, magnetospheric accretion zones can be reduced in size and conditions arise that favor radially outflowing stellar winds.

Accepted by The Astrophysical Journal

URL: astro-ph/0611585

Anatomy of a Flaring Proto-Planetary Disk Around a Young Intermediate-Mass Star

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Although planets are being discovered around stars more massive than the Sun, information about the proto-planetary disks where such planets have built up is sparse. We have imaged mid-infrared emission from polycyclic aromatic hydrocarbons at the surface of the disk surrounding the young intermediate-mass star HD 97048 and characterized the disk. The disk is in an early stage of evolution, as indicated by its large content of dust and its hydrostatic flared geometry, indicative of the presence of a large amount of gas that is well mixed with dust and gravitationally stable. The disk is a precursor of debris disks found around more-evolved A stars such as β Pictoris and provides the rare opportunity to witness the conditions prevailing before (or during) planet formation.

Published by Science (Vol. 314, #5799, p. 621)

New members in the Upper Scorpius association from the UKIRT Infrared Deep Sky Survey Early Data Release

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We present the results of a 9.3-deg^2 infrared (ZYJHK) survey in the Upper Scorpius association extracted from the UKIRT Infrared Deep Sky Survey (UKIDSS) Galactic Cluster Survey Early Data Release. We have selected a total of 112 candidates from the (Z-J, Z) colourmagnitude diagram over the Z = 12.5-20.5 magnitude range, corresponding to M = 0.25-0.01 $M_\odot$ at an age of 5 Myr and a distance of 145 pc. Additional photometry in J and K filters revealed most of them as reddened stars, leaving 32 possible members. Among them, 15 have proper motion consistent with higher-mass members from Hipparcos and optical spectra with strong Hα in emission and weak gravity features. We have also extracted two lower-mass candidate members for which no optical spectra are in hand. Three members exhibit strong Hα equivalent widths (> 20 Å, suggesting that they could still undergo accretion, whereas two other dwarfs show signs of chromospheric activity. The likelihood of the binarity of a couple of new stellar and substellar members is discussed as well.

Published by Monthly Notices of the Royal Astronomical Society (Vol. 373, p. 95)

Investigating grain growth in disks around southern T Tauri stars at millimetre wavelengths

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CONTEXT - Low-mass stars form with disks in which the coagulation of grains may eventually lead to the formation of planets. It is not known when and where grain growth occurs, as models that explain the observations are often degenerate. A way to break this degeneracy is to resolve the sources under study. AIMS - To find evidence for the existence of grains of millimetre sizes in disks around in T Tauri stars, implying grain growth. METHODS - The Australia Telescope Compact Array (ATCA) was used to observe 15 southern T Tauri stars, five in the constellation Lupus and ten in Chamaeleon, at 3.3 millimetre. The five Lupus sources were also observed with the Submillimeter

Array (SMA) at 1.4 millimetre. Our new data are complemented with data from the literature to determine the slopes of the spectral energy distributions in the millimetre regime. RESULTS - Ten sources were detected at better than 3sigma with the ATCA, with sigma 1-2 mJy, and all sources that were observed with the SMA were detected at better than 15sigma, with sigma 4 mJy. Six of the sources in our sample are resolved to physical radii of 100 AU. Assuming that the emission from such large disks is predominantly optically thin, the millimetre slope can be related directly to the opacity index. For the other sources, the opacity indices are lower limits. Four out of six resolved sources have opacity indices ¡ 1, indicating grain growth to millimetre sizes and larger. The masses of the disks range from ¡0.01 to 0.08 MSun, which is comparable to the minimum mass solar nebula. A tentative correlation is found between the millimetre slope and the strength and shape of the 10 micron silicate feature, indicating that grain growth occurs on similar (short) timescales in both the inner and outer disk.

Accepted by Astronomy and Astrophysics

http://lanl.arxiv.org/abs/astro-ph/0610667

Energy transport, overshoot, and mixing in the atmospheres of M-type main- and pre-main-sequence objects

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We constructed hydrodynamical model atmospheres for mid M-type main-, as well as pre-main-sequence (PMS) objects. Despite the complex chemistry encountered in these cool atmospheres a reasonably accurate representation of the radiative transfer is possible, even in the context of time-dependent and three-dimensional models. The models provide detailed information about the morphology of M-type granulation and statistical properties of the convective surface flows. In particular, we determined the efficiency of the convective energy transport, and the efficiency of mixing by convective overshoot. The convective transport efficiency was expressed in terms of an equivalent mixing-length parameter $\alpha_{\rm MLT}$ in the formulation of mixing-length theory (MLT) given by Mihalas (1978). $\alpha_{\rm MLT}$ amounts to values around ≈2 for matching the entropy of the deep, adiabatically stratified regions of the convective envelope, and lies between 2.5 and 3.0 for matching the thermal structure of the deep photosphere. For current spectral analysis of PMS objects this implies that MLT models based on $\alpha_{\rm MLT} = 2.0$ overestimate the effective temperature by 100 K and surface gravities by 0.25 dex. The average thermal structure of the formally convectively stable layers is little affected by convective overshoot and wave heating, i.e., stays close to radiative equilibrium conditions. Our models suggest that the rate of mixing by convective overshoot declines exponentially with geometrical distance to the Schwarzschild stability boundary. It increases at given effective temperature with decreasing gravitational acceleration.

Published by Astronomy & Astrophysics (Vol. 459, p. 599)

Spectral and photographic studies of the known T association in the neighborhood of Cyg OB7

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Spectral and photographic observations of an $11' \times 11'$ region in the center of the known association Cyg OB7 are presented. The observations were made on the 2.6-m telescope of the Byurakan Astrophysical Observatory in 2004. The spectral camera SCORPIO, a multiregime focal reducer for the primary focus, was used. One new HH node and

three new emission stars were discovered in the region under study. One of the previously known emission stars is found to have spectral class M0Ve and to lie at a distance of 200 pc. Some variability is detected in the brightness of a known infrared nebula and the cometary nebula CN2.

Published by Astrophysics (Vol. 49, p. 320)

Shock-Wave Heating Model for Chondrule Formation: Prevention of Isotopic Fractionation

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Chondrules are considered to have much information on dust particles and processes in the solar nebula. It is naturally expected that protoplanetary disks observed in present star-forming regions have similar dust particles and processes, so study of chondrule formation may provide us great information on the formation of the planetary systems. Evaporation during chondrule melting may have resulted in depletion of volatile elements in chondrules. However, no evidence for a large degree of heavy-isotope enrichment has been reported in chondrules. In order to meet this observational constraint, the rapid heating rate at temperatures below the silicate solidus is required to suppress the isotopic fractionation. We have developed a new shock-wave heating model, taking into account the radiative transfer of the dust thermal continuum emission and the line emission of gas molecules, and we have calculated the thermal history of chondrules. We have found that optically thin shock waves for the thermal continuum emission from dust particles can meet the rapid heating constraint, because the dust thermal emission does not retain the dust particles' high temperature for a long time in the preshock region and dust particles are abruptly heated by the gas drag heating in the postshock region. We have also derived the upper limit of optical depth of the preshock region using the radiative diffusion approximation, above which the rapid heating constraint is not satisfied. It is about 1-10.

Published by The Astrophysical Journal (Vol. 651, p. 1272)

Stellar Encounters with Massive Star-Disk Systems

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The dense, clustered environment in which massive stars form can lead to interactions with neighboring stars. It has been hypothesized that collisions and mergers may contribute to the growth of the most massive stars. In this paper we extend the study of star-disk interactions to explore encounters between a massive protostar and a less massive cluster sibling using the publicly available SPH code GADGET-2. Collisions do not occur in the parameter space studied, but the end state of many encounters is an eccentric binary with a semi-major axis ~ 100 AU. Disk material is sometimes captured by the impactor. Most encounters result in disruption and destruction of the initial disk, and periodic torquing of the remnant disk. We consider the effect of the changing orientation of the disk on an accretion driven jet, and the evolution of the systems in the presence of on-going accretion from the parent core.

Accepted by The Astrophysical Journal

http://arxiv.org/abs/astro-ph/0608070

Probable association of T Tauri stars with the L1014 dense core

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Using the Wide Field Grism Spectrograph 2 (WFGS2), we have carried out slit-less spectroscopy, $g'r'i'$ photometry, and slit spectroscopy on the L1014 dense core. We detected three Hα emission line stars. We interpret one as weak-line T Tauri star (WTTS) and the others as classical T Tauri stars (CTTS). Since their $g' - i'$ colors and/or classified spectral types are consistent with those of T Tauri stars and two of them show less extinction than the cloud, these three stars are likely to be T Tauri stars associated with L1014. Adopting an age range for T Tauri stars, 1–10 Myr, the color-magnitude diagram suggests a distance of $\sim$ 400–900 pc, rather than the previously assumed distance, 200 pc.This could strongly affect on the mass estimate of L1014-IRS, which is thought to be either a very young protostar or proto-brown dwarf.

Accepted by PASJ (Vol.58, No.5, October 25, 2006)

astro-ph/0608477

Brownian Motion in Planetary Migration

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A residual planetesimal disk of mass 10-100 $M_\oplus$ remained in the outer solar system following the birth of the giant planets, as implied by the existence of the Oort cloud, coagulation requirements for Pluto, and inefficiencies in planet formation. Upon gravitationally scattering planetesimal debris, planets migrate. Orbital migration can lead to resonance capture, as evidenced here in the Kuiper and asteroid belts, and abroad in extrasolar systems. Finite sizes of planetesimals render migration stochastic ("noisy"). At fixed disk mass, larger (fewer) planetesimals generate more noise. Extreme noise defeats resonance capture. We employ order-of-magnitude physics to construct an analytic theory for how a planet's orbital semimajor axis fluctuates in response to random planetesimal scatterings. The degree of stochasticity depends not only on the sizes of planetesimals, but also on their orbital elements. We identify the conditions under which the planet's migration is maximally noisy. To retain a body in resonance, the planet's semimajor axis must not random walk a distance greater than the resonant libration width. We translate this criterion into an analytic formula for the retention efficiency of the resonance as a function of system parameters, including planetesimal size. We verify our results with tailored numerical simulations. Application of our theory reveals that capture of resonant Kuiper Belt objects by a migrating Neptune remains effective if the bulk of the primordial disk was locked in bodies having sizes $\ll \mathcal{O}(100)$ km and if the fraction of disk mass in objects with sizes $\gtrsim 1000$ km was less than a few percent. Coagulation simulations produce a size distribution of primordial planetesimals, which easily satisfies these constraints. We conclude that stochasticity did not interfere with nor modify in any substantive way Neptune's ability to capture and retain resonant Kuiper Belt objects during its migration.

Published by The Astrophysical Journal (Vol. 651, p. 1194)

How Long Can Tiny H I Clouds Survive?

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We estimate the evaporation timescale for spherical H I clouds consisting of the cold neutral medium surrounded by the warm neutral medium. We focus on clouds smaller than 1 pc, which corresponds to tiny H I clouds recently discovered by Braun & Kanekar and Stanimirović & Heiles. By performing one-dimensional, spherically symmetric numerical simulations of the two-phase interstellar medium (ISM), we derive the timescales as a function of the cloud size and of pressure of the ambient warm medium. We find that the evaporation timescale of the clouds of 0.01 pc is about 1 Myr with standard ISM pressure, $p/k_B \sim 10^{3.5}$ K cm^{-3}, and for clouds larger than about 0.1 pc it depends strongly on the pressure. In high-pressure cases, there exists a critical radius for clouds growing as a function of pressure, but the minimum critical size is ~ 0.03 pc for a standard environment. If tiny H I clouds exist ubiquitously, our analysis suggests two implications: tiny H I clouds are formed continuously with the timescale of 1 Myr, or the ambient pressure around the clouds is much higher than the standard ISM pressure. The cloud-size dependence of the timescale is well explained by an analytic approximate formula derived by Nagashima, Koyama, & Inutsuka. We also compare it with the evaporation rate given by McKee & Cowie.

Published by The Astrophysical Journal Letters (Vol. 652, p. L41)

A SCUBA survey of Orion – the low-mass end of the core mass function

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We have re-analysed all of the SCUBA archive data of the Orion star-forming regions. We have put together all of the data taken at different times by different groups. Consequently we have constructed the deepest submillimetre maps of these regions ever made. There are four regions that have been mapped: Orion A North & South, and Orion B North & South. We find that two of the regions, Orion A North and Orion B North, have deeper sensitivity and completeness limits, and contain a larger number of sources, so we concentrate on these two. We compare the data with archive data from the Spitzer Space Telescope to determine whether or not a core detected in the submillimetre is pre-stellar in nature. We extract all of the pre-stellar cores from the data and make a histogram of the core masses. This can be compared to the stellar initial mass function (IMF). We find the high-mass core mass function follows a roughly Salpeter-like slope, just like the IMF, as seen in previous work. Our deeper maps allow us to see that the core mass function (CMF) turns over at $\sim 1.3 M_\odot$, about a factor of 4 higher than our completeness limit. This turnover has never previously been observed, and is only visible here due to our much deeper maps. It mimics the turnover seen in the stellar IMF at $\sim 0.1 M_\odot$. The low-mass side of the CMF is a power-law with an exponent of 0.35 ± 0.2, which is consistent with the low-mass slope of the young cluster IMF of 0.3 ± 0.1. This shows that the CMF continues to mimic the shape of the IMF all the way down to the lower completeness limit of these data at $\sim$0.3M$_\odot$.

Accepted by MNRAS

astro-ph/0611164

Polarimetry in the Outskirts of NGC 6611

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We present new polarimetric UBVRI observations of 25 stars in the direction of the halo of NGC 6611, the rich stellar open cluster embedded in an ionized hydrogen complex (M16). Our plan is to characterize the interstellar material (ISM) associated with halo stars in order to make a comparison with the ISM dusty core characteristics that resulted from a previous investigation by the same authors. Of the halo stars, 47% (8 out of 17) show indications of intrinsic polarization in their light, similar to what was found for core stars (50%). We have identified the presence of nearby dust clouds located on the Local arm that produce a mean polarization of about 1%; a value $\overline{\lambda_{max}} = 0.61 \pm 0.07\mu$m, which is slightly larger than that of the average ISM; and a mean direction of the polarization vectors of $\overline{\theta_V} = 81.^\circ 9 \pm 1.^\circ 8$. The ISM associated with the halo region has $\overline{\lambda_{max}}$ similar to the general interstellar medium ($0.55 \pm 0.07\mu$m). The observed polarizations show a gradual increase from halo ($\overline{P_{max}} = 1.93\% \pm 0.3\%$) to core ($\overline{P_{max}} = 3.19\% \pm 0.63\%$). Position angles of the e-vector for both groups are generally similar, but there exists a slight difference in mean direction between them that is within the errors. We have also found that the halo stars are possibly represented by Whittet & van Breda's relationship, while in the cluster's core the dust does not fulfill the above-mentioned relationship. As a conclusion, we cannot find any clear difference between core and halo dust characteristics, with the exception of $\overline{\lambda_{max}}$, which may suggest a change in dust size.

Published by The Astronomical Journal (Vol. 132, p. 1783)

The Power Spectrum of Supersonic Turbulence in Perseus

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We test a method of estimating the power spectrum of turbulence in molecular clouds based on the comparison of power spectra of integrated intensity maps and single-velocity-channel maps, suggested by Lazarian and Pogosyan. We use synthetic ^{13}CO data from non-LTE radiative transfer calculations based on density and velocity fields of a simulation of supersonic hydrodynamic turbulence. We find that the method yields the correct power spectrum with good accuracy. We then apply the method to the Five College Radio Astronomy Observatory ^{13}CO map of the Perseus region, from the COMPLETE website. We find a power law power spectrum with slope $\beta = 1.81 \pm 0.10$. The values of β as a function of velocity resolution are also confirmed using the lower resolution map of the same region obtained with the AT&T Bell Laboratories antenna. Because of its small uncertainty, this result provides a useful constraint for numerical codes used to simulate molecular cloud turbulence.

Accepted by ApJ Letters

astro-ph/0611248

Self-Correlation Analysis of the Photometric Variability of T Tauri Stars

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T Tauri stars are variable stars that are in an early phase of evolution, in which accretion and contraction to the main sequence are still taking place. Their photometric variability is complex; it takes place on a variety of timescales, due to a variety of physical processes. Periodic variability occurs due to rotation and the presence of cool or hot spots on the star. It may also occur due to periodic obscuration of the star by inhomogeneities in the still present accretion disk. But the periodicity may be masked by other forms of variability, or by time variation in the cool or hot spots, or the obscuring inhomogeneities. For other types of variable stars, self-correlation has proven to be a useful adjunct to Fourier analysis for studying semiregular variability; it determines the cycle-to-cycle behavior of the star, averaged over all the data. We have therefore used it to investigate the photometric variability of about 30 T Tauri stars using existing data. It has provided useful information about periods and their coherence, about the amplitude of the periodic variation, or its upper limit, and about the "profile" of the amplitude-timescale behavior. In most cases, it has confirmed periods previously determined by Fourier analysis, but in some cases it has suggested that the previously determined period is spurious.

Published by The Astronomical Society of the Pacific (Vol. 118, p. 1390)

Probing the formation of intermediate- to high-mass stars in protoclusters II. Comparison between millimeter interferometric observations of NGC 2264-C and SPH simulations of a collapsing clump

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The earliest phases of massive star formation in clusters are still poorly understood. Here, we test the hypothesis for

high-mass star formation proposed in our earlier paper (Peretto et al. 2006) stating that a massive, ultra-dense core may be currently forming at the center of the collapsing NGC 2264-C protocluster via the gravitational coalescence of several intermediate-mass Class 0 objects.

In order to confirm the physical validity of this hypothesis, we carried out IRAM Plateau de Bure interferometer observations of NGC 2264-C and performed SPH numerical simulations of the collapse of a Jeans-unstable, prolate dense clump. A detailed comparison between these hydrodynamic simulations and both our earlier IRAM 30m observations and the new interferometer observations is presented.

Our Plateau de Bure observations provide evidence for disk emission in three of the six Class 0-like objects identified earlier with the 30m in the NGC 2264-C clump. Furthermore, they reveal the presence of a new compact source (C-MM13) located only $\sim$ 10000 AU away, but separated by $\sim$ 1.1 km.s^{-1} in (projected) velocity, from the most massive Class 0 object (C-MM3) lying at the very center of NGC 2264-C. Detailed comparison with our numerical SPH simulations supports the view that NGC 2264-C is an elongated cluster-forming clump in the process of collapsing and fragmenting along its long axis, leading to a strong dynamical interaction and possible protostar merger in the central region of the clump. The marked velocity difference observed between the two central objects C-MM3 and C-MM13, which can be reproduced in the simulations, is interpreted as an observational signature of this dynamical interaction. The present study also sets several quantitative constraints on the initial conditions of large-scale collapse in NGC 2264-C. Our hydrodynamic simulations indicate that the observed velocity pattern characterizes an early phase of protocluster collapse which survives for an only short period of time (i.e., $\leq 1 \times 10^5$ yr). To provide a good match to the observations the simulations require an initial ratio of turbulent to gravitational energy of only $\sim 5\,\%$, which strongly suggests that the NGC 2264-C clump is structured primarily by gravity rather than turbulence. The required "cold" initial conditions may result from rapid compression by an external trigger.

We speculate that NGC 2264-C is not an isolated case but may point to key features of the initial phases of high-mass star formation in protocluster.

Accepted by A&A

http://arxiv.org/abs/astro-ph/0611277

Cluster-assisted accretion for massive stars

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Gravitational interactions in very young high-density stellar clusters can to some degree change the angular momentum in the circumstellar discs surrounding initially the majority of stars. However, for most stars the cluster environment alters the angular momentum only slightly. For example, in simulations of the Orion Nebula cluster (ONC) encounters reduce the angular momentum of the discs on average at most by 3-5% and in the higher density region of the Trapezium by 15-20% - still a minor loss process. However, in this paper it is demonstrated that the situation is very different if one considers high-mass stars (M* >10 Msun) only. Assuming an age of 2 Myr for the ONC, their discs have on average a 50-90% lower angular momentum than primordially. This enormous loss in angular momentum in the disc should result in an equivalent increase in accretion, implying that the cluster environment boosts accretion for high-mass stars, thus making them even more massive.

Accepted by ApJL

astro-ph/0610581

Captured older stars as the reason for apparently prolonged star formation in young star clusters

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The existence of older stars within a young star cluster can be interpreted to imply that star formation occurs on time scales longer than a free-fall time of a pre-cluster cloud core. Here the idea is explored that these older stars are not related to the star formation process forming the young star cluster but rather that the orbits of older field stars are focused by the collapsing pre-cluster cloud core. Two effects appear: The focussing of stellar orbits leads to an enhancement of the density of field stars in the vicinity of the centre of the young star cluster. And due to the time-dependent potential of the forming cluster some of these stars can get bound gravitationally to the cluster. These stars exhibit similar kinematical properties as the newly formed stars and can not be distinguished from them on the basis of radial-velocity or proper-motion surveys. Such contaminations may lead to a wrong apparent star-formation history of a young cluster. In the case of the ONC the theoretical number of gravitationally bound older low-mass field stars agrees with the number of observed older low-mass stars.

Accepted by MNRAS

http://arxiv.org/abs/astro-ph/0611517

Modeling Spitzer observations of VV Ser. I. The circumstellar disk of a UX Orionis star

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We present mid-infrared Spitzer-IRS spectra of the well-known UX Orionis star VV Ser. We combine the Spitzer data with interferometric and spectroscopic data from the literature covering UV to submillimeter wavelengths. The full set of data are modeled by a two-dimensional axisymmetric Monte Carlo radiative transfer code. The model is used to test the prediction of Dullemond et al. (2003) that disks around UX Orionis stars must have a self-shadowed shape, and that these disks are seen nearly edge-on, looking just over the edge of a puffed-up inner rim, formed roughly at the dust sublimation radius. We find that a single, relatively simple model is consistent with all the available observational constraints spanning 4 orders of magnitude in wavelength and spatial scales, providing strong support for this interpretation of UX Orionis stars. The mid-infrared flux as measured by Spitzer-IRS is declining and exhibits weak silicate emission features, consistent with a self-shadowed geometry. MIPS and SCUBA imaging shows that the disk has a small grain dust mass as low as $0.8 \times 10^{-7}\,M_\odot$. The low apparent dust mass may be due to strong grain growth and settling. Further evidence for this is provided by the fact that the grains in the upper layers of the puffed-up inner rim must be small (0.01–0.4$\,\mu$m) to reproduce the colors ($R_V \sim 3.6$) of the extinction events, while the shape and strength of the mid-infrared silicate emission features indicate that grains in the outer disk (> 1-2 AU) are somewhat larger (0.3–3.0$\,\mu$m). From the model fit, the location of the puffed-up inner rim is estimated to be at a dust temperature of 1500 K or at 0.7–0.8 AU for small grains. This is almost twice the rim radius estimated from near-infrared interferometry. Since larger (more grey) grains are able to penetrate closer to the star for the same dust sublimation temperature, a plausible interpretation of the data is that these larger grains have settled to the disk mid-plane in the puffed-up inner rim. An best fitting model for the inner rim in which large grains in the disk mid-plane reach to within 0.25 AU of the star, while small grains in the disk surface create a puffed-up inner rim at $\sim 0.7 - 0.8$ AU, is able to reproduce all the data, including the near-infrared visibilities.

Accepted by ApJ

astro-ph/0610385

Dust rings and filaments around the isolated young star V1331 Cygni

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We characterize the small- and large-scale environment of the young star V1331 Cygni with high-resolution HST/WFPC2 and Digitized Sky Survey images. In addition to a previously known outer dust ring (≈30" in diameter), the HST/WFPC2 scattered light image reveals an inner dust ring for the first time. This ring has a maximum radius of ≈6.5" and is possibly related to a molecular envelope. Large-scale optical images show that V1331 Cyg is located at the tip of a long dust filament linking it to the dark cloud LDN 981. We discuss the origin of the observed dust morphology and analyze the object's relation to its parent dark cloud LDN 981. Finally, based on recent results from the literature, we investigate the properties of V1331 Cyg and conclude that in its current state the object does not show sufficient evidence to be characterized as an FU Ori object.

Accepted by ApJ

http://xxx.lanl.gov/abs/astro-ph/0610786

Terrestrial planet formation surrounding close binary stars

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Most stars reside in binary/multiple star systems; however, previous models of planet formation have studied growth of bodies orbiting an isolated single star. Disk material has been observed around both components of some young close binary star systems. Additionally, it has been shown that if planets form at the right places within such disks, they can remain dynamically stable for very long times. Herein, we numerically simulate the late stages of terrestrial planet growth in circumbinary disks around close binary star systems with stellar separations 0.05 AU$\leq$ a_B $\leq$ 0.4 AU and binary eccentricities $0 \leq e_B \leq 0.8$. In each simulation, the sum of the masses of the two stars is 1 $M_\odot$, and giant planets are included. The initial disk of planetary embryos is the same as that used for simulating the late stages of terrestrial planet formation within our Solar System by Chambers [Chambers, J.E., 2001. Icarus 152, 205-224], and around each individual component of the α Centauri AB binary star system by Quintana et al. [Quintana, E.V., Lissauer, J.J., Chambers, J.E., Duncan, M.J., 2002. Astrophys. J. 576, 982-996]. Multiple simulations are performed for each binary star system under study, and our results are statistically compared to a set of planet formation simulations in the Sun-Jupiter-Saturn system that begin with essentially the same initial disk of protoplanets. The planetary systems formed around binaries with apastron distances $Q_B \equiv a_B(1 + e_B) \lesssim 0.2$ AU are very similar to those around single stars, whereas those with larger maximum separations tend to be sparcer, with fewer planets, especially interior to 1 AU. We also provide formulae that can be used to scale results of planetary accretion simulations to various systems with different total stellar mass, disk sizes, and planetesimal masses and densities.

Published by Icarus (Vol. 185, p. 1)

High-Mass Star Formation. III. The Functional Form of the Submillimeter Clump Mass Function

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We investigate the mass function of cold, dusty clumps in 11 low- and high-mass star-forming regions. Using a homogeneous fitting technique, we analyze the shape of each region's clump mass function and examine the commonalities among them. We find that the submillimeter continuum clump mass function in low-mass star-forming regions is typically best fitted by a lognormal distribution, while that in high-mass star-forming regions is better fitted by a double power law. A single power-law clump mass distribution is ruled out in all cases. Fitting all of the regions with a double power law, we find that the mean power-law exponent at the high-mass end of each mass function is $\alpha_{high} = -2.4 \pm 0.1$, consistent with the Salpeter result of $\alpha = -2.35$. We find no region-to-region trend in high with the mass scale of the clumps in a given region, as characterized by their median mass. Similarly, nonparametric tests

show that the shape of the clump mass function does not change much from region to region, despite the obvious changes in the intrinsic mass scale. This result is consistent with the hypothesis that the clump mass distribution is determined by a highly stochastic process, such as turbulent fragmentation. It may also suggest that the data reduction and analysis techniques strongly affect the shape of the derived mass function.

Published by The Astrophysical Journal Letters (Vol. 650, p. 970)

V733 Cep (Persson's Star): A New FUor in Cepheus

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Persson (2004) recently found that a faint star had appeared in a cloud in Cepheus. A CCD image shows a R∼17.3 nebulous star, now known as V733 Cep, located in the L1216 = Cep F cloud at the apex of a cavity in the cloud. Infrared photometry indicates a modest infrared excess. Optical spectroscopy shows a well-defined Li I λ6707 line, and blueshifted absorption troughs at the Hα and Na I D lines extending to at least 200 km s^{-1}, indicative of a massive fast wind. An infrared 1-4 μm spectrum of V733 Cep shows the presence of strong water vapor features, and is almost identical to a similar IR spectrum of FU Ori that is reddened by A_V = 8 magnitudes. Assuming a similar intrinsic energy distribution as FU Ori, V733 Cep has a luminosity of about 135 $L_\odot$ at the assumed distance of 800 pc. The star was detected by the MSX satellite at 8.3 μm, but not by IRAS. Nor is it detected at 850 μm, indicating that while the star possesses circumstellar material it is not surrounded by a significant cool envelope. A ^{12}CO (3-2) map shows what appears to be a small molecular outflow along the same axis as the cavity seen in optical images. There is evidence for a limited amount of other low- and medium-mass star formation in the Cep F cloud. The totality of the evidence strongly indicates that V733 Cep is a new FU Ori-type object that must have erupted sometime between 1953 and 1984.

Accepted by Astron. J.

An X-ray and Near-infrared Study of Young Stars in the Carina Nebula

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We present a multiwavelength study of the central region of the Carina Nebula, including Trumpler 16 and part of Trumpler 14. Our analysis of the *Chandra X-ray Observatory* archival data led to the identification of 454 X-ray sources. These sources were then cross-identified with optical photometric and spectroscopic information available from the literature, and with newly obtained near-infrared (JHK_s) imaging observations. A total of 38 known OB stars are found to be X-ray emitters. All the O stars and early-B stars follow the nominal relation between the X-ray and bolometric luminosities, $L_{\rm X} \sim 10^{-7} L_{\rm bol}$. A few mid- to late-type B stars are found to be associated with X-ray emission, likely attributable to T Tauri companions. We discovered 16 OB star candidates that suffer a large extinction in the optical wavebands. Some 300 sources have the X-ray and infrared characteristics of late-type pre-main sequence stars. Our sample represents the most comprehensive census of the young stellar population in the Carina Nebula so far and should be useful for the study of the star-formation history of this massive starburst region. We also report the finding of a compact ($2' \times 4'$) group of 10 relatively bright X-ray sources, all of which are detected in the near-infrared wavelengths and are highly reddened. The group is spatially coincident with the dark 'V' shaped dust lane bisecting the Carina Nebula, and may be part of an embedded association. The distribution of the young stellar

groups surrounding the HII region associated with Trumpler 16 is consistent with the collect-and-collapse scenario of triggered star formation.

Accepted by The Astrophysical Journal

http://cepheus.astro.ncu.edu.tw/~kaushar/download/

Fractal dimension of interstellar clouds: opacity and noise effects

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There exists observational evidence that the interstellar medium has a fractal structure in a wide range of spatial scales. The measurement of the fractal dimension (D_f) of interstellar clouds is a simple way to characterize this fractal structure, but several factors, both intrinsic to the clouds and to the observations, may contribute to affect the values obtained. In this work we study the effects that opacity and noise have on the determination of D_f. We focus on two different fractal dimension estimators: the perimeter-area based dimension (D_{per}) and the mass-size dimension (D_m). We first use simulated fractal clouds to show that opacity does not affect the estimation of D_{per}. However, D_m tends to increase as opacity increases and this estimator fails when applied to optically thick regions. In addition, very noisy maps can seriously affect the estimation of both D_{per} and D_m, decreasing the final estimation of D_f. We apply these methods to emission maps of Ophiuchus, Perseus and Orion molecular clouds in different molecular lines and we obtain that the fractal dimension is always in the range $2.6 \leq D_f \leq 2.8$ for these regions. These results support the idea of a relatively high (> 2.3) average fractal dimension for the interstellar medium, as traced by different chemical species.

Accepted by The Astrophysical Journal

http://arxiv.org/abs/astro-ph/0610613

The Effect of Noise in Dust Emission Maps on the Derivation of Column Density, Temperature and Emissivity Spectral Index

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We have mapped the central 10'×10' of the dense core TMC-1C at 450, 850 and 1200 microns using SCUBA on the James Clerk Maxwell Telescope and MAMBO on the IRAM 30m telescope. We show that although one can, in principle, use images at these wavelengths to map the emissivity spectral index, temperature and column density independently, noise and calibration errors would have to be less than ∼2% to accurately derive these three quantities from a set of three emission maps. Because our data are not this free of errors, we use our emission maps to fit the dust temperature and column density assuming a constant value of the emissivity spectral index and explore the effects of noise on the derived physical parameters. We find that the derived extinction values for TMC-1C are large for a starless core (∼80 mag A_V), and the derived temperatures are low (∼6 K) in the densest regions of the core, using our derived value of $\beta = 1.8$.

Accepted by ApJ

http://arxiv.org/abs/astro-ph/0611535

ProtoBrown Dwarf Disks as Products of Protostellar Disk Encounters

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The formation of brown dwarfs (BDs) via encounters between protostars has been confirmed with high-resolution numerical simulations with a restricted treatment of the thermal conditions. The new results indicate that young BDs formed this way are disklike and often reside in multiple systems. The newly formed proto-BD disks are up to 18 AU in size and spin rapidly, making small-scale bipolar outflows, fragmentation, and the possible formation of planetary companions likely, as have recently been observed for BDs. The object masses range from 2 to 73 Jupiter masses, distributed in a manner consistent with the observed substellar initial mass function. The simulations usually form multiple BDs on eccentric orbits about a star. One such system was hierarchical, a BD binary in orbit around a star, which may explain recently observed hierarchical systems. One-third of the BDs were unbound after a few thousand years, and interactions among orbiting BDs may eject more or add to the number of binaries. Improvements over prior work include resolution down to a Jupiter mass, self-consistent models of the vertical structure of the initial disks, and careful attention to avoid artificial fragmentation.

Published by The Astrophysical Journal Letters (Vol. 651, p. L145)

Evidence of a High Carbon Abundance in the Local Interstellar Cloud

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The nature of the local interstellar cloud (LIC) is highly constrained by the combination of in situ heliospheric and line-of-sight data toward nearby stars. We present a new interpretation of the LIC components of the absorption-line data toward ϵ CMa, based on recent atomic data that include new rates for the Mg^+ to Mg^0 dielectronic recombination rate, and using in situ measurements of the temperature and density of neutral helium inside of the heliosphere. With these data we are able to place interesting limits on the gas-phase abundance of carbon in the LIC. If the C/S abundance ratio is solar, ~ 20, then no simultaneous solution exists for the N(Mg I), N(Mg II), N(C II), and N(C II*) data. The combined column density and in situ data favor an abundance ratio $A_C/A_S = 47^{+22}_{-26}$. We find that the most probable gas-phase C abundance is in the range 400-800 ppm with a lower limit of ~ 330. We speculate that such a supersolar abundance could have come to be present in the LIC via destruction of decoupled dust grains. Similar enhanced C/H ratios are seen in very low column density material, $N(H) < 10^{19}$ cm^{-2}, toward several nearby stars.

Published by The Astrophysical Journal Letters (Vol. 651, p. L37)

A VLA search for young protostars embedded in dense cores

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Aims: Four dense cores, L1582A, L1689A, B133 and B68, classified as prestellar in terms of the absence of detectable NIR emission, are observed at radio wavelengths to investigate whether they nurture very young protostars.

Methods: We perform deep radio continuum observations at 3.6 cm and 6 cm using the VLA.

Results: No definite young protostars were discovered in any of the four cores observed. A few radio sources were discovered close to the observed cores, but these are most likely extragalactic sources or YSOs unrelated to the cores observed.
In L1582A we discovered a weak radio source near the centre of the core with radio characteristics and offset from the peak of the submillimeter emission similar to that of the newly discovered protostar in the core L1014, indicating a

possible protostellar nature for this source. This needs to be confirmed with near- and/or mid-infrared observations (e.g. with *Spitzer*). Hence based on the current observations we are unable to confirm unequivocally that L1582A is starless.
In L1689A a possible 4.5-σ radio source was discovered at the centre of the core,but needs to be confirmed with future observations.
In B133 a weak radio source, possibly a protostar, was discovered at the edge of the core on a local peak of the core submm emission, but no source was detected at the centre of the core. Thus, B133 is probably starless, but may have a protostar at its edge.
In B68 no radio sources were discovered inside or at the edge of the core, and thus B68 is indeed starless.
Four more radio sources with spectral indices characteristic of young protostars were discovered outside the cores but within the extended clouds in which these cores reside.

Conclusion: We conclude that the number of cores misclassified as prestellar is probably very small and does not significantly alter the estimated lifetime of the prestellar phase.

Accepted by A&A

astro-ph/0611290

Molecular CO outflows in the L1641-N cluster: kneading a cloud core

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We present results of 1.3 mm interferometric and single-dish observations of the center of the L1641-N cluster in Orion. Single-dish wide-field continuum and CO(2-1) observations reveal the presence of several molecular outflows driven by deeply embedded protostellar sources. At higher angular resolution, the dominant millimeter source in the cluster center is resolved into a pair of protostars (L1641-N-MM1 and MM3), each driving a collimated outflow, and a more extended, clumpy core. Low-velocity CO line-wing emission is widely spread over much of the cluster area. We detect and map the distribution of several other molecular transitions (^{13}CO, $C^{18}O$, ^{13}CS, SO, CH_3OH, CH_3CN, and OCS). CH_3CN and OCS may indicate the presence of a hot corino around L1641-N-MM1. We tentatively identify a velocity gradient over L1641-N-MM1 in CH_3CN and OCS, oriented roughly perpendicular to the outflow direction, perhaps indicative of a circumstellar disk. An analysis of the energy and momentum load of the CO outflows, along with the notion that apparently a large volume fraction is affected by the multiple outflow activity, suggests that outflows from a population of low-mass stars might have a significant impact on clustered (and potentially high-mass) star formation.

Accepted by AJ

http://www.eso.org/∼tstanke/preprints.html

The new nebula in LDN 1415 - A cry from the cradle of a low-luminosity source

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A survey for candidate Herbig-Haro objects was performed to search for evidence of star formation in Galactic dark clouds. For this aim true colour images were created from blue, red, and infrared DSS2 plates and inspected. Follow-up *I*-band, Hα, and [S II] CCD imaging as well as long-slit spectroscopy using the Tautenburg 2-m telescope was carried out to verify candidate objects. In the case of LDN 1415, the presence of a Herbig-Haro flow could be revealed which is henceforth named HH 892. In addition, an arcuate nebula was found which is barely seen on the DSS2 infrared plate (epoch 1996) and not detected in archival Kiso Schmidt data (epoch 2001). Thus, this nebula must have brightened by about 3.8 mag in recent years. The nebula is associated with IRAS 04376+5413. The 2MASS images show a red counterpart of the IRAS source, designated as L1415-IRS . Its morphology resembles that of a bipolar young object. The luminosity of this source integrated from 0.9 μm to 60 μm in the low state amounts to 0.13 $L_\odot$ for an assumed

distance of 170 pc. Thus it seems to be a young very-low mass star or it might even be of substellar mass. The current brightness increase of the nebula is caused by a FUor- or EXor-like outburst as indicated by the presence of a P Cygni profile of the Hα line. L1415-IRS is by far the least luminous member of the sparse sample of FUor and EXor objects.

Accepted by A&A

astro-ph/0611295

Thermal instability in a weakly ionized plasma

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We revisit the problem of clump formation due to thermal instabilities in a weakly ionized plasma with the help of a linear perturbation analysis, as discussed by Nejad-Asghar & Ghanbari. In the absence of a magnetic field and ambipolar diffusion the characteristic equation reduces to the thermal instability described by Field. We derive the critical wavelengths, which separate the spatial ranges of stability and instability. Contrary to the original analysis of Nejad-Asghar & Ghanbari, perturbations with a wavelength larger than the critical wavelength destabilize the cloud. Moreover, the instability regime of isentropic perturbations is drastically reduced. Isobaric modes with real values of the critical wavelength appear only if the density dependence of the cooling rate is more pronounced than the temperature dependence. Isentropic modes arise only if the power of the density in the cooling rate is smaller than 1/2, which is not fulfilled for CO cooling. We find that ambipolar diffusion is not a dominating heating process in molecular gas.

Published by Monthly Notices of the Royal Astronomical Society (Vol. 372, p. 862)

The first high-resolution X-ray spectrum of a Herbig Star: The case of AB Aurigae

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The X-ray emission from Herbig Be/Ae stars has so far defied an unequivocal explanation. In later-type T Tauri stars, X-rays are thought to be produced by magnetically trapped coronal plasma, although accretion-shock induced X-rays have also been suggested. In earlier-type (OB) stars, shocks in unstable winds are thought to produce X-rays. We use X-ray spectroscopy data from the XMM-Newton Reflection Grating Spectrometers and the EPIC instruments. The spectra are interpreted using thermal, optically thin emission models with variable element abundances and a photoelectric absorption component. We interpret line flux ratios in He-like triplet of O VII as a function of electron density and the UV radiation field. We use the nearby co-eval classical T Tauri star SU Aur as a comparison. AB Aurigae reveals a soft X-ray spectrum, most plasma being concentrated at 1–6 MK. The He-like triplet reveals no signatures of increased densities as reported for some accreting T Tau stars in the previous literature. There are also no clear indications for strong abundance anomalies in the emitting plasma. The light curve displays modulated variability, with a period of $\approx$ 42 hr. It is unlikely that a nearby, undetected lower-mass companion is the source of the X-rays. Accretion shocks close to the star should be irradiated by the photosphere, leading to alteration in the He-like triplet fluxes of O VII, which we do not measure. Also, no indications for high densities are found, although the mass accretion rate is presently unknown. Emission from wind shocks is unlikely, given the weak radiation pressure. A possible explanation would be a solar-like magnetic corona. Magnetically confined winds provide a very promising alternative. The X-ray period is indeed close to periods previously measured in optical lines from the wind.

Accepted by A&A, to appear in a special section/issue dedicated to the XMM-Newton Extended Survey of the Taurus Molecular Cloud (XEST)

http://www.issibern.ch/teams/Taurus/papers.html

High Resolution X-ray Spectroscopy of T Tauri Stars in the Taurus-Auriga Complex

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Differences have been reported between the X-ray emission of accreting and non-accreting stars. Some observations have suggested that accretion shocks could be responsible for part of the X-ray emission in Classical T Tauri stars (CTTS). We present high-resolution X-ray spectroscopy of nine pre-main sequence stars in order to test the proposed spectroscopic differences between accreting and non-accreting pre-main sequence stars. We use X-ray spectroscopy from the *XMM-Newton* Reflection Grating Spectrometers and the EPIC instruments. We interpret the spectra using optically thin thermal models with variable abundances, together with an absorption column density. For BP Tau and AB Aur we derive electron densities from the O VII triplets. Using the O VII/O VIII count ratios as a diagnostic for cool plasma, we find that CTTS display a soft excess (with equivalent electron temperatures of $\approx 2.5-3$ MK) when compared with WTTS or zero-age main-sequence stars. Although the O VII triplet in BP Tau is consistent with a high electron density (3.4×10^{11} cm^{-3}), we find a low density for the accreting Herbig star AB Aur ($n_\mathrm{e} < 10^{10}$ cm^{-3}). The element abundances of accreting and non-accreting stars are similar. The Ne abundance is found to be high (4-6 times the Fe abundance) in all K and M-type stars. In contrast, for the three G-type stars (SU Aur, HD 283572, and HP Tau/G2), we find an enhanced Fe abundance (0.4-0.8 times solar photospheric values) compared to later-type stars. Adding the results from our sample to former high-resolution studies of T Tauri stars, we find a soft excess in all accreting stars, but in none of the non-accretors. On the other hand, high electron density and high Ne/Fe abundance ratios do not seem to be present in all accreting pre-main sequence stars.

Accepted by A&A, to appear in a special section/issue dedicated to the XMM-Newton Extended Survey of the Taurus Molecular Cloud (XEST)

http://www.issibern.ch/teams/Taurus/papers.html

Migration and the formation of systems of hot super-Earths and Neptunes

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The existence of extrasolar planets with short orbital periods suggests that planetary migration induced by tidal interaction with the protoplanetary disk is important. Cores and terrestrial planets may undergo migration as they form. In this paper we investigate the evolution of a population of cores with initial masses in the range 0.1-1 earth mass embedded in a disk. Mutual interactions lead to orbit crossing and mergers, so that the cores grow during their evolution. Interaction with the disk leads to orbital migration, which results in the cores capturing each other in mean motion resonances. As the cores migrate inside the disk inner edge, scatterings and mergers of planets on unstable orbits together with orbital circularization causes strict commensurability to be lost. Near commensurability however is usually maintained. All the simulations end with a population of typically between two and five planets, with masses depending on the initial mass. These results indicate that if hot super-Earths or Neptunes form by mergers of inwardly migrating cores, then such planets are most likely not isolated. We would expect to always find at least one, more likely a few, companions on close and often near-commensurable orbits. To test this hypothesis, it would be of interest to look for planets of a few to about 10 earth masses in systems where hot super-Earths or Neptunes have already been found.

Accepted by ApJ

http://fr.arxiv.org/abs/astro-ph/0609779

Molecular Cloud Evolution II. From cloud formation to the early stages of star formation in decaying conditions

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We present a self-consistent numerical study of the formation of giant dense cloud complexes and of stars within them. The simulations use an SPH scheme including self-gravity, sink particles and cooling, and describe the collision of oppositely-directed gas streams ("inflows") in the warm neutral medium (WNM) with lengths $\sim$ 50–100 pc and moderately supersonic velocities (9.2 km s^{-1}, or a Mach number $\sim$ 1.2 in the unperturbed WNM). The collisions trigger a transition to the cold phase in the gas, and an overshoot to physical conditions typical of molecular clouds (MCs). Simultaneously, they generate turbulence in the resulting "cloud", here defined as the gas at densities $n > 50$ cm^{-3}. After the inflows subside, the turbulence in the cloud begins to decay. The cooling and the mass gain of the dense gas eventually cause the cloud to become much more massive than its mean Jeans mass, and to begin undergoing global collapse. The turbulent, nonlinear density fluctuations induce numerous local and fast collapse events while the cloud is collapsing globally, converting most of its mass to stars. Since stellar energy feedback is not included, our simulations probably cease to be realistic when the total mass in stars is large enough that the energy feedback from the most massive among them becomes capable of halting the collapse or even dispersing the cloud. Our simulations show that: a) The clouds are *not* in a state of equilibrium. Instead, they are continually evolving, increasing their mass and gravitational energy $E_{\rm g}$, until the latter becomes comparable to the turbulent energy $E_{\rm k}$, at which time global and later local collapse (star formation) set in. b) After this time, the cloud begins to contract gravitationally as a whole, and this contraction produces a simultaneous increase in $|E_{\rm g}|$ and $E_{\rm k}$, satisfying a near-equipartition condition $|E_{\rm g}| \sim 2E_{\rm k}$. c) This mechanism of forming MCs naturally explains their apparent "virialized" state and the ubiquitous presence of HI halos around them. d) Longer inflow durations delay the onset of both global and local collapse, by maintaining a higher turbulent velocity dispersion in the cloud over longer times. e) The star formation rate is large from the beginning, without any period of slow and accelerating star formation. f) At the onset of star formation, the column densities of the local star-forming clumps are typically 0.5–2 $\times 10^{21}$ cm^{-2}, very similar to reported values of the column density required for molecule formation, suggesting that locally molecular gas and star formation occur nearly simultaneously. At that time, the bulk of the cloud is still expected to remain atomic. Within their framework and assumptions, our simulations thus support the scenario of rapid star formation *after* MCs are formed, although long ($\geq$ 15 Myr) accumulation periods are probably spent in the atomic phase, during which the clouds build up their gravitational energy.

Accepted by Astrophys. Journal

`http://arxiv.org/abs/astro-ph/0608375`

Temperature Inversion on the Surface of Externally Heated Optically Thick Multigrain Dust Clouds

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It was recently discovered that the temperature in the surface layer of externally heated optically thick gray dust clouds increases with the optical depth for some distance from the surface, as opposed to the normal decrease in temperature with distance in the rest of the cloud. This temperature inversion is a result of efficient absorption of diffuse flux from the cloud interior by the surface dust exposed to external radiation. Grains of size 1μm or bigger experience this effect when the external flux is of stellar spectrum. We explore what happens to the effect when dust is a mixture of grain sizes (multigrain). Two possible boundary conditions are considered: (1) a constant external flux without constrains on the dust temperature, and (2) the maximum dust temperature set to the sublimation temperature. We find that the first condition allows small grains to completely suppress the temperature inversion of big grains if the overall opacity is dominated by small grains. The second condition enables big grains to maintain the inversion even when they are a minor contributor to the opacity. In reality, the choice of boundary condition depends on the dust dynamics. When applied to the physics of protoplanetary disks, the temperature inversion leads to a previously unrecognized disk structure in which optically thin dust can exist inside the dust destruction radius of an optically thick disk. We conclude that the transition between the dusty disk and the gaseous inner clearing is not a sharp edge, but rather a large optically thin region.

Published by The Astrophysical Journal (Vol. 651, p. 906)

Dense Cores with Multiple Protostars: The Velocity Fields of L1448 IRS 3, NGC 1333 IRAS 2, and NGC 1333 IRAS 4

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The embedded cores L1448 IRS 3, NGC 1333 IRAS 2, and NGC 1333 IRAS 4 are mapped in emission from the $C^{18}O$, $H^{13}CO^+$, and N_2H^+ J = 1-0 transitions. The maps are created by combining BIMA and FCRAO observations and are tuned to resolutions of $\sim 50''$, $10''$, $5''$, and $3''$. The higher resolution maps reveal emission structures that are considerably smaller than the characteristic core radius ($\sim$ 0.1 pc) identified in earlier single-dish studies. We focus our study on the kinematics of the envelope material traced by the emission lines. We find that although the FCRAO data show relatively smooth velocity gradients across the cores, the velocity fields seen with higher resolution are more random, with central velocities varying over a range of ~ 1 km s^{-1}. In general, the distribution of velocities, as well as the complexity of the fields, increases with resolution. To analyze variations in the widths of the emission lines, we employ a method of gridding the datacubes that was initially developed to quantify properties of turbulent cloud models. The cores exhibit a broad range of line widths even at the smallest measurable scales. Pure thermal broadening at the prevailing envelope temperatures (T $\approx$ 20 K) is insufficient to produce the measured line widths; the narrowest lines must have a turbulent component at least as great as the thermal component, and for nearly all lines, the turbulent component makes the dominant contribution. Our results suggest that turbulent motions persist down to subcore scales of at least 2400 AU.

Published by The Astrophysical Journal Letters (Vol. 651, p. 301)

An Asymmetric Outflow from the Herbig Ae Star HD 163296

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We present an observational picture of the HH 409 bipolar outflow including the detection of six previously unreported Herbig-Haro knots from the Herbig Ae star HD 163296. This study combines seven years of data from ground-based Fabry-Pérot and HST coronagraphic imagery, as well as HST long-slit spectral imagery. The redshifted counterjet includes a chain of six Herbig-Haro knots spanning $> 27''$ to the northeast (P.A. $\approx 42^\circ$) of the source and has been active for >80 yr. The brightest knot in the counterjet is HH 409 C, a low-excitation bow shock with a shock velocity $V_s \sim 50$ km s^{-1} and total space motion $V_{jet} \approx 260$ km s^{-1}. The presence of additional knots in the counterjet beyond

the bow shock may indicate precession of the jet axis. The blueshifted jet includes two closely spaced knots within 10″ and a distant bow shock (≈ 21″) southwest (P.A. ≈ 223°) of the source. The brightest knot in the jet is HH 409 A, a higher excitation more bullet-like shock with $V_s \sim 90$ km s^{-1} and $V_{jet} \approx 360$ km s^{-1}. The average opening angles for both the jet and counterjet are similar, $\alpha_a \sim 2°$, and consistent with opening angles of lower mass T Tauri stars. The mass-loss rates in both lobes of the flow, despite the asymmetry of the knots, are also comparable, $\dot{M}_{out} \sim 1.0^{-8}$ $M_\odot$ yr^{-1}. This suggests that variations in the mass outflow rate are not more than a factor of ∼ 2.

Published by The Astrophysical Journal Letters (Vol. 650, p. 985)

Numerical simulations of the interaction of accretion disks with young star magnetospheres

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Aims. We present the results of the numerical simulations of the interaction between a magnetized star and an imperfectly conducting accretion disk. The star is rotating with constant angular velocity. The differentially rotating Keplerian disk is treated as a boundary condition. We are interested in the magnetic field topology dependence on the electrical conductivity of the disk.

Methods. To analyze the "star-disk" interaction we numerically investigate the MHD equations using Godunov-type high resolution numerical methods.

Results. It was found that in our model the "star-disk" interaction occurs with a quasi-periodic reconnection of the magnetic field coronal loops and plasmoid ejections. In the case of the perfect disk conductivity, the evolution of the coronal magnetic field leads to the periodic outflow of angular momentum from the disk. In the case of an imperfectly conducting disk, the configuration of the magnetic field is formed such that the disk angular momentum carried by the magnetic field is balanced by angular momentum carried by matter. It should be noted that we used the ideal MHD equation to obtain the solutions. The reconnection process in the disk corona depends on the numerical diffusivity that exists in our numerical code. Our simulations treat reconnection as occurring in current sheets. The thickness of the current sheet is broadened by numerical resistivity. Nevertheless, we suppose that the reconnection and plasmoid ejection takes place as well for real magnetic diffusivity. To verify the method and results we also used several more detailed grids to estimate the numerical diffusivity of the scheme. It is turned out that the setup model presented in the paper quite reasonable satisfies the goal of this paper, i.e., to investigate the regime of interaction between the magnetized star and the disk.

Published by Astronomy & Astrophysics (Vol. 458, p. 679)

Submillimeter Common-User Bolometer Array Mapping of Spitzer c2d Small Clouds and Cores

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We present submillimeter observations of dark clouds that are part of the Spitzer Legacy program "From Molecular Cores to Planet-Forming Disks" (c2d). We used the Submillimeter Common-User Bolometer Array to map the regions observed by Spitzer with the c2d program to create a census of dense molecular cores including data from the infrared to the submillimeter. In this paper we present the basic data from these observations: maps, fluxes, and source

attributes. We also show data for an object just outside the Perseus cloud that was serendipitously observed in our program. We propose that this object is a newly discovered evolved protostar.

Published by The Astronomical Journal (Vol. 132, p. 1998)

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

Latex macros for submitting abstracts and dissertation abstracts (by e-mail to reipurth@ifa.hawaii.edu) are appended to each issue of the newsletter. You can also submit via the Newsletter web interface at http://www2.ifa.hawaii.edu/star-formation/index.cfm .

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

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the Newsletter bounces back from an address for three consecutive months, the address is deleted from the mailing list.

Numerical Simulations of Binary Star Formation

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Ph.D dissertation directed by: Anthony Whitworth
Ph.D degree awarded: October 2006

Binary star formation is the dominant mode of star formation, in contrast to the traditional picture of single star formation. The work in this thesis investigates the properties of binary stars with the aid of numerical simulations, using N-body and Smoothed Particle Hydrodynamics codes.

First, we develop a simple model of isolated binary star formation assuming prestellar cores fragment due to rotational instabilities into a ring of $\mathcal{N}$ (≤ 6) stars. We follow the decay of this small-N cluster into singles and multiple systems using the N-body code NBODY3. We can reproduce most of the observed stellar and binary properties of young stars, including the high multiplicity and wide separation distribution, in low-mass star forming regions like Taurus. We extend this further into a model of clustered binary star formation assuming 100 small-N clusters form in fractal clusters of radius $\sim$ 1 pc, similar to many young embedded clusters. We follow the dynamical interactions of these clusters using the N-body code NBODY6. We find that disruptive binary-binary encounters in dense clusters can explain the differences between binary properties in low-density and high-density star forming regions.

We develop a new test of Smoothed Particle Hydrodynamics (SPH) called the Jeans Test. We demonstrate that SPH correctly models fragmentation and that under-resolved SPH simulations supress real fragmentation rather than promote artificial fragmentation. Thus binary and multiple systems produced in SPH simulations are real and not the result of numerical effects. Finally, we perform simulations of turbulent prestellar cores in the context of binary star formation. We extend the work of Goodwin, Whitworth & Ward-Thompson (2004) by investigating $2.17\,M_\odot$ and $4.34\,M_\odot$ cores.

http://www.astro.cf.ac.uk/pub/David.Hubber/thesis

New Jobs

Two EU post-doc fellowships at AIU Jena, Germany

In a new EU FP6 Marie-Curie Transfer-of-Knowledge project at the Astrophysical Institute and University Observatory (AIU) of the Friedrich-Schiller-University Jena, Germany, on

"Interferometric Observations of Planetary Systems"

we invite applications for two post-doc researchers starting 1 March 2007, for two years each.

This project includes the development of integrated optical devices for astronomical interferometry as well as astronomical observations and is a coorperation of AIU Jena with LAOG Grenoble, France, INAF Capodimonte, Italy, and the Frauhofer Institute for Applied Optics and Precision Engineering, Jena.

The main scientific interest of AIU is *the formation and early evolution of stars, brown dwarfs, and planets including the observation and theory of extra-solar planets and debris disks by various techniques.* As an active, internationally highly visible research group with strong links and cooperations to several institutes world-wide, we can offer a stimulating work environment. See also www.astro.uni-jena.de and www.exoplanet.de (and www.iof.fraunhofer.de for optics).

Expertise sought includes application of interferometry in astronomy, soft- and hardware development for interferometer instruments, observations of sub-stellar objects by transit, astrometry, direct imaging or other techniques; the post-docs should also participate in observations at our 90cm-telescope in Grosschwabhausen near Jena, where we have recently started a new planet transit search project.

At least one of the two post-doc researchers should work on observational astronomy. One post-doc should be selected to work on hardware for integrated optics beam combination in the 1 to 2.5 micro-meter wavelength regime, e.g. for a 2nd Generation ESO/VLTI instrument, for which we participate in the phase A study (PI institute is LAOG Grenoble). Extended stays at the two partner institutes in Grenoble and Napoli are foreseen.

We offer a competitive salary according to the Marie-Curie standards plus up to 800 Euro/month mobility allowance, depending on family status.

Applicants should have experience in astronomy and optics and should have a doctoral degree or four years of full-time research experience.

Applicants must be nationals of EU member or candidate states (swiss and EFTA-nationals are also eligible). Other international candidates and German citizen can be considered in exceptional cases only. For eligibility, check the EU Marie-Curie web pages or ask us. Questions can be directed to Ralph Neuhaeuser rne@astro.uni-jena.de (but only before 22 Dec 2006).

Applications (with all relevant documents including CV, description of previous research projects, publication list, papers, and suggestions for a research project) received by 8 Jan 2007 will receive full consideration. Applications and two letters of reference should be sent independently by normal mail to

Prof. Dr. Ralph Neuhaeuser
AIU, University Jena
Schillergaesschen 2-3
D-07745 Jena
Germany

Massive Star Formation: Observations confront Theory

This is the first announcement for a conference to be held from September 10th to 14th 2007 in Heidelberg/Germany.

Objectives

Although high-mass stars shape the interstellar medium, star clusters and whole galaxies tremendously throughout their whole lifetime, the actual massive star formation processes are still poorly understood. This meeting will gather the astrophysical community working theoretically and observationally in the field of massive star formation. Various theoretical concepts for the formation of massive stars are currently discussed, and it is important to derive predictions which can be tested observationally, and which discriminate between the various models. Furthermore, new observations, ranging from cm and (sub)mm wavelengths to the Infrared and X-ray regime, reveal intriguing features requiring theoretical explanations.

Observationally, the Galactic plane surveys from Spitzer (GLIMPSE and MIPSGAL) are expected to reveal many new insights, the submm regime will be exploited with new instruments like APEX and the SMA, existing observatories are significantly upgraded (e.g., PdBI, IRAM30m, JCMT, MOPRA, VLA, VLTI), CARMA is coming online soon, and new telescopes like ALMA, Herschel, and LBT are at the horizon.

From the theoretical/modeling perspective, the ever-increasing computational power allows to incorporate more and more physical and chemical parameters important for the formation of massive stars and their surrounding clusters. It is an important goal of this meeting that the different "disciplines" in high-mass star formation research interact, and together try to solve the outstanding questions of massive star formation.

The format of the meeting should stress new results. A few selected reviews will be given outlining the current status of the several sub-fields, but the major focus will be on the presentation and discussion of the recent results and the implications for the formation of massive stars. Controversial discussion to constrain the potential and limitations of observations, theory and modeling will be highly encouraged. Furthermore, selected open panel discussions about the hottest current topics may even better constrain the directions the massive star formation community should head for.

Topics

1. The earliest stages of high-mass star formation: Initial conditions and early collapse
2. Properties and evolution of massive protostars
3. Clustered massive star formation
4. Feedback (outflows, turbulence, dust and gas bubbles, ionization)
5. Massive Star Formation in a Galactic Context
6. Extragalactic star formation
7. Future perspectives for observational, theoretical and modeling tools

Scientific Organizing Committee

Henrik Beuther (Chair), Michael Burton, Ed Churchwell, Guido Garay, Thomas Henning, Paul Ho, Stan Kurtz, Karl Menten, Frederique Motte, Francesco Palla, Jonathan Tan, Malcolm Walmsley

Review speakers

F. Wyrowski, H. Yorke, K. Brooks, L. Allen, M. McLow (tbc), B. Whitney, O. Krause, J. Gallagher (tbc)

Panel discussions and their moderators

- Theoretical models and observational constraints for high-mass star formation (moderator: H. Zinnecker)
- What is a massive protostar? Theoretical definitions, observational criteria and evolutionary sequence (moderator: N. Evans)

Location

This conference will be held in the Heidelberg Convention Center (Kongresshaus Stadthalle Heidelberg) located directly in the center of downtown Heidelberg overlooking the river Neckar.

The venue is a beautiful old (1903) building equipped with all modern conference facilities. Due to its central location, hotels, touristic sights, the castle and numerous restaurants are all within walking distance.

Heidelberg hosts one of the oldest Universities of Europe, and it has ever been an academic center over a wide field of research areas. The city has five astrophysical institutes, and a large community is interested in star formation research.

Web-site and Registration

Additional information on this meeting can be found at

http://www.mpia.de/MSF07/

There will be ample room for contributed talks and posters. The registration will at the beginning of 2007. If you want to be added to the email-list for additional announcements about the conference, just write an email to beuther@mpia.de.

Hope to see you in Heidelberg next year!

2007 Origins of Solar System Gordon Conference

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

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

The Chair and Vice-Chair of the 2007 Origins of Solar Systems conference are Lee Hartmann (Michigan) and Sara Russell (Natural History Museum, London). We expect to announce the invited speakers by the end of November. Information on registering, travel arrangements, accomodations, etc. will soon be available at
http://www.grc.org/programs/2007/origins.htm in the very near future.

Multiplicity in Star Formation

An international workshop in Toronto
2007 May 16-18

The role of multiplicity in star and planet formation is at the forefront of current research and debate. This workshop aims to bring together observers and theorists to review the latest findings and stimulate discussion. The focus will be on low-mass star formation.

Sub-topics will include:

- multiplicity surveys of protostars, T Tauri stars and brown dwarfs
- multiplicity and Initial Mass Function
- multiples as testbeds for evolutionary models
- binarity vs. disks and jets
- planet formation in multiple systems

The goal is to have an informal meeting, limited to 60 participants, with lots of short talks and time for interaction; no posters, no proceedings.

For more information and expressions of interest, please visit: **http://www.astro.utoronto.ca/msf**

Please note that the number of participants is strictly limited: in the event of over-subscription, the SAC may have to select the participants based on their proposed contributions while aiming to reach a good mix of junior and senior scientists and a reasonable balance of sub-topics.

Scientific Advisory Committee:
Jerome Bouvier (Grenoble)
Cathie Clarke (Cambridge)
Andrea Ghez (UCLA)
Ray Jayawardhana (Toronto; *Chair*)
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Aleks Scholz
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IAU Symposium No. 249

Exoplanets: Detection, Formation and Dynamics

Oct. 22-26, 2007, Suzhou, PR. China

Objectives: In this conference wide topics related to the observations, physics and dynamics of exoplanets and planetary systems will be discussed. Noteworthy, the first results from CoRoT and Kepler missions are highly expected and may highlight this conference. This meeting will be a forum for the discussion of the existing results on the Physics and the Dynamics of exoplanets and exoplanetary systems.

Topics: Terrestrial planet detection (CoRoT and Kepler); Transits of planets across the stars; Determination of orbits and physical parameters; Physical modelling (atmosphere, structure, evolution); Star-Hot Jupiter interactions (tides, evaporation, magnetic fields); Planetary formation; Disk-planet interaction: theory and simulations; Planetary migration; Dynamics of multi-planet systems; Planets in binary stars; Planetary habitability.

Venue: The conference site, Suzhou, a town near Shanghai, is famous for its garden architecture and Chinese traditional culture. The local host will be colleagues form Nanjing University and Soochow University.

Sponsor: IAU, NSFC, Nanjing Univ, Soochow University

SOC Chairs: Sylvio Ferraz-Mello (Brasil) and Yi-Sui Sun (China)

Contact: Ji-Lin Zhou (zhoujl@nju.edu.cn)

Website: http://iaus249.nju.edu.cn/

70th Annual Meeting of the Meteoritical Society

The meeting will be held August 13-17, 2007 in Tucson, Arizona.

For further information, please refer to the first announcement at: http://www.lpi.usra.edu/meetings/metsoc2007/home.shtml.

To aid in planning purposes, we strongly urge you to submit an electronic Indication of Intent at: http://www.lpi.usra.edu/meetings/
The information on this form will not only provide invaluable information for the meeting organizers as they plan for the meeting, but will also subscribe you to an e-mail notification list to receive late-breaking news and information about the conference. Please make sure to include a valid e-mail address.

Further details regarding the program, topics for discussion, opportunities for participation, as well as guidelines for abstract submission, will be included in the second announcement that will be available on the web site in April 2007.

FIRST ANNOUNCEMENT:

Workshop on The Chronology of Meteorites and the Early Solar System dedicated to C.J. Allègre, G.W. Lugmair, L. Nyquist, D. Papanastassiou and J.G. Wasserburg

PLACE AND TIME: Hawaii (Maui, Big Island or Kauai, November 12-14, 2007 (place and dates to be confirmed)

HOSTED BY Hawaii Institute of Geophysics and Planetology (HIGP), School of Ocean and Earth Science and Technology (SOEST), University of Hawaii at Manoa (UH) Institute for Astronomy (IfA), UH

SPONSORED BY Lunar and Planetary Institute, NASA, University of Hawaii at Manoa

CONVENORS: Martin Bizzarro (Geological Institute, Denmark), Joel Baker (Victoria University of Wellington, New Zealand), Alexander N. Krot, Edward R. D. Scott, Klaus Keil (HIGP/SOEST, UH, USA)

SCIENTIFIC COMMITTEE: F. Albarede (France), Y. Amelin (Canada), M. Bizzarro (Denmark), M. Chaussidon (France), A. Davis (USA), G. Huss (USA), K. Keil (USA), A. Krot (USA), F. Podosek (USA), B. Reipurth (USA), E. Scott (USA), M. Wadhwa (USA)

OBJECTIVES: This interdisciplinary meeting is aimed at understanding the chronology of the processes in the early Solar System as revealed by meteorites. This includes the astrophysical setting of Solar System formation, the origin of short-lived radioisotopes, and the chronology of nebular and asteroidal processes: formation of chondrules, refractory inclusions and matrices of primitive chondrites, timing of accretion and thermal processing (aqueous alteration, thermal metamorphism, and igneous differentiation) of asteroids and comets. The workshop will review recent advances in long-lived isotopes and short-lived isotopes such as 26Al-26Mg, 60Fe-60Ni, 10Be-10B, 41Ca-41K, 182Hf-182W, 53Mn-53Cr with the goal of reconciling long-lived and short-lived isotope chronologies, as well as potential chronological significance of O-isotopes. The workshop will also address technical aspects (i.e. limitations, advantages, precision, accuracy, inter-laboratory calibration) of various analytical techniques used in cosmochronology such as LA-MC-ICPMS, MC-ICPMS, SIMS and TIMS. An important outcome of the workshop is to identify outstanding questions and establish future research directions.

STRUCTURE OF THE MEETING: The meeting will largely consist of invited talks with a small number of contributed talks, and a poster session. The workshop proceedings will be published as papers in Geochimica et Cosmochimica Acta. All papers will be subjected to a regular review process.

TRAVEL GRANTS: A number of student travel grants will be made available to qualified students and recent Ph.D.s. Applicants should be first author of an abstract to be presented at the meeting and submit a travel award application form to the LPI with their abstract. More information will be included in the second announcement.

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Alexander N. Krot HIGP/SOEST, University of Hawai'i at Manoa, 2525 Correa Road, Honolulu, HI 96822, USA Phone: 808-956-3900 FAX: 808-956-6322 E-mail: sasha@higp.hawaii.edu

LPI MEETING COORDINATOR:
Mary Cloud
Publications and Program Services Department
Lunar and Planetary Institute
E-mail: cloud@lpi.usra.edu

New Books

IAU Symposium No. 227
Massive Star Birth: A Crossroads of Astrophysics

Edited by Riccardo Cesaroni, Marcello Felli, Ed Churchwell, and Malcolm Walmsley

These are the proceedings of a symposium held in Acireale, Italy on May 16-20, 2005. Massive stars have short lives but produce the most dramatic effects on the surrounding interstellar medium in terms of dynamics, ionization, and chemical enrichment. At IAU Symposium No. 227, more than 200 astronomers presented the latest results concerning the birth and infancy of massive stars. These proceedings show the achievements reached in this field, due to observations in the radio at mm and sub-mm wavelengths and in the infrared, and to theoretical models that simulate what happens during the formation of a massive star. The book contains 57 articles based on the oral contributions, and a sample of the larger ones are listed below:

Cambridge University Press

ISBN 0-521-85198-X, hardbound, 460 pages, 2006
US$100.00

Available from: http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=052185198X

Short Announcements

ASTROPHYSICS SOFTWARE DATABASE

www.mpia.de/ASD

The *ASTROPHYSICS SOFTWARE DATABASE (ASD)* was created with the goal to provide an easy-to-use tool for the many different areas of astrophysics where software is developed and used.

Main Goals

Foster the communication between developers and users of astrophysical software
Provide an overview about existing software solutions in the community

You are invited to post a description of **your** software projects at **www.mpia.de/ASD** in order to make your work "visible" to the entire astronomical community.

This concerns data reduction and analysis software, simulation codes, databases, instrument software, software lists, etc. .

(Sebastian Wolf and Matthias Kleiser, contact: swolf@mpia.de)