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Abstracts of recently accepted papers

Constraints on the Birth Aggregate of the Solar System

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Using the observed properties of our solar system, in particular the isotopic compositions of meteorites and the regularity of the planetary orbits, we constrain the star formation environment of the Sun within the scenario of (external) radioactive enrichment by a massive star. This calculation yields a probability distribution for the number of stars in the solar birth aggregate. The Sun is most likely to have formed within a stellar group containing $N = \langle N \rangle \approx 2000 \pm 1100$ members. The *a priori* probability of a star forming in this type of environment is $\mathcal{P} \approx 0.0085$, i.e., only about 1 out of 120 solar systems are expected to form under similar conditions. We discuss additional implications of this scenario, including possible effects from the radiation fields provided by the putative cluster environment and dynamical disruption of the Kuiper Belt. The constraints of this paper place tight restrictions on the properties of the solar birth aggregate for the scenario of external enrichment by a massive star; alternately, these tight constraints slightly favor a self-enrichment scenario for the short-lived radioactive species.

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preprints available on the web: astro-ph/0011326

The Internal Structure of a Cold Dark Cloud from Extinction of Background Starlight

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Stars and planets form within dark molecular clouds. However, despite 30 years of study little is understood about the internal structure of these clouds and consequently the initial conditions that give rise to star and planet formation. This is largely due to the fact that molecular clouds are primarily composed of molecular hydrogen, which is virtually inaccessible to direct observation. Here we report the application of a new and powerful observational technique that takes advantage of measurements of background starlight extincted by trace amounts of dust to probe the internal structure of these objects. We use deep infrared imaging observations of the dark cloud Barnard 68 to derive the most finely sampled and highest signal-to-noise density profile ever obtained for a dense molecular cloud. We find the cloud's density structure to be extremely well described by the equations for a pressure confined, self-gravitating isothermal sphere, which is critically stable according to the Bonnor-Ebert criteria. For the first time, the internal structure of a dark cloud has been specified with a detail only exceeded by that characterizing a stellar interior. As a result we are able to precisely specify the physical conditions of a dark cloud on the verge of collapse to form a star.

Accepted by Nature

Quantification of molecular cloud structure using the Δ-variance

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We present a detailed study of the Δ-variance as a method to quantify molecular cloud structure. The Δ-variance was introduced by Stutzki et al. (1998) to analyze the drift behaviour of scalar functions and is used to characterize the spatial structure of observed molecular cloud images. For *fractional Brownian motion structures* (*fBm-fractals*), characterized by a power law power spectrum and random phases, the Δ-variance allows to determine the power spectral index β.

We present algorithms to determine the Δ-variance for discretely sampled maps and study the influence of white noise, beam smoothing and the finite spatial extent of the maps. We find that for images with $\beta > 3$, edge effects can bias the structure parameters when determined by means of a Fourier transform analysis. In contrast, the Δ-variance provides a reliable estimate for the spectral index β, if determined in the spatial domain. The effects of noise and beam smoothing are analytically represented in a leading order approximation. This allows to use the Δ-variance of observed maps even at scales where the influence of both effects becomes significant, allowing to derive the spectral index β over a wider range and thus more reliably than possible otherwise.

The Δ-variance is applied to velocity integrated spectral line maps of several clouds observed in rotational transitions of ^{12}CO and ^{13}CO. We find that the spatial structure of the emission is well characterized by a power law power spectrum in all cases. For linear scales larger than ∼0.5 pc the spectral index is remarkably uniform for the different clouds and transitions observed ($2.5 \leq \beta \leq 2.8$). Significantly larger values ($\beta > 3$) are found for observations made with higher linear resolution toward the molecular cloud MCLD 123.5+24.9 in the Polaris Flare, indicating a smoother spatial structure of the emission at small scales (<0.5 pc).

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Planetary dynamics in stellar clusters

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We investigate how the formation and evolution of extrasolar planetary systems can be affected by stellar encounters that occur in the crowded conditions of a stellar cluster. Using plausible estimates of cluster evolution, we show how planet formation may be supressed in globular clusters while planets wider than $\gtrsim$0.1 AU that do form in such environments can be ejected from their stellar system. Less crowded systems such as open clusters have a much reduced effect on any planetary system. Planet formation is unaffected in open clusters and only the wider planetary systems will be disrupted during the cluster's lifetime. The potential for free-floating planets in these environments is also discussed.

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http://star-www.st-and.ac.uk/astronomy/Welcome.html

RXJ1603.8-3938 – a surprising pre-main sequence spectroscopic binary

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We have determined the orbit of the double-lined spectroscopic binary RXJ1603.8-3938. The binary consists of two weak-line T Tauri stars, both of which have a spectral type between K3 and K4. The period of the circular orbit is 7.55626 ± 0.00021 days and the mass ratio 0.9266 ± 0.0063. To our knowledge RXJ1603.8-3938 is thus the pre-main sequence binary with the longest period that has a circular orbit. Despite the fact that the masses and spectral types of the two components are almost identical, the photospheric lines are much stronger in one component than in the other. In the wavelength region between 5500 and 7800 Å we find that the ratio of the equivalent widths of the primary to the secondary is 0.60 ± 0.03. This ratio is constant in time, and is the same for all photospheric lines. Since the components are weak-line T Tauri stars, the effect can not be explained by any kind of veiling. We are led to the conclusion that the secondary is 0.55 ± 0.05 mag fainter than the primary. It thus turns out that evolutionary tracks of pre-main sequence single stars are unable to explain the position of this system in the H-R diagram.

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http://www.tls-tautenburg.de/research/tls-research/pub00.html

On Age Spreads in Star-Forming Regions

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I consider current observational constraints on age spreads in star-forming regions and recent attempts to infer the star-forming histories of molecular cloud complexes. My analysis concentrates on low-mass pre-main sequence stars on Hayashi tracks, which constitute the bulk of the stellar population. Current observational and theoretical uncertainties probably preclude any robust inferences of the detailed variation of star formation rates as a function of time. These results do not change the conclusion, supported again recently by the systematic study of Palla & Stahler, that star formation is rapid.

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

On the Be and Ae Stars in NGC 6611

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The young cluster NGC 6611 is of interest because it has been believed to contain an unusually large number of Be and Ae stars. The cluster is imbedded in a very bright H II region so that proper subtraction of that background on slit or multiobject fiber-fed spectra is important. If stellar line emission is present in blue-violet Balmer lines, it should be more prominent at Hα. We have examined some 40 of these cluster stars on Hα slitless spectrograms, which are not subject to such contamination, and were able to confirm the presence of Hα emission above the continuum level in only 4. About 25 much fainter Hα emitters were found in the cluster; these are probably the brightest members of a low-mass T Tauri population. None are convincingly associated with the famous elephant-trunk structures seen in projection against the H II region.

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The initial conditions of isolated star formation: IV – $C^{18}O$ observations and modelling of the pre-stellar core L1689B

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We present $C^{18}O$ observations of the pre-stellar core L1689B, in the (J=3→2) and (J=2→1) rotational transitions, taken at the James Clerk Maxwell Telescope in Hawaii. We use a λ-iteration radiative transfer code to model the data. We adopt a similar form of radial density profile to that which we have found in all pre-stellar cores, with a 'flat' inner profile, steepening towards the edge, but we make the gradient of the 'flat' region a free parameter. We find that the core is close to virial equilibrium, but there is tentative evidence for core contraction. We allow the temperature to vary with a power-law form and find we can consistently fit all of the CO data with an inverse temperature gradient that is warmer at the edge than the centre. However, when we combine the CO data with the previously published millimetre data we fail to find a simultaneous fit to both data-sets without additionally allowing the CO abundance to decrease towards the centre. This effect has been observed qualitatively many times before, as the CO freezes out onto the dust grains at high densities, but we quantify the effect. Hence we show that the combination of mm/submm continuum and spectral line data is a very powerful method of constraining the physical parameters of cores on the verge of forming stars.

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Available from: http://www.astro.cf.ac.uk/pub/Derek.Ward-Thompson/publications.html

Close stellar encounters with planetesimal discs: The dynamics of asymmetry in the β Pictoris system

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We numerically investigate the dynamics of how a close stellar fly-by encounter of a symmetrical circumstellar planetesimal disc can give rise to the many kinds of asymmetries and substructures attributed to the edge-on dusty disc of β Pic. In addition we present new optical coronagraphic observations of the outer parts of β Pic's disc, and report that the radial extent is significantly greater than was found in previous measurements. The northeasterly extension of the disc's midplane is now measured out to 1835 au from the star; the southwesterly component is measured out to 1450 au. Thus the asymmetry in the length of the former with respect to the latter is approximately 25 per cent. We proceed to use the length asymmetry induced in the distribution of simulation test particles as the principal diagnostic feature when modelling the disc response in order to constrain fly-by parameters. In particular we favour a low inclination prograde and near-parabolic orbit perturber of mass approximately $0.5\,M_{\odot}$. These initial conditions suggest that the perturber could have been physically associated with β Pic prior to the encounter. Thus we also consider the possibility that the perturber could be bound to β Pic: a consideration also of general interest where dust discs are known to exist in binary star systems. We show that a further consequence of a low velocity encounter is that the perturber could have captured planetesimals from the β Pic disc, and we deduce that as a result of this the perturber could display a dust disc that is presently amenable to observation. In some of our models, we can relate groupings of perturbed particles to the large-scale structure of the β Pic disc. The groupings correspond to: high eccentricity and inclination particles that reach apocentre and maximum height in the southwest, moderately eccentric and low inclination particles that reach apocentre in the northeast, and relatively unperturbed particles inside ∼200 au radius.

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PostScript file available from: http://www.maths.qmw.ac.uk/∼jdl/preprint.html

A Spectral Line Survey from 138.3 to 150.7 GHz toward Orion-KL

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We present the results of a spectral line survey from 138.3 to 150.7 GHz toward Orion-KL. The observations were made using the 14 m radio telescope of Taeduk Radio Astronomy Observatory. Typical system temperatures were between 500 and 700 K, with the sensitivity between $0.02 - 0.06$ K in units of T_A^*.

A total of 149 line spectra are detected in this survey. Fifty lines have been previously reported, however we find 99 new detections. Among these new lines, 32 are 'unidentified', while 67 are from molecular transitions with known identifications. There is no detection of H or He recombination lines. The identified spectra are from a total of 16 molecular species and their isotopic variants. In the range from 138.3 to 150.7 GHz, the strongest spectral line is the J=3 − 2 transition of CS molecule, followed by transitions of the H_2CO, CH_3OH, CH_3CN, and SO_2. Spectral lines from the large organic molecules such as CH_3OH, CH_3OCH_3, $HCOOCH_3$, C_2H_5CN and CH_3CN are prominent; with 80 % of the identified lines arising from transitions of these molecules. The rotational temperatures and column densities are derived using the standard rotation diagram analysis for CH_3OH ($^{13}CH_3OH$), $HCOOCH_3$, CH_3CN and SO_2 with $10 \sim 270$ K and $0.2 \sim 20 \times 10^{15}$ cm^{-2}. These estimates are fairly comparable to the values for the same molecule in other frequency regions by other studies.

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Quiescent Giant Molecular Cloud Cores in the Galactic Center

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We have used the Long Wavelength Spectrometer (LWS) aboard the Infrared Space Observatory (ISO) to map the far-infrared continuum emission (45–175 μm) toward several massive Giant Molecular Cloud (GMC) cores located near the Galactic center. The observed far-infrared and submillimeter spectral energy distributions imply low temperatures ($\sim$15–22 K) for the bulk of the dust in all the sources, consistent with external heating by the diffuse ISRF and suggest that these GMCs do not harbor high-mass star-formation sites, in spite of their large molecular mass. Observations of FIR atomic fine structure lines of CII and OI indicate an ISRF enhancement of $\sim 10^3$ in the region. Through continuum radiative transfer modeling we show that this radiation field strength is in agreement with the observed FIR and submillimeter spectral energy distributions, assuming primarily external heating of the dust with only limited internal luminosity ($\sim 2 \times 10^5$ $L_\odot$). Spectroscopic observations of millimeter-wave transitions of H_2CO, CS, and $C^{34}S$ carried out with the Caltech Submillimeter Observatory (CSO) and the Institut de Radio Astronomie Millimétrique (IRAM) 30-meter telescope indicate a gas temperature of $\sim$80 K, significantly higher than the dust temperatures, and density of $\sim 1 \times 10^5$ cm^{-3} in GCM0.25+0.01, the brightest submillimeter source in the region. We suggest that shocks caused by cloud collisions in the turbulent interstellar medium in the Galactic center region are responsible for heating the molecular gas. This conclusion is supported by the presence of wide-spread emission from molecules such as SiO, SO, and CH_3OH, which are considered good shock tracers. We also suggest that the GMCs studied here are representative of the "typical", pre-starforming cloud population in the Galactic center.

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ISO spectroscopy of circumstellar dust in 14 Herbig Ae/Be systems: towards an understanding of dust processing.

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We present Infrared Space Observatory (ISO) spectra of fourteen isolated Herbig Ae/Be (HAEBE) stars, to study the characteristics of their circumstellar dust. These spectra show large star-to-star differences, in the emission features of both carbon-rich and oxygen-rich dust grains. The IR spectra were combined with photometric data ranging from the UV through the optical into the sub-mm region. We defined two key groups, based upon the spectral shape of the infrared region. The derived results can be summarized as follows: (1) the continuum of the IR to sub-mm region of all stars can be reconstructed by the sum of a power-law and a cool component, which can be represented by a black body. Possible locations for these components are an optically thick, geometrically thin disc (power-law component) and an optically thin flared region (black body); (2) all stars have a substantial amount of cold dust around them, independent of the amount of mid-IR excess they show; (3) also the near-IR excess is unrelated to the mid-IR excess, indicating different composition/location of the emitting material; (4) remarkably, some sources lack the silicate bands; (5) apart from amorphous silicates, we find evidence for crystalline silicates in several stars, some of which are new detections; (6) PAH bands are present in at least 50% of our sample, and their appearance is slightly different from PAHs in the ISM; (7) PAH bands are, with one exception, not present in sources which only show a power-law continuum in the IR; their presence is unrelated to the presence of the silicate bands; (8) the dust in HAEBE stars shows strong evidence for coagulation; this dust processing is unrelated to any of the central star properties (such as age, spectral type and activity).

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Proper motion of very low mass stars and brown dwarfs in the Pleiades cluster

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We report proper motion measurements for 25 very-low mass (VLM) star and brown dwarf (BD) candidates of the Pleiades cluster previously identified by Bouvier et al. (1998). Proper motions are measured with an accuracy of 9 mas/yr, compared to an expected tangential motion of about 50 mas/yr for Pleiades members. Of the 25 candidates, 15 have a membership probability of 95% or more and 7 are rejected as being field dwarfs. The 3 remaining candidates exhibit independent evidence for membership (lithium absorption or long-term proper motion). From the firm identification of Pleiades VLM and BD members, the cluster's substellar mass function is revised to $dN/dM \propto M^{-0.5}$ in the mass range from 0.04 to $0.3 M_{\odot}$.

Accepted by A&A

Preprint available at: http://www-laog.obs.ujf-grenoble.fr/activites/starform/formation.html

Emission Line Diagnostics of T Tauri Magnetospheric Accretion. II. Improved Model Tests and Insights into Accretion Physics

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We present new radiative transfer models of magnetospheric accretion in T Tauri stars. Hydrogen and Na I line profiles were calculated including line damping and continuum opacity for a grid of models spanning a large range of infall rates, magnetospheric geometries, and gas temperatures. We also calculated models for rotating magnetospheres, and show that for typical T Tauri rotation rates the line profiles are not significantly affected. We show that line damping wings can produce significant high-velocity emission at Hα, and to a lesser extent in higher Balmer lines, in much

better agreement with observations than previous models. We present comparisons to specific objects spanning a wide range of accretion activity, and find that in most cases the models successfully reproduce the observed emission profile features. Blueshifted absorption components cannot be explained without including a wind outside of the magnetosphere, and true P Cygni Balmer line profiles in the few objects with extreme accretion activity indicate both absorption and emission from a wind. We constrain the range of gas temperatures required to explain observational diagnostics like profile shapes, line ratios, and continuum emission. The exact heating mechanism remains unclear, but is probably linked to the accretion process itself. In order to explain observed correlations between line emission and accretion luminosity, we find that the size of the emitting region must be correlated with the accretion rate. We suggest that such a correlation may manifest itself in reality via nonaxisymmetric accretion, where the number and/or width of discrete funnel flows increases with increasing accretion rate, a scenario also indicated by accretion shock models.

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

Orbital Eccentricity Growth Through Disc–Companion Tidal Interaction

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We investigate the driving of orbital eccentricity of giant protoplanets and brown dwarfs through disc–companion tidal interactions by means of two dimensional numerical simulations. We consider disc models that are thought to be typical of protostellar discs during the planet forming epoch, with characteristic surface densities similar to standard minimum mass solar nebula models. We consider companions, ranging in mass between 1 and 30 Jupiter masses M_J, that are initially embedded within the discs on circular orbits about a central solar mass.

We find that a transition in orbital behaviour occurs at a mass in the range $10 - 20M_J$. For low mass planetary companions, we find that the orbit remains essentially circular. However, for companion masses exceeding about $20M_J$, we find that non steady behaviour of the orbit occurs, characterised by a growth in eccentricity to values of $0.1 \leq e \leq 0.25$.

Analysis of the disc response to the presence of a perturbing companion indicates that for the higher masses, the inner parts of the disc that lie exterior to the companion orbit become eccentric through an instability driven through the coupling of an initially small disc eccentricity to the companion's tidal potential. This coupling leads to the excitation of an $m = 2$ spiral wave at the 1:3 outer eccentric Lindblad resonance, which transports angular momentum outwards, leading to a growth of the disc eccentricity. The interaction of the companion with this eccentric disc, and the driving produced by direct resonant wave excitation at the 1:3 resonance, can lead to the growth of orbital eccentricity, with the driving provided by the eccentric disc being the stronger. Eccentricity growth occurs when the tidally induced gap width is such that eccentricity damping caused by corotating Lindblad resonances is inoperative.

These simulations indicate that for standard disc models, gaps become wide enough for the 1:3 resonance to dominate, such that the transition from circular orbits can occur, only for masses in the brown dwarf range. However, the transition mass might be reduced into the range for extrasolar planets if the disc viscosity is significantly lower enabling wider gaps to occur for these masses.

Another possibility is that an eccentric disc is produced by an alternative mechanism, such as viscous overstability resulting in a slowly precessing non axisymmetric mass distribution. A large eccentricity in a planet orbit contained within an inner cavity might then be produced.

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Preprints available at this URL: http://www.maths.qmw.ac.uk/∼rpn/preprint.html:

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

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We have photometrically monitored ∼3600 young, low-mass stars in four $45' \times 45'$ fields in the outer Orion Nebula Cluster (ONC), surrounding but not including the Trapezium region. The 281 periodic variables we find do not produce the expected bimodal distribution of rotation periods. There is no unambiguous correlation of period with $(I_C - K_s)$, $(H - K_s)$, and $(U - V)$ color excesses or more indirect disk indicators; the slowest rotators are not necessarily the disk candidates, and the disk candidates are not necessarily the slow rotators, regardless of how one defines a disk candidate. To the extent that the small numbers allow, the disk candidates represent a constant fraction of the total sample to P=15d, beyond which there are no disk candidates, inconsistent with the hypothesis that the more slowly rotating stars are more likely to have disks. We find an intriguing relationship between specific angular momentum (j) and some excesses, namely $(H - K_s)$ excesses and the strongest $(U - V)$ excesses; whereas stars are found with j values ranging over $\sim 10^6 - 10^8$ km^{2}s^{-1}, disk candidates with these excesses are restricted to $10^{6.5} < j < 10^{7.5}$ km^{2}s^{-1}. A similar relationship is not found for the $(I_C - K_s)$ disk candidates, nor in the less excessive $(U - V)$ candidates. There is no clear correlation between signal amplitude and period or log j. Other investigators have found differences in period distributions for stars more and less massive than 0.25 $M_\odot$; we find ambiguous evidence for differences in distributions of P and no difference in those of log j on either side of this boundary, although for stars more massive than ∼0.6 $M_\odot$, values appear to cluster around $j = 10^7$ km^{2}s^{-1}. When comparing the log j distribution derived here to those for other clusters, we find that it is consistent with a population of stars draining angular momentum into disks. We conclude that disk locking may be operating, but it is not the complete solution to the problem of angular momentum distributions in young stars.

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

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http://irastro.jpl.nasa.gov/∼rebull

A Luminous Infrared Companion in the Young Triple System WL 20

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We present spatially resolved near-infrared and mid-infrared (1–25 μm) imaging of the WL 20 triple system in the nearby (d = 125 pc) ρ Ophiuchi star-forming cloud core. We find WL 20 to be a new addition to the rare class of "infrared companion systems", with WL 20:E and WL 20:W displaying Class II (T-Tauri star) spectral energy distributions (SEDs) and total luminosities of 0.61 and 0.39 $L_\odot$, respectively, and WL 20:S, the infrared companion, with a Class I (embedded protostellar) SED and a luminosity of 1.0–1.8 $L_\odot$. WL 20:S is found to be highly variable over timescales of years, to be extended (40 AU diameter) at mid-infrared wavelengths, and to be the source of the centimeter emission in the system.

The photospheric luminosities of 0.53 $L_\odot$ for WL 20:E and 0.35 $L_\odot$ for WL 20:W, estimated from our data, combined with existing, spatially resolved near-infrared spectroscopy, allow us to compare and test current pre-main-sequence evolutionary tracks. The most plausible, non-accreting tracks describing this system are those of d'Antona & Mazzitelli (1998). These tracks give an age of 2–2.5 $\times 10^6$ yr and masses of 0.62–0.68 $M_\odot$ for WL 20:E and 0.51–0.55 $M_\odot$ for WL 20:W, respectively. The age and mass of WL 20:S cannot be well determined from the currently available data. WL 20:E and WL 20:W fall into the region of the H-R diagram in which sources may appear up to twice as old as

they actually are using non-accreting tracks, a fact which may reconcile the co-existence of two T-Tauri stars with an embedded protostar in a triple system. The derived masses and observed projected separations of the components of the WL 20 triple system indicate that it is in an unstable dynamical configuration, and may therefore provide an example of dynamical evolution during the pre-main-sequence phase.

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`http://irastro.jpl.nasa.gov/~ressler`

An $H^{13}CO^+$ Survey for Dense Envelopes around Low-Mass Embedded Sources in Taurus

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A dense gas survey was carried out toward ten low-mass embedded young sources in Taurus with the Nobeyama Millimeter Array (NMA) to investigate protostellar evolution. All the sources were observed in the $H^{13}CO^+$(J=1-0) line, a high density tracer. Significant $H^{13}CO^+$ emission ($\geq$ 4.5 σ) was detected toward six of them. The $H^{13}CO^+$ emission is distributed roughly perpendicular to the molecular outflow axes indicating that the $H^{13}CO^+$ line traces the dense envelopes associated with the central stars. The sizes and masses of the dense envelopes are estimated to be (1-7) $\times$ 10^3 AU and 0.01 - 0.2 $M_\odot$, respectively. The ten sources are divided into the following three classes based on their $H^{13}CO^+$ intensities of the NMA maps and their properties are studied using our and available data. Class A sources have $H^{13}CO^+$ emission centered on the star with its elongation perpendicular to the molecular outflow axes. These sources also have dense outflowing gas and centrally condensed parent cores. Class B sources have $H^{13}CO^+$ emission near the source positions and dense outflowing gas. The parent cores around Class B sources, however, have a shallower density profile. Class C sources have neither $H^{13}CO^+$ emission nor wing emission in dense gas tracers. From these properties, we conclude that low-mass protostars evolve from Class A, B to C sources by dissipating their parent cloud cores, which is consistent with the widely accepted ideas of star formation. In addition, these observational data suggest that significant dispersion of a parent core by a molecular outflow and main accretion phase ends at the early protostellar phase. Six of the ten sources are detected in continuum emission at 87 GHz. The intensities of the $H^{13}CO^+$ emission do not correlate with the flux densities at 87 GHz. This is because our continuum maps trace compact disks on a 10^2 AU scale and not dense gas on a 10^{3-4} AU scale.

Accepted by Ap. J.

The protostellar system HH108MMS

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We probe the region around the protostar HH108MMS by deep mid infrared photometric and polarimetric imaging. The protostar is detected at 14μm in absorption against the diffuse background. Next to HH108MMS, we find a second absorbing core, named Q1, and the young stellar object IRAS18331–0035 which is more advanced in its evolution and already seen in emission at 12μm and 14μm. HH108MMS, Q1 and IRAS18331–0035 form a triplet along an extended filamentary absorption feature. From the variation of the surface brightness across the source, we derive for HH108MMS and Q1 the optical depth and density profile. Along the axes which are parallel to the filament, the density distributions follow a $\rho \propto r^{-1.8}$ power law. We estimate that the intensity of the background radiation at 14μm is about two times stronger than the intensity of the interstellar radiation field in the solar neighborhood. The present photometric data of IRAS18331–0035 between 12μm and 1.3mm can be explained by a central source with a luminosity of 2.5 $L_\odot$ that is surrounded by a spherical cloud of 1.1 $M_\odot$ with a $1/r$ density distribution. As HH108MMS is also seen in the millimeter dust emission, we can derive the ratio of the dust extinction coefficients at 14μm and 1.3mm and obtain $\kappa_{14\mu m}/\kappa_{1300\mu m} \sim 470$. Because models for the dust in the diffuse interstellar medium

predict a ratio of around 2000, our value points to fluffy composite grains which are expected to prevail in dense and cold environments.

First mid infrared polarisation images of pre–stellar absorbing cores are presented. At 12μm and 14μm the polarisation of the region around HH108MMS is strong ($\geq 15\%$) and tightly correlated with the source triplet. We demonstrate that the high degree of polarisation can be explained by extinction of rotationally aligned dust particles of moderate elongation.

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Supersonic water masers in 30 Doradus

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We report on extremely high velocity molecular gas, up to -80 km s^{-1} relative to the ambient medium, in the giant star-formation complex 30 Doradus in the Large Magellanic Cloud (LMC), as observed in new 22 GHz H_2O $6_{16} \rightarrow 5_{23}$ maser emission spectra obtained with the Mopra radio telescope. The masers may trace the velocities of protostars, and the observed morphology and kinematics indicate that current star formation occurs near the interfaces of colliding stellar-wind blown bubbles. The large space velocities of the protostars and associated gas could result in efficient mixing of the LMC. A similar mechanism in the Milky Way could seed the galactic halo with relatively young stars and gas.

Accepted by Astrophysical Journal Letters

Infrared Properties of Weak Radio Sources in the ρ Ophiuchi Molecular Cloud

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We report mid-infrared ISOCAM observations for a sample of radio continuum sources in the ρ Ophiuchi molecular cloud core with unknown or poorly studied infrared counterparts. These data are combined with existing infrared photometry, including recently published ISOCAM data, for previously studied radio sources to investigate the evolutionary states of 35 radio-emitting young stars in the ρ Oph cloud core. About 50% of the radio stars are found to have Class I, Flat, or Class II spectral energy distributions with near-infrared excesses arising from circumstellar disks. Their radio emission is most likely thermal emission from gas ionized by stellar winds. The remaining radio emitters are young stars with Class III spectral energy distributions which lack infrared excesses and circumstellar disks. Their radio emission is likely non-thermal emission from magnetic surface activity. The lack of young stars with weak infrared excesses supports earlier suggestions that disk dissipation is rapid. Class III sources are twice as common as Class II sources in this radio-selected sample compared to extinction-limited samples, underscoring the importance of radio surveys in obtaining a complete census of young stellar objects. The concentration of diskless Class III objects in the high column density molecular core, and their median age of 0.3 Myr derived from their positions in a Hertzsprung-Russell diagram, indicate they are contemporaries of Class II objects which include the classical T Tauri stars. It appears that these Class III objects have shorter disk survival times than Class II objects in the cloud.

Accepted by The Astrophysical Journal

Preprints available on http://newton.umsl.edu/~ brucew

Dissertation Abstracts

Magnetic Fields and Outflows in Viscous Accretion Discs around Young Stars

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Ph.D dissertation directed by: John C.B. Papaloizou

Ph.D degree awarded: October 2000

In this thesis we address issues relating to the evolution of magnetised accretion discs including the effects of outflows. We construct vertically averaged, radially global, time-dependent models including magnetic torques, viscosity, ν, and magnetic diffusivity, η. We follow the evolution of an initially uniform external magnetic field permeating a disc. We find that when the radial inflow in the disc is calculated self-consistently field lines can be inclined sufficiently to the vertical for centrifugal acceleration of an outflow to occur, provided that $\eta/\nu \lesssim 0.5$. We also follow the evolution of a disc with a magnetic field generated through a non-linear $\alpha - \Omega$ dynamo. Using a form of α which is appropriate for magnetohydrodynamical turbulence in discs we find that magnetic fields of dipolar symmetry are produced. The magnetic field strength and field line inclinations are in general sufficiently large to launch a centrifugally accelerated wind, even for $\eta/\nu > 1$. The evolution of an externally magnetised accretion disc with an outflow is also simulated. We find that for constant η/ν steady states with unrealistically large magnetic fields are produced. Self-consistency arguments are used to propose a variable diffusivity which is a function of the magnetic field. When this diffusivity is implemented the subsequent disc evolution is in general cyclic. During outbursts both the mass accretion and the mass loss rate increase on average by two orders of magnitude. The applicability of this model in observed outbursts in Fuors and X-ray binaries is also explored. Finally we study two-dimensional, force-free equilibria of a star-disc magnetosphere. The poloidal magnetic field is found to be significantly inflated when it is sufficiently wound up. The magnetic torque resulting in this interaction is found to be much smaller than the torque associated with an untwisted poloidal magnetic field.

For more information: http://www-star.qmw.ac.uk/~va

New Jobs

Star Formation Group of the Laboratoire d'Astrophysique de l'Observatoire de Grenoble

Postdoctoral position available

In the framework of the European Commission Research Training Network entitled "The Formation and Evolution of Young Stellar Clusters" (see `http://www.aip.de/~mjm/ecrtn_clusters/`), a postdoctoral position is available for two years in the Star Formation Group of the Laboratoire d'Astrophysique de l'Observatoire de Grenoble (LAOG), France.

LAOG is a major CNRS-University research institute involving about 70 staff members, post-docs and students with a strong focus on stellar astrophysics and the development of instrumentation for high angular resolution imaging. It is located about 100 km south of Lyon at the foot of the Alps.

The Star Formation Group includes 9 permanent staff members, 2 post-docs and 2 students. A description of the activities of the institute and of the Star Formation Group can be found at: http://www-laog.obs.ujf-grenoble.fr/

Our main interests are the study of:

- brown dwarfs and the substellar IMF in young clusters and star forming regions (visual and IR wide-field imaging).
- the formation and pre-main sequence evolution of binary systems (high angular resolution imaging and spectroscopy with adaptive optics).
- the structure and evolution of disks and outflows around young stars (integral field spectroscopy with adaptive optics, near-IR and mm interferometry).

Predominantly an observational group, we have direct access to the ESO facilities, as well as to IRAM, CFHT and national observatories. We also benefit from the development of instrumentation at LAOG for the ESO VLT/VLTI (NAOS, AMBER). As part of the EC Research Training Network, the star formation group also has collaborative access to British, German, Italian, and Portuguese facilities.

Our group also develops radiative transfer models for the circumstellar environment of young stars (circumstellar and circumbinary disks, extended envelopes), closely collaborates with other groups at LAOG that study field brown dwarfs and Beta Pic-like circumstellar disks, and develops stellar evolution codes and MHD models of the accretion-ejection structure of young stars.

We welcome people interested in the study of brown dwarfs in young clusters, young binaries, and/or circumstellar disks around young stars. While experience with astronomical observations, especially wide field imaging and/or high angular resolution imaging/spectroscopy in the near-IR is certainly welcomed, we are also interested in applications from theoreticians/modellers, in particular in the area of radiative transfer in complex geometries (disks, stellar magnetospheres), and the dynamical evolution of clusters.

The successful applicant is expected to take an active role in an ongoing effort to improve our understanding of the formation and early evolution of young stars and their circumstellar environment. He/She will work primarily on the acquisition and interpretation of visual, near-IR and/or (sub-)mm observations, and/or on related theoretical modelling, in collaboration with other teams of the network, which include Arcetri, Cambridge, Cardiff, Lisbon, Potsdam, and Saclay.

Applicants should have a Ph.D. and observational or theoretical experience in young stellar objects, or related fields. They should be 35 or under at the time of appointment, be a national of a European Community member or associated state other than France or have lived in the EC for at least five years before appointment; and not have lived in France

for more than 12 of the 24 months prior to appointment. The position is available immediately but the starting date is very flexible.

The net salary, after deduction of charges, medical coverage, etc. will be around 14,000-15,000 FF/month (2150-2250 euros/month).

Interested scientists should submit a curriculum vitae, a list of publications and a statement of research interests, and should arrange for three letters of reference to be sent to:

Jérôme Bouvier,
Laboratoire d'Astrophysique,
Observatoire de Grenoble,
Université Joseph Fourier,
B.P. 53,
38041 Grenoble Cedex, France
(Phone: + 33 4 76 51 47 90; FAX: + 33 4 76 44 88 21; E-mail: jbouvier@obs.ujf-grenoble.fr)

Review of applications will begin on 15 December 2000 and continue until the position is filled.

Faculty Position in Origins of Solar Systems
THE UNIVERSITY OF CALIFORNIA LOS ANGELES

The Department of Physics & Astronomy and Institute of Geophysics and Planetary Physics (IGPP) at the University of California, Los Angeles, are soliciting applications for a tenure-track position. The position is expected to be at the Assistant Professor level, but a higher level appointment could be considered. The area for this search is the theory of Origins of Solar Systems including, but not limited to, such topics as protostellar disks, jets, planetary dynamics, and star formation.

Facilities available to the person appointed include Keck Observatory, Lick Observatory, and the UCLA Infrared Laboratory. UCLA is also a member of NSF's Center of Adaptive Optics in Astronomy & Vision Science, NASA's Astrobiology Institute, and NASA's Stratospheric Observatory For Infrared Astronomy (SOFIA).

Applications should be sent to:

Selection Committee, Origins of Solar Systems,
c/o F.V. Coroniti, Chair
UCLA Department of Physics and Astronomy
Los Angeles, CA 90095-1547, USA

Applications should include a curriculum vitae, a statement of research interests and the names of at least three people who can be contacted for further information. Reviews of dossiers will begin on February 15, 2001 and will continue until the position is filled. The University of California is an affirmative action and equal opportunity employer. An overview of the Physics & Astronomy Department is available at http://www.physics.ucla.edu, the Division of Astronomy and Astrophysics at http://www.astro.ucla.edu, and IGPP at http://www.igpp.ucla.edu. For further information contact Ferd Coroniti (coroniti@physics.ucla.edu), Andrea Ghez (ghez@astro.ucla.edu), or Michael Ghil (mghil@igpp.ucla.edu).

Faculty Position in Theoretical Astrophysics/Plasma Physics
THE UNIVERSITY OF CALIFORNIA LOS ANGELES

The Department of Physics & Astronomy and Institute of Geophysics and Planetary Physics (IGPP) at the University of California, Los Angeles (UCLA), are soliciting applications for a tenure-track position in Theoretical Astrophysics. The position is expected to be at the Assistant Professor level, but a higher level appointment could be considered. The primary area for this search is Plasma Astrophysics, with potential focus on research areas such as, but not limited to, Origins of Solar Systems, Astrophysical Disks, Jets, Winds. Appointments will be made either solely by the Department of Physics and Astronomy or jointly with IGPP, depending on the subject area.

Applications should be sent to:

Selection Committee, Astrophysics Theory,
c/o F.V. Coroniti, Chair
UCLA Department of Physics and Astronomy
Los Angeles, CA 90095-1547, USA

Applications should include a curriculum vitae, a statement of research interests and the names of at least three people who can be contacted for further information. Reviews of dossiers will begin on February 15, 2001, and will continue until the position is filled. The University of California is an affirmative action and equal opportunity employer. An overview of the Physics & Astronomy Department is available at http://www.physics.ucla.edu, the Division of Astronomy and Astrophysics at http://www.astro.ucla.edu, and IGPP at http://www.igpp.ucla.edu. For further information contact Ferd Coroniti (coroniti@physics.ucla.edu), Andrea Ghez (ghez@astro.ucla.edu) or Michael Ghil (mghil@igpp.ucla.edu).

Announcements

There is now a version of the RATRAN computer program that writes its output in FITS format, which can be downloaded from http://www.mpifr-bonn.mpg.de/staff/fvandertak. This program to calculate molecular line emission from any spherically symmetric source model, described in Hogerheijde & van der Tak 2000, A&A 362, 697, is publicly available.

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.

Meetings

The Earliest Phases of Massive Star Birth

Massive star birth is one of the least understood and most exciting new areas of stellar astrophysics. Our workshop will bring together active scientists and students who study the properties of young massive stars from the giant molecular cloud stage, through to the commencement of their main sequence phase, when they are still obscured by their natal cloud at optical wavelengths. The forthcoming workshop provides a follow-up, albeit to the successful 'Massive Star Birth' Joint Discussion that was held at the IAU General Assembly in Manchester, August 2000. It is expected that an IAU Symposium on this topic will be proposed in the near future, to be held in approx 2004.

A tentative outline of the workshop, together with registration details, is available at the following website:

http://jilawww.colorado.edu/StarBirth

Speakers confirmed as of 29 Nov 00 include, Ed Churchwell, Neal Evans, Stan Kurtz, Melvin Hoare, Nolan Walborn, Harold Yorke, Andre Maeder, Ian Bonnell, John Bally, Chris McKee, Bob Blum, Jean Turner & Paul Ho. Since the capacity of the venue for the meeting, NCAR, is strictly limited, early registration is highly recommended. Given that we are not seeking outside sponsorship, and a registration fee will have to carry the expenses, we will not be able to offer travel or any other expenses. The registration fee is likely to be US $150-200, including lunch, conference dinner and a copy of the proceedings. We can, however, promise an invigorating and interactive meeting and a comfortable environment for this conference.

SOC Ed Churchwell, Peter Conti (co-Chair), Paul Crowther (co-Chair), Bo Reipurth

LOC Kelsey Johnson (Chair), Remy Indebetouw, Joel Parker

For further information or registration, please contact `StarBirth@jila.colorado.edu`

The Star Formation Newsletter is a vehicle for fast distribution of information of interest for astronomers working on star formation and molecular clouds. You can submit material for the following sections: *Abstracts of recently accepted papers* (only for papers sent to refereed journals, not reviews nor conference notes), *Dissertation Abstracts* (presenting abstracts of new Ph.D dissertations), *Meetings* (announcing meetings broadly of interest to the star formation and interstellar medium community), *New Books* (giving details of books relevant for the same community), *New Jobs* (advertising jobs specifically aimed towards persons within our specialty), and *Short Announcements* (where you can inform or request information from the community).

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

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