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Abstracts of recently accepted papers

Desorption of CO and O₂ interstellar ice analogs

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Solid O₂ has been proposed as a possible reservoir for oxygen in dense clouds through freeze-out processes. The aim of this work is to characterize quantitatively the physical processes that are involved in the desorption kinetics of CO-O₂ ices by interpreting laboratory temperature programmed desorption (TPD) data. This information is used to simulate the behavior of CO-O₂ ices under astrophysical conditions. The TPD spectra have been recorded under ultra high vacuum conditions for pure, layered and mixed morphologies for different thicknesses, temperatures and mixing ratios. An empirical kinetic model is used to interpret the results and to provide input parameters for astrophysical models. Binding energies are determined for different ice morphologies. Independent of the ice morphology, the desorption of O₂ is found to follow 0th-order kinetics. Binding energies and temperature-dependent sticking probabilities for CO-CO, O₂-O₂ and CO-O₂ are determined. O₂ is slightly less volatile than CO, with binding energies of 912±15 versus 858±15 K for pure ices. In mixed and layered ices, CO does not co-desorb with O₂ but its binding energies are slightly increased compared with pure ice whereas those for O₂ are slightly decreased. Lower limits to the sticking probabilities of CO and O₂ are 0.9 and 0.85, respectively, at temperatures below 20 K. The balance between accretion and desorption is studied for O₂ and CO in astrophysically relevant scenarios. Only minor differences are found between the two species, i.e., both desorb between 16 and 18 K in typical environments around young stars. Thus, clouds with significant abundances of gaseous CO are unlikely to have large amounts of solid O₂.

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Does radiative feedback by the first stars promote or prevent second generation star formation?

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We study the effect of starlight from the first stars on the ability of other minihaloes in their neighbourhood to form additional stars. The first stars in the Λ cold dark matter (Λ CDM) universe are believed to have formed in minihaloes of total mass $\sim 10^{5-6} M_{\odot}$ at redshifts $z \gtrsim 20$, when molecular hydrogen (H₂) formed and cooled the dense gas at their centres, leading to gravitational collapse. Simulations suggest that the Population III (Pop III) stars thus formed were massive ($\sim 100 M_{\odot}$) and luminous enough in ionizing radiation to cause an ionization front (I-front) to sweep outward, through their host minihalo and beyond, into the intergalactic medium. Our previous work suggested that this I-front was trapped when it encountered other, nearby minihaloes, and that it failed to penetrate the dense gas at

their centres within the lifetime of the Pop III stars ($\lesssim 3$ Myr). The question of what the dynamical consequences were for these target minihaloes, of their exposure to the ionizing and dissociating starlight from the Pop III star requires further study, however. Towards this end, we have performed a series of detailed, one-dimensional (1D), radiation-hydrodynamical simulations to answer the question of whether star formation in these surrounding minihaloes was triggered or suppressed by radiation from the first stars. We have varied the distance to the source (and, hence, the flux) and the mass and evolutionary stage of the target haloes to quantify this effect. We find (1) trapping of the I-front and its transformation from R-type to D-type, preceded by a shock front; (2) photoevaporation of the ionized gas (i.e. all gas originally located outside the trapping radius); (3) formation of an H_2 precursor shell which leads the I-front, stimulated by partial photoionization; and (4) the shock-induced formation of H_2 in the minihalo neutral core when the shock speeds up and partially ionizes the gas. The fate of the neutral core is mostly determined by the response of the core to this shock front, which leads to molecular cooling and collapse that, when compared to the same halo without external radiation, is (a) expedited, or (b) delayed, or (c) unaltered, or (d) reversed or prevented, depending upon the flux (i.e. distance to the source) and the halo mass and evolutionary stage. When collapse is expedited, star formation in neighbouring minihaloes or in merging subhaloes within the host minihalo sometimes occurs within the lifetime of the first star. Roughly speaking, most haloes that were destined to cool, collapse and form stars in the absence of external radiation are found to do so even when exposed to the first Pop III star in their neighbourhood, while those that would not have done so are still not able to. A widely held view that the first Pop III stars must exert either positive or negative feedback on the formation of the stars in neighbouring minihaloes should, therefore, be revisited.

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Proper Motions of the Jets in the Region of HH 30 and HL/XZ Tau. Evidence for a Binary Exciting Source of the HH 30 Jet

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We present [SII] images of the HH 30 and HL/XZ Tau region obtained at two epochs, as well as long-slit optical spectroscopy of the HH 30 jet. We measured proper motions of ~ 100 – 300 km s⁻¹ for the HH 30 jet and counterjet, and of ~ 120 km s⁻¹ for the HL Tau jet. Inclination angles with respect to the plane of the sky are 0° – 40° for the HH 30 jet and 60° for the HL Tau jet. Comparison with previous observations suggests that most of the jet knots consist of persisting structures. Also, we corroborate that the HH 30-N knots correspond to the head of the HH 30 jet. The overall HH 30 jet structure can be well described by a wiggling ballistic jet, arising either by the orbital motion of the jet source around a primary or by precession of the jet axis because of the tidal effects of a companion. In the first scenario, the orbital period would be 53 yr and the total mass 0.25 – $2 M_\odot$. In the precession scenario, the mass of the jet source would be ~ 0.1 – $1 M_\odot$, the orbital period < 1 yr, and the mass of the companion less than a few times $0.01 M_\odot$, thus being a substellar object or a giant exoplanet. In both scenarios a binary system with a separation < 18 AU ($< 0''.13$) is required. Since the radius of the flared disk observed with the *HST* is ~ 250 AU, we conclude that this disk appears to be circumbinary rather than circumstellar, suggesting that the search for the collimating agent of the HH 30 jet should be carried out at much smaller scales.

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<http://arxiv.org/abs/astro-ph/0703155>

On the Nature of the Photometric Activity of the T Tauri Star V1184 Tau

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We present two-year photometric (V, R_c, I_c) observations of the T Tauri star V1184 Tau. They show that the relatively quiet photometric "life" of this object, which ended in 2004 with a sharp brightness decline by four stellar magnitudes, was succeeded by a qualitatively new stage of activity characterized by high-amplitude irregular photometric variability. Judging by its color variations, the object belongs to the class of UX Ori stars and, hence, variable circumstellar extinction is responsible for its brightness variations. Moreover, the $(V - I_c)/V$ color-magnitude diagram for the object is identical to that for UX Ori itself, suggesting that the optical properties of dust grains in the circumstellar space of these stars are similar. At the same time, V1184 Tau is quite dissimilar to UX Ori stars in its light curve, variability amplitude (reaching 4.5 magnitudes in the V band), and some other parameters.

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Efficient Simulations of Interstellar Gas-Grain Chemistry Using Moment Equations

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Networks of reactions on dust-grain surfaces play a crucial role in the chemistry of interstellar clouds, leading to the formation of molecular hydrogen in diffuse clouds as well as various organic molecules in dense molecular clouds. Due to the submicron size of the grains and the low flux, the population of reactive species per grain may be very small and strongly fluctuating. Under these conditions rate equations fail, and the simulation of surface-reaction networks requires stochastic methods such as the master equation. However, the master equation becomes infeasible for complex networks because the number of equations proliferates exponentially. Here we introduce a method based on moment equations for the simulation of reaction networks on small grains. The number of equations is reduced to just one equation per reactive species and one equation per reaction. Nevertheless, the method provides accurate results, which are in excellent agreement with the master equation. The method is demonstrated for the methanol network that has been recently shown to be of crucial importance.

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Interferometric multi-wavelength (sub)millimeter continuum study of the young high-mass protocluster IRAS 05358+3543

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Aims: We study the small-scale structure of massive star-forming regions through interferometric observations in several (sub)mm wavelength bands. These observations resolve multiple sources, yield mass and column density estimates, and give information about the density profiles as well as the dust and temperature properties.

Methods: We observed the young massive star-forming region IRAS 05358+3543 at high-spatial resolution in the continuum emission at 3.1 and 1.2 mm with the Plateau de Bure Interferometer, and at 875 and 438 μm with the Submillimeter Array. The observations are accompanied by VLA 3.6 cm archival continuum data.

Results: We resolve at least four continuum sub-sources that are likely of protostellar nature. Two of them are potentially part of a proto-binary system with a projected separation of 1700 AU. Additional (sub)mm continuum peaks are not necessarily harboring protostars but maybe caused by the multiple molecular outflows. The spectral energy distributions (SEDs) of the sub-sources show several features. The main power house mm1, which is associated with CH_3OH maser emission, a hypercompact HII region and a mid-infrared source, exhibits a typical SED with a free-free emission component at cm and long mm wavelengths and a cold dust component in the (sub)mm part of the spectrum (spectral index between 1.2 mm and 438 μm $\alpha \sim 3.6$). The free-free emission corresponds to a Lyman continuum flux of an embedded $13 M_\odot$ B1 star. The coldest source of the region, mm3, has $\alpha \sim 3.7$ between 1.2 mm

and $875\ \mu\text{m}$, but has lower than expected fluxes in the shorter wavelength $438\ \mu\text{m}$ band. This turnover of the Planck-function sets an upper limit on the dust temperature of mm3 of approximately 20 K. The uv-data analysis of the density structure of individual sub-cores reveals distributions with power-law indices between 1.5 and 2. This resembles the density distributions of the larger-scale cluster-forming clump as well as those from typical low-mass cores. *The files for figures 2, 3, 4 & 6 are also available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/>.*

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<http://www.mpia.de/homes/beuther/papers.html>

A search for 22-GHz water masers within the giant molecular cloud associated with RCW 106

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We report the results of a blind search for 22-GHz water masers in two regions, covering approximately half a square degree, within the giant molecular cloud associated with RCW 106. The complete search of the two regions was carried out with the 26-m Mount Pleasant radio telescope and resulted in the detection of nine water masers, five of which are new detections. Australia Telescope Compact Array (ATCA) observations of these detections have allowed us to obtain positions with arcsecond accuracy, allowing meaningful comparison with infrared and molecular data for the region. We find that for the regions surveyed there are more water masers than either 6.7-GHz methanol, or main-line OH masers. The water masers are concentrated towards the central axis of the star formation region, in contrast to the 6.7-GHz methanol masers which tend to be located near the periphery. The colours of the GLIMPSE point sources associated with the water masers are similar to those of 6.7-GHz methanol masers, but slightly less red. We have made a statistical investigation of the properties of the ^{13}CO and 1.2-mm dust clumps with and without associated water masers. We find that the water masers are associated with the more massive, denser and brighter ^{13}CO and 1.2-mm dust clumps. We present statistical models that are able to predict those ^{13}CO and 1.2-mm dust clumps that are likely to have associated water masers, with a low misclassification rate.

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A CO (J = 3-2) Outflow Survey of the Elias 29 Region

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We present a $5' \times 5'$ integrated intensity map of ^{12}CO (J = 3-2) emission from the ρ Ophiuchi cloud core that traces low-luminosity outflow emission from two protostars: Elias 29 and, most likely, LFAM 26. The morphology of the outflow from Elias 29 is bipolar and has a curved axis that traces the S-shaped symmetry seen in H_2 emission. The outflow from LFAM 26 is a new detection and oriented in the east-west direction near the plane of the sky with most of the blueshifted emission being absorbed by intervening clouds. The outflow axis of this object also appears to intersect a knot of H_2 emission previously attributed to Elias 29. LFAM 26 is a low-luminosity source ($L_{\text{bol}} = 0.06 L_{\odot}$), which, in combination with the observed outflow, makes it a candidate very low luminosity object (VeLLO). We derive lower limits to the gas column densities and energetics for both outflows. The mechanical luminosities for Elias 29 and LFAM 26 are 6.4 and $10.3 \times 10^{-3} L_{\odot}$, respectively.

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Galactic Interstellar Gas Cloud Mass Functions: A Simple Quantitative Approach

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We present here a simple approach to understanding the gas cloud mass distribution function by simulating formation and destruction of gas clouds and gas clumps in the ISM. We include as relevant processes coagulation to form bigger clouds, as well as disruption by collisions and the removal of gas by collapse to form stars. We evolve initial sets of preexisting gas clumps with a range of initial distribution functions (flat, Gaussian, fractal) for their physical parameters and with different geometrical forms (spherical or elongated) for the individual clouds, and constrain them within an imaginary box representing gravitational bounding, applying the kinematic laws of nonelastic collisions. The results agree well with observations of the mass distribution function of Galactic giant gas clouds if we choose a Gaussian for the initial distribution function, and initial gas clouds which are quasi-spherical.

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Magnetic field of the star θ^1 Ori C

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A longitudinal magnetic field is measured for the star θ^1 Ori C at eight points in its period using the C IV 5801 and 5812 Å absorption lines. The maximum value was $+231 \pm 47$ G. The measurements were made with the Main Stellar Spectrograph on the BTA telescope using a circular polarization analyzer with an image slicer and in the back-and-forth mode.

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Further Indications of Jet Rotation in New Ultraviolet and Optical HST/STIS Spectra

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We present survey results which suggest rotation signatures at the base of T-Tauri jets. Observations were conducted with the Hubble Space Telescope Imaging Spectrograph at optical and near ultraviolet wavelengths (NUV). Results are presented for the approaching jet from DG Tau, CW Tau, HH 30 and the bipolar jet from TH 28. Systematic asymmetries in Doppler shift were detected across the jet, within 100 AU from the star. At optical wavelengths, radial velocity differences were typically 10 to 25 (+/-5) km/s, while differences in the NUV range were consistently lower at typically 10 (+/-5) km/s. Results are interpreted as possible rotation signatures. Importantly, there is agreement between the optical and NUV results for DG Tau. Under the assumption of steady magnetocentrifugal acceleration, the survey results lead to estimates for the distance of the jet footpoint from the star, and give values consistent with earlier studies. In the case of DG Tau, for example, we see that the higher velocity component appears to be launched from a distance of 0.2 to 0.5 AU from the star along the disk plane, while the lower velocity component appears to trace a wider part of the jet launched from as far as 1.9 AU. The results for the other targets are similar. Therefore, if indeed the detected Doppler gradients trace rotation within the jet then, under the assumption of steady MHD ejection, the derived footpoint radii support the existence of magnetized disk winds. However, since we do not resolved the innermost layers of the flow, we cannot exclude the possibility that there also exists an X-wind or stellar wind component.

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Unveiling the Cygnus OB2 stellar population with Chandra

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Aims. The aim of this work is to identify the so far unknown low mass stellar population of the ~ 2 Myr old Cygnus OB2 star forming region, and to investigate the X-ray and near-IR stellar properties of its members.

Methods. We analyzed a 97.7 ks Chandra ACIS-I observation pointed at the core of the Cygnus OB2 region. Sources were detected using the PWDETECT code and were positionally correlated with optical and near-IR catalogs from the literature. Source events were extracted with the Acis EXTRACT package. X-ray variability was characterized through the Kolmogorov-Smirnov test and spectra were fitted using absorbed thermal plasma models.

Results. We detected 1003 X-ray sources. Of these, 775 have near-IR counterparts and are expected to be almost all associated with Cygnus OB2 members. From near-IR color-color and color-magnitude diagrams we estimate a typical absorption toward Cygnus OB2 of $A_v \approx 7.0$ mag. Although the region is young, very few stars ($\sim 4.4\%$) show disk-induced excesses in the near-IR. X-ray variability is detected in $\sim 13\%$ of the sources, but this fraction increases, up to 50%, with increasing source statistics. Flares account for at least 60% of the variability. Despite being generally bright, all but 2 of the 26 detected O- that early B-type stars are not significantly variable. Typical X-ray spectral parameters are $\log N_H \sim 22.25$ (cm^{-2}) and $kT \sim 1.35$ keV with 1σ dispersion of 0.2 dex and 0.4 keV, respectively. Variable and flaring sources have harder spectra with median $kT = 3.3$ and 3.8 keV, respectively. OB stars are typically softer ($kT \sim 0.75$ keV). X-ray luminosities range between 10^{30} and 10^{31} erg s^{-1} for intermediate- and low-mass stars, and 2.5×10^{30} and between 6.3×10^{33} erg s^{-1} for OB stars.

Conclusions. The Cygnus OB2 region has a very rich population of low-mass X-ray emitting stars. Circumstellar disks seem to be very scarce. X-ray variability is related to the magnetic activity of low-mass stars ($M/M_\odot \sim 0.5$ to 3.0) display X-ray activity levels comparable to those of Orion Nebular Cluster (ONC) sources in the same mass range.

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A GLIMPSE-based search for 6.7-GHz Methanol Masers and the lifetime of their spectral features

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The University of Tasmania Mt Pleasant 26-m and Ceduna 30-m radio telescopes have been used to search for 6.7-GHz class II methanol masers towards two hundred GLIMPSE sources. The target regions were selected on the basis of their mid-infrared colours as being likely to be young high-mass star formation regions and are either bright at $8.0 \mu\text{m}$, or have extreme [3.6]-[4.5] colour. Methanol masers were detected towards 38 sites, nine of these being new detections. The prediction was that approximately 20 new 6.7-GHz methanol masers would be detected within 3.5 arcmin of the target GLIMPSE sources, but this is the case for only six of the new detections. A number of possible reasons for the discrepancy between the predicted and actual number of new detections have been investigated. It was not possible to draw any firm conclusions as to the cause, but it may be because many of the target sources are at an evolutionary phase prior to that associated with 6.7-GHz methanol masers. Through comparison of the spectra collected as part of this search with those in the literature, the average lifetime of individual 6.7-GHz methanol maser spectral features is estimated to be around 150 years, much longer than is observed for 22-GHz water masers.

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Large Magnetic Fields and Motions of OH Masers in W75N

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We report on a second epoch of VLBA observations of the 1665 and 1667 MHz OH masers in the massive star-forming region W75N. We find evidence to confirm the existence of very strong (~ 40 mG) magnetic fields near source VLA 2. The masers near VLA 2 are dynamically distinct and include a very bright spot apparently moving at 50 km s^{-1} relative to those around VLA 1. This fast-moving spot may be an example of a rare class of OH masers seen in outflows in star-forming regions. Due to the variability of these masers and the rapidity of their motions, tracking these motions will require multiple observations over a significantly shorter time baseline than obtained here. Proper motions of the masers near VLA 1 are more suggestive of streaming along magnetized shocks rather than Keplerian rotation in a disk. The motions of the easternmost cluster of masers in W75N(B) may be tracing slow expansion around an unseen exciting source.

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Simultaneous X-ray, radio, near-infrared, and optical monitoring of Young Stellar Objects in the *Coronet* cluster

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Multi-wavelength (X-ray to radio) monitoring of Young Stellar Objects (YSOs) can provide important information about physical processes at the stellar surface, in the stellar corona, and/or in the inner circumstellar disk regions. While coronal processes should mainly cause variations in the X-ray and radio bands, accretion processes may be traced by time-correlated variability in the X-ray and optical/infrared bands. Several multi-wavelength studies have been successfully performed for field stars and $\sim 1 - 10$ Myr old T Tauri stars, but so far no such study succeeded in detecting simultaneous X-ray to radio variability in extremely young objects like class I and class 0 protostars. Here we present the first simultaneous X-ray, radio, near-infrared, and optical monitoring of YSOs, targeting the *Coronet* cluster in the Corona Australis star-forming region, which harbors at least one class 0 protostar, several class I objects, numerous T Tauri stars, and a few Herbig AeBe stars. In August 2005, we obtained five epochs of *Chandra* X-ray observations on nearly successive days accompanied by simultaneous radio observations at the NRAO Very Large Array during four epochs, as well as by simultaneous optical and near-infrared observations from ground-based telescopes in Chile and South Africa. Seven objects are detected simultaneously in the X-ray, radio, and optical/infrared bands; they constitute our core sample. While most of these sources exhibit clear variability in the X-ray regime and several also display optical/infrared variability, none of them shows significant radio variability on the timescales probed. We also do not find any case of clearly time-correlated optical/infrared and X-ray variability. Remarkable intra-band variability is found for the class I protostar IRS 5 which shows much lower radio fluxes than in previous observations, and the Herbig Ae star R CrA, which displays enhanced X-ray emission during the last two

epochs, but no time-correlated variations are seen for these objects in the other bands. The two components of S CrA vary nearly synchronously in the *I* band. The absence of time-correlated multi-wavelength variability suggests that there is no direct link between the X-ray and optical/infrared emission and supports the notion that accretion is *not* an important source for the X-ray emission of these YSOs. No significant radio variability was found on timescales of days.

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Herbig-Haro flows in L1641N

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Aims: To study the Herbig-Haro (HH) flows in L1641N, an active star formation region in the southern part of the Orion GMC and one of the most densely populated regions of HH objects in the entire sky. By mapping the velocities of these HH objects, combined with mid-IR observations of the young stars, the major flows in the region and the corresponding outflow sources can be revealed.

Methods: We have used the 2.56m Nordic Optical Telescope (NOT) to observe two deep fields in L1641N, selected on the basis of previous shock studies, using the $2.12\ \mu\text{m}$ transition of H_2 (and a K_S filter to sample the continuum) for a total exposure time of 4.6 hours (72 min K_S) in the overlapping region. The resulting high-resolution mosaic (0.23" pixel size, 0.75" seeing) shows numerous new shocks and resolves many known shocks into multiple components. Using previous observations taken 9 years earlier we calculate a proper motion map and combine this with Spitzer $24\ \mu\text{m}$ observations of the embedded young stars.

Results: The combined H_2 mosaic shows many new shocks and faint structures in the HH flows. From the proper motion map we find that most HH objects belong to two major bi-polar HH flows, the large-scale roughly North-South oriented flow from central L1641N and a previously unseen HH flow in eastern L1641N. Combining the tangential velocity map with the mid-IR Spitzer images, two very likely outflow sources are found. The outflow source of the eastern flow, L1641N-172, is found to be the currently brightest mid-IR source in L1641N and seem to have brightened considerably during the past 20 years. We make the first detection of this source in the near-IR (K_S) and also find a near-IR reflection nebula pointing at the source, probably the illuminated walls of a cone-shaped cavity cleared out by the eastern lobe of the outflow. Extending a line from the eastern outflow source along the proper motion vector we find that HH 301 and HH 302 (almost 1 pc away) belong to this new HH flow.

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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 $10\ \text{km s}^{-1} \times 3'' \times 2''$. Among the objects and regions revealed in this study are (1) the Diffuse Blue Layer, an extended layer of moderately blueshifted, 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.

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Non-thermal desorption from interstellar dust grains *via* exothermic surface reactions.

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Aims: The gas-phase abundance of methanol in dark quiescent cores in the interstellar medium cannot be explained by gas-phase chemistry. In fact, the only possible synthesis of this species appears to be production on the surfaces of dust grains followed by desorption into the gas. Yet, evaporation is inefficient for heavy molecules such as methanol at the typical temperature of 10 K. It is necessary then to consider non-thermal mechanisms for desorption. But, if such mechanisms are considered for the production of methanol, they must be considered for all surface species.

Methods: Our gas-grain network of reactions has been altered by the inclusion of a non-thermal desorption mechanism in which the exothermicity of surface addition reactions is utilized to break the bond between the product species and the surface. Our estimated rate for this process derives from a simple version of classical unimolecular rate theory with a variable parameter only loosely constrained by theoretical work.

Results: Our results show that the chemistry of dark clouds is altered slightly at times up to 10^6 yr, mainly by the enhancement in the gas-phase abundances of hydrogen-rich species such as methanol that are formed on grain surfaces. At later times, however, there is a rather strong change. Instead of the continuing accretion of most gas-phase species onto dust particles, a steady-state is reached for both gas-phase and grain-surface species, with significant abundances for the former. Nevertheless, most of the carbon is contained in an undetermined assortment of heavy surface hydrocarbons.

Conclusions: The desorption mechanism discussed here will be better constrained by observational data on pre-stellar cores, where a significant accretion of species such as CO has already occurred.

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HERACLES: a three-dimensional radiation hydrodynamics code

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Aims. We present a new three-dimensional radiation hydrodynamics code called HERACLES that uses an original moment method to solve the radiative transfer.

Methods. The radiation transfer is modelled using a two-moment model and a closure relation that allows large angular anisotropies in the radiation field to be preserved and reproduced. The radiative equations thus obtained are solved by a second-order Godunov-type method and integrated implicitly by using iterative solvers. HERACLES has been parallelized with the MPI library and implemented in Cartesian, cylindrical, and spherical coordinates. To characterize the accuracy of HERACLES and to compare it with other codes, we performed a series of tests including purely radiative tests and radiation-hydrodynamics ones.

Results. The results show that the physical model used in HERACLES for the transfer is fairly accurate in both the diffusion and transport limit, but also for semi-transparent regions.

Conclusions. This makes HERACLES very well-suited to studying many astrophysical problems such as radiative shocks, molecular jets of young stars, fragmentation and formation of dense cores in the interstellar medium, and protoplanetary discs.

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Star formation region in Vela

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A star formation region connected with SNO 41 is investigated. The observations of this region were carried out in the ¹²CO (1-0) line and in the 1.2-mm (with SIMBA) with the 15-m SEST mm telescope (Cerro La Silla, Chile). A blue shifted outflow is revealed from the ¹²CO(1-0) observations, while a bipolar outflow is apparent from the 1.2-mm SIMBA image. In CO it seems that a very faint dust envelope around SNO 41 probably exists, which is expanding with a velocity of ~ 10.5 km/s. The distance to SNO 41 is estimated as ~ 1500 pc. There are outflows also present in 2MASS images. A spiral jet has a condensation (resembling a HH object) at the end. Another jet has a discontinuity and a bow-shock-like structure on it. In 2MASS images there are also spots resembling HH objects. In this region there is also a rather luminous point source (IRAS 08546-4254), which has IR colors typical for an YSO connected with a water maser. The detection of a strong CS (2-1) line emission toward IRAS 08546-4254, with the same velocity as the CO line, shows the existence of a high density core of molecular gas associated to this source. A methanol maser is also associated with that IRAS source. The existence of CS line emission and a methanol maser (at 6.669 GHz) is an indication of the presence of a very young massive star. It is not excluded that this IRAS source is the center of outflows mentioned above, because this source coincides with the center of the 1.2-mm SIMBA image and also with the place of origin of the jet with bow-shock-like structure.

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The Galactic distribution of magnetic fields in molecular clouds and HII regions

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Aims. Magnetic fields exist on all scales in our Galaxy. There is a controversy about whether the magnetic fields in molecular clouds are preserved from the permeated magnetic fields in the interstellar medium (ISM) during cloud formation. We investigate this controversy using available data in the light of the newly revealed magnetic field structure of the Galactic disk obtained from pulsar rotation measures (RMs).

Methods. We collected measurements of the magnetic fields in molecular clouds, including Zeeman splitting data of OH masers in clouds and OH or HI absorption or emission lines of clouds themselves.

Results. The Zeeman data show structures in the sign distribution of the line-of-sight component of the magnetic field. Compared to the large-scale Galactic magnetic fields derived from pulsar RMs, the sign distribution of the Zeeman data shows similar large-scale field reversals. Previous such examinations were flawed in the over-simplified global model used for the large-scale magnetic fields in the Galactic disk.

Conclusions. We conclude that the magnetic fields in the clouds may still “remember” the directions of magnetic fields in the Galactic ISM to some extent, and could be used as complementary tracers of the large-scale magnetic structure. More Zeeman data of OH masers in widely distributed clouds are required.

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EX Lupi: History and Spectroscopy

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EX Lupi is the prototype of the “EXor” class, which are pre-main-sequence variables that normally remain at minimum

light, but are subject to relatively brief (a few months to a few years) flareups of several magnitudes amplitude. This paper examines what is known about EX Lup itself, and describes new photometric and spectroscopic information collected between 1995 and 2005, during which time the star underwent four flareups. It is concluded, in agreement with previous investigations, that the flareups are due to intermittent mass infall. The evidence: veiling of the M0-type absorption spectrum, appearance of reversed P Cyg-type absorption components displaced up to $+340 \text{ km s}^{-1}$ at many emission lines, and striking variations in emission-line structure. It remains to be seen if these phenomena are shared by other EXors, often classified as such on the basis of fragmentary observational evidence.

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The Role of Ambipolar Diffusion in the Formation Process of Moderately Magnetized Diffuse Clouds

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We investigate the dynamical condensation process in a magnetized, thermally bistable medium. We perform one-dimensional two-fluid numerical simulations that describe the neutral and ionized components in the interstellar medium with purely transverse magnetic fields. We find that the clouds that are formed as a consequence of the thermal instability always have a magnetic field strength on the order of a few microgauss irrespective of the initial strength. This shows good agreement with the measurements of the magnetic field strength in diffuse clouds. We show analytically that the final magnetic field strength in the clouds is determined by the balance between ambipolar diffusion and the accumulation of the magnetic field due to condensation.

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Protoplanetary disk turbulence driven by the streaming instability: Non-linear saturation and particle concentration

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We present simulations of the non-linear evolution of streaming instabilities in protoplanetary disks. The two components of the disk, gas treated with grid hydrodynamics and solids treated as superparticles, are mutually coupled by drag forces. We find that the initially laminar equilibrium flow spontaneously develops into turbulence in our unstratified local model. Marginally coupled solids (that couple to the gas on a Keplerian time-scale) trigger an upward cascade to large particle clumps with peak overdensities above 100. The clumps evolve dynamically by losing material downstream to the radial drift flow while receiving recycled material from upstream. Smaller, more tightly coupled solids produce weaker turbulence with more transient overdensities on smaller length scales. The net inward radial drift is decreased for marginally coupled particles, whereas the tightly coupled particles migrate faster in the saturated turbulent state. The turbulent diffusion of solid particles, measured by their random walk, depends strongly on their stopping time and on the solids-to-gas ratio of the background state, but diffusion is generally modest, particularly for tightly coupled solids. Angular momentum transport is too weak and of the wrong sign to influence stellar accretion. Self-gravity and collisions will be needed to determine the relevance of particle overdensities for planetesimal formation.

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A comparison of density structures of a star forming and a non-star-forming globule - DCld303.8-14.2 and Thumbprint nebula

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We present a study of radial density structure of the star forming globule, DC1d303.8-14.2 (DC303), and a non-star forming globule, Thumbprint Nebula (TPN), using near-infrared data taken with the ISAAC instrument on the Very Large Telescope. We derive the extinction through the globules using the color excess technique and examine the radial density distribution using Bonnor-Ebert and power-law models. The two globules have significantly different density structures. The extinction profile of DC303 is best fitted with a single power-law with an exponent $p = 2.29 \pm 0.08$. An unstable Bonnor-Ebert model with a dimensionless parameter $\xi_{\max} = 23 \pm 3$ provides equally good fit to data. The extinction profile of TPN flattens at small radii, making the profile significantly different from the profile of DC303. We are unable to fit the Bonnor-Ebert model for TPN in a robust manner, but derive the lower limit $\xi_{\max} \gtrsim 8$ for the dimensionless outer edge. The density profile derived for TPN is typical compared to recently observed pre-protostellar globules, with high ξ_{\max} value which could be interpreted as the presence of significant additional support or very slow contraction.

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Near-Infrared Imaging Polarimetry of the Star Forming Region NGC 2024

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We conducted wide-field JHK_s imaging polarimetry toward NGC 2024, which is a massive star-forming region in the Orion B cloud. We found a prominent and extended polarized nebula over NGC 2024, and constrained the location of illuminating source of the nebula through the analysis of polarization vectors. A massive star, IRS 2b with a spectral type of O8 – B2, is located in the center of the symmetric vector pattern. Five small polarized nebulae associated with YSOs are discovered on our polarization images. These nebulae are responsible for the structures of circumstellar matter (i.e., disk/envelope systems) that produce strongly polarized light through dust scattering. For the point-like sources, we performed software aperture polarimetry in order to measure integrated polarizations, with which we detected candidate sources associated with circumstellar material by selecting sources with a larger polarization than that estimated from the extinction of foreground material. We investigated the fraction of highly polarized sources against the intrinsic luminosity of stars (\propto mass), and found that the source detection rate remains constant from low (brown dwarfs) to higher luminosity (solar-type) stars. This result indicates the relative disk scale-height is rather independent of the stellar mass. We confirmed the result using our polarimetry of the stars with known spectral types in NGC 2024. We found five young brown dwarfs with highly polarized integrated emission. These sources serve as direct evidence for the existence of disk/envelope system around brown dwarfs. We investigated the magnetic field structure of NGC 2024 through the measurements of dichroic polarization. The average position angle of projected magnetic fields across the region is found to be 110° . We found a good consistency in magnetic field structures obtained using near-infrared dichroic polarization and sub-mm/far-infrared dust emission polarization, indicating that the dichroic polarizations at near-infrared wavelengths trace magnetic field structures inside dense ($A_V \lesssim 50$ mag) molecular clouds.

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High-resolution simulations of clump-clump collisions using SPH with Particle Splitting

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We investigate, by means of numerical simulations, the phenomenology of star formation triggered by low-velocity collisions between low-mass molecular clumps. The simulations are performed using an SPH code which satisfies the Jeans condition by invoking On-the-Fly Particle Splitting.

Clumps are modelled as stable truncated (non-singular) isothermal, i.e. Bonnor-Ebert, spheres. Collisions are characterised by M_0 (clump mass), b (offset parameter, i.e. ratio of impact parameter to clump radius), and \mathcal{M} (Mach Number, i.e. ratio of collision velocity to effective post-shock sound speed). The gas subscribes to a barotropic equation of state, which is intended to capture (i) the scaling of pre-collision internal velocity dispersion with clump mass, (ii) post-shock radiative cooling, and (iii) adiabatic heating in optically thick protostellar fragments.

The efficiency of star formation is found to vary between 10% and 30% in the different collisions studied and it appears to increase with decreasing M_0 , and/or decreasing b , and/or increasing \mathcal{M} . For $b < 0.5$ collisions produce shock compressed layers which fragment into filaments. Protostellar objects then condense out of the filaments and accrete from them. The resulting accretion rates are high, 1 to $5 \times 10^{-5} M_{\odot} \text{yr}^{-1}$, for the first 1 to 3×10^4 yrs. The densities in the filaments, $n_{\text{H}_2} \gtrsim 5 \times 10^5 \text{cm}^{-3}$, are sufficient that they could be mapped in NH_3 or CS line radiation, in nearby star formation regions.

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Torsionally Excited Methyl Formate in Orion KL

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We report the first detection of rotational transitions of methyl formate (HCOOCH_3) in the first torsionally excited state ($v_t = 1$). Recent progress on the assignment of laboratory spectra of methyl formate made it possible for us to assign about 20 unidentified lines in Orion KL from previous line surveys below 200 GHz to the first torsionally excited methyl formate. The rotational temperature and column density obtained in the first torsionally excited state were 44 ± 10 K and $(8.6 \pm 3.2) \times 10^{14} \text{cm}^{-2}$, respectively. They were compared with those in the ground state.

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Measuring the Mass of a Pre-Main Sequence Binary Star Through the Orbit of TWA 5A

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We present the results of a five year monitoring campaign of the close binary TWA 5Aab in the TW Hydrae association,

using speckle and adaptive optics on the W.M. Keck 10 m telescopes. These measurements were taken as part of our ongoing monitoring of pre-main sequence (PMS) binaries in an effort to increase the number of dynamically determined PMS masses and thereby calibrate the theoretical PMS evolutionary tracks. Our observations have allowed us to obtain the first determination of this system's astrometric orbit. We find an orbital period of 5.94 ± 0.09 years and a semi-major axis of $0.066'' \pm 0.005''$. Combining these results with a kinematic distance, we calculate a total mass of $0.71 \pm 0.14 M_{\odot} (D/44 \text{ pc})^3$ for this system. This mass measurement, as well as the estimated age of this system, are consistent to within 2σ of all theoretical models considered. In this analysis, we properly account for correlated uncertainties, and show that while these correlations are generally ignored, they increase the formal uncertainties by up to a factor of five and therefore are important to incorporate. With only a few more years of observation, this type of measurement will allow the theoretical models to be distinguished.

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Structure of the inner region of the accretion disk of the Herbig Ae star CQ Tau based on long-term monitoring data

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Results from simultaneous spectral and photometric monitoring of the Herbig Ae star CQ Tau in the neighborhood of the H α and resonance sodium doublet Na I D lines are presented. It is shown that the inner structure of the accretion disk of CQ Tau is nonuniform and consists of two regions with quite different kinematic characteristics. Region I is characterized by relative stability and a smooth long-term variation in the velocity of the gas along the line of sight. Region II is distinguished by the highest velocities and a variability in their maximum values over time scales from a few days to 700 days. The dust clouds which produce the stars brightness minima may also be the source of cold gas and contribute to the observed spectral variability. We assume that region I of the disk coincides with the accretion disk of the star. The kinematic differences in region II may be caused by dissipation of circumstellar dust clouds which, moving in elongated orbits, are able to approach the star quite closely.

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Visual/infrared interferometry of Orion Trapezium stars: Preliminary dynamical orbit and aperture synthesis imaging of the θ^1 Orionis C system

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Context: Located in the Orion Trapezium cluster, θ^1 Ori C is one of the youngest and nearest high-mass stars (O5-O7) known. Besides its unique properties as a magnetic rotator, the system is also known to be a close binary.

Aims: By tracing its orbital motion, we aim to determine the orbit and dynamical mass of the system, yielding a characterization of the individual components and, ultimately, also new constraints for stellar evolution models in the high-mass regime. Furthermore, a dynamical parallax can be derived from the orbit, providing an independent

estimate for the distance of the Trapezium cluster.

Methods: Using new multi-epoch visual and near-infrared bispectrum speckle interferometric observations obtained at the BTA 6 m telescope, and IOTA near-infrared long-baseline interferometry, we traced the orbital motion of the θ^1 Ori C components over the interval 1997.8 to 2005.9, covering a significant arc of the orbit. Besides fitting the relative position and the flux ratio, we applied aperture synthesis techniques to our IOTA data to reconstruct a model-independent image of the θ^1 Ori C binary system.

Results: The orbital solutions suggest a highly eccentricity ($e \approx 0.91$) and short-period ($P \approx 10.9$ yrs) orbit. As the current astrometric data only allows rather weak constraints on the total dynamical mass, we present the two best-fit orbits. Of these two, the one implying a system mass of $48 M_{\odot}$ and a distance of 434 pc to the Trapezium cluster can be favored. When also taking the measured flux ratio and the derived location in the HR-diagram into account, we find good agreement for all observables, assuming a spectral type of O5.5 for θ^1 Ori C1 ($M = 34.0 M_{\odot}$, $T_{\text{eff}} = 39\,900$ K) and O9.5 for C2 ($M = 15.5 M_{\odot}$, $T_{\text{eff}} = 31\,900$ K). Using IOTA, we also obtained first interferometric observations on θ^1 Ori D, finding some evidence for a resolved structure, maybe by a faint, close companion.

Conclusions: We find indications that the companion C2 is massive itself, which makes it likely that its contribution to the intense UV radiation field of the Trapezium cluster is non-negligible. Furthermore, the high eccentricity of the preliminary orbit solution predicts a very small physical separation during periastron passage (~ 1.5 AU, next passage around 2007.5), suggesting strong wind-wind interaction between the two O stars.

Call for observations: Based on our findings, we strongly encourage observers to acquire high dispersion spectra of the system in order to trace the expected radial velocity variations during periastron passage and, potentially, wind-wind interaction within the system. Accurate radial velocity measurements could also result in a first spectroscopic orbit. Combined with a final astrometric orbital solution, such observations could yield new constraints for stellar evolutionary models in the high-mass regime and a precise, independent estimation of the distance to the Orion Trapezium cluster.

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W51 IRS 2: A Massive Jet Emerging from a Molecular Cloud into an H II Region

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We have mapped [Ne II] ($12.8\mu\text{m}$) and [S IV] ($10.5\mu\text{m}$) emission from W51 IRS 2 with TEXES on Gemini North, and we compare these data to VLA free-free observations and VLT near-infrared images. With $0.5''$ spatial and 4 km s^{-1} spectral resolution, we are able to separate the ionized gas into several components: an extended H II region on the front surface of the molecular cloud, several embedded compact H II regions, and a streamer of high-velocity gas. We interpret the high-velocity streamer as a precessing or fanlike jet, which has emerged from the molecular cloud into an OB star cluster where it is being ionized.

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Molecular oxygen in the Ophiuchi cloud

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Molecular oxygen, O₂, has been expected historically to be an abundant component of the chemical species in molecular clouds and, as such, an important coolant of the dense interstellar medium. However, a number of attempts from both ground and from space have failed to detect O₂ emission.

The work described here uses heterodyne spectroscopy from space to search for molecular oxygen in the interstellar medium.

The Odin satellite carries a 1.1 m sub-millimeter dish and a dedicated 119 GHz receiver for the ground state line of O₂. Starting in 2002, the star forming molecular cloud core ρ Oph A was observed with Odin for 34 days during several observing runs.

We detect a spectral line at $v_{\text{LSR}} = +3.5 \text{ km s}^{-1}$ with $\Delta v_{\text{FWHM}} = 1.5 \text{ km s}^{-1}$, parameters which are also common to other species associated with ρ Oph A. This feature is identified as the O₂ ($N_J = 1_1 - 1_0$) transition at 118 750.343 MHz.

The abundance of molecular oxygen, relative to H₂, is 5×10^{-8} averaged over the Odin beam. This abundance is consistently lower than previously reported upper limits.

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On the Nature of the Extended Radio Emission Surrounding T Tauri South

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At centimeter wavelengths, the young stellar system T Tauri is known to be composed of two sources, the northern one associated with the optical star T Tau itself, and the southern one related to the infrared companion T Tau S. Here we reexamine the origin of the radio emission from these two components using archival 2 cm, 3.6 cm, and 6 cm VLA observations. The emission from the northern member is confirmed to be largely dominated by free-free radiation from an ionized wind, while the southern radio source is confirmed to consist of a compact component of magnetic origin, surrounded by an extended halo. Only moderately variable, the extended structure associated with the southern source is most likely the result of free-free radiation related to stellar winds. However, its flat spectral energy distribution, its extent, and the lack of variation of its size with the frequency of observation are incompatible with the classical picture of a fully ionized wind with constant velocity and mass-loss rate leading to an electron density distribution of $n_e(r) \propto r^{-2}$. Instead, we propose a model in which the ionization results from the impact of a supersonic wind driven by T Tau Sb onto dense surrounding material, possibly associated with the circumbinary disk recently identified around the T Tau Sa/T Tau Sb pair. The timescales for cooling and recombination in such a situation are in good agreement with the observed morphological changes undergone by the extended structure as its driving source moves through the environment.

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Unraveling the Origins of Nearby Young Stars

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A systematic search for close conjunctions and clusterings in the past of nearby stars younger than the Pleiades is undertaken, which may reveal the time, location, and mechanism of formation of these often isolated, disconnected from clusters and star-forming regions, objects. The sample under investigation includes 101 T Tauri, post-TT, and main-sequence stars and stellar systems with signs of youth, culled from the literature. Their Galactic orbits are traced back in time and near approaches are evaluated in time, distance, and relative velocity. Numerous clustering events are detected, providing clues to the origin of very young, isolated stars. Each star's orbit is also matched with those of nearby young open clusters, OB and TT associations and star-forming molecular clouds, including the Ophiuchus, Lupus, Corona Australis, and Chamaeleon regions. Ejection of young stars from open clusters is ruled out for nearly all investigated objects, but the nearest OB associations in Scorpius-Centaurus, and especially, the dense clouds in Ophiuchus and Corona Australis have likely played a major role in the generation of the local streams (TWA, Beta Pic, and Tucana-Horologium) that happen to be close to the Sun today. The core of the Tucana-Horologium association probably originated from the vicinity of the Upper Scorpius association 28 Myr ago. A few proposed members of the AB Dor moving group were in conjunction with the coeval Cepheus OB6 association 38 Myr ago.

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Star formation in the Vela Molecular Ridge. Large scale mapping of cloud D in the mm continuum

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The Vela Molecular Ridge is one of the nearest intermediate-mass star forming regions, located within the galactic plane and outside the solar circle. Cloud D, in particular, hosts a number of small embedded young clusters. We present the results of a large-scale map in the dust continuum at 1.2 mm of a $\sim 1^\circ \times 1^\circ$ area within cloud D. The main aim of the observations was to obtain a complete census of cluster-forming cores and isolated (both high- and

low-mass) young stellar objects in early evolutionary phases. The bolometer array SIMBA at SEST was used to map the dust emission in the region with a typical sensitivity of ~ 20 mJy/beam. This allows a mass sensitivity of $\sim 0.2 M_{\odot}$. The resolution is $24''$, corresponding to ~ 0.08 pc, roughly the radius of a typical young embedded cluster in the region. The continuum map is also compared to a large scale map of CO(1–0) integrated emission. Using the CLUMPFIND algorithm, a robust sample of 29 cores has been obtained, spanning the size range $0.03 - 0.25$ pc and the mass range $0.4 - 88 M_{\odot}$. The most massive cores are associated both with red IRAS sources and with embedded young clusters, and coincide with CO(1–0) integrated emission peaks. The cores are distributed according to a mass spectrum $\sim M^{-\alpha}$ and a mass-versus-size relation $\sim D^x$, with $\alpha \sim 1.45 - 1.9$ and $x \sim 1.1 - 1.7$. They appear to originate in the fragmentation of gas filaments seen in CO(1–0) emission and their formation is probably induced by expanding shells of gas. The core mass spectrum is flatter than the Initial Mass Function of the associated clusters in the same mass range, suggesting further fragmentation within the most massive cores. A threshold $A_V \sim 12$ mag seems to be required for the onset of star formation in the gas.

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Spectral and morphological studies of an “infrared” nebula in the region of Cyg OB7

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Spectral and morphological studies of an infrared nebula in the neighborhood of Cyg OB7 discovered in 2007 are reported. It is shown that over the last several years the brightness and shape of the nebula have changed significantly. Spectral observations of the nebula made with the 2.6-m telescope at the Byurakan Observatory in 2004 and 2005 reveal the existence of a faint trace of continuum spectrum, indicating the existence of a star inside the dark cloud. Classification of these spectra shows that over one year the stars spectral class changed from late G to early K. It is also shown that the absorption in the direction of the nebula is as high as 8^m-10^m .

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N-Body Simulation of Planetesimal Formation through Gravitational Instability of a Dust Layer

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We performed N-body simulations of a dust layer without a gas component and examined the formation process of planetesimals. We found that the formation process of planetesimals can be divided into three stages: the formation of nonaxisymmetric wakelike structures, the creation of aggregates, and the collisional growth of the aggregates. Finally, a few large aggregates and many small aggregates are formed. The mass of the largest aggregate is larger than the mass predicted by the linear perturbation theory. We examined the dependence of system parameters on the planetesimal formation. We found that the mass of the largest aggregates increases as the size of the computational domain increases. However, the ratio of the aggregate mass to the total mass M_{aggr}/M_{total} is almost constant, 0.8-0.9. The mass of the largest aggregate increases with the optical depth and the Hill radius of particles.

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A radiation driven implosion model for the enhanced luminosity of protostars near HII regions

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Context. Molecular clouds near the H II regions tend to harbor more luminous protostars. *Aims.* Our aim in this paper is to investigate whether or not radiation-driven implosion mechanism enhances luminosity of protostars near regions of high-ionizing fluxes. *Methods.* We performed numerical simulations to model collapse of cores exposed to UV radiation from O stars. We investigated dependence of mass loss rates on the initial density profiles of cores and variation of UV fluxes. We derived simple analytic estimates of accretion rates and final masses of protostars. *Results.* Radiation-driven implosion mechanism can increase accretion rates of protostars by 1-2 orders of magnitude. On the other hand, mass loss due to photo-evaporation is not large enough to have a significant impact on the luminosity. The increase of accretion rate makes luminosity 1-2 orders higher than those of protostars that form without external triggering. *Conclusions.* Radiation-driven implosion can help explain the observed higher luminosity of protostars in molecular clouds near H II regions.

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Formation of a massive protostar through disk accretion. II. SINFONI integral field spectroscopy of the M 17 silhouette disk and discovery of the associated H₂ jet

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Context. Recent observational results suggest that high-mass (proto-)stars form in a similar way to low- and intermediate-mass stars, i.e., via disk accretion of gas and dust.

Aims. To further characterize and understand the on-going physical processes associated with a large circumstellar disk, seen as a dark silhouette against the bright background of the M 17 H II region, we report and discuss new high angular resolution integral field spectroscopy performed in the K-band.

Methods. The data were taken with the Adaptive Optics (AO) supported near-infrared integral field spectrograph SINFONI at ESO's Very Large Telescope Yepun (VLT UT 4) as part of the science verification of this new instrument.

Results. Based on obtained H₂ v=1-0S(1) and H₂ v=1-0S(3) emission maps, we report the discovery of a H₂ jet, which apparently arises from the suspected protostellar source(s) located at the very center of the disk. In addition, both diameter (about 4000 AU) and sub-structures of the innermost, densest part of the flared disk are inferred from Br γ , Br δ , and He I maps.

Conclusions. Because ejection of material through a jet / outflow is always linked to accretion of gas and dust either onto the circumstellar disk or onto the central (protostellar) source(s), the presence of a collimated H₂ jet provides indirect but unquestionable evidence for ongoing accretion processes in the case of the M17 disk. The high mass outflow and accretion rates of $> 10^{-5} M_{\odot} \text{yr}^{-1}$ derived from the SINFONI data suggest that a star of rather high mass is forming.

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Two regimes of Turbulent Fragmentation and the stellar IMF from Primordial to Present Day Star Formation

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The Padoan and Nordlund model of the stellar initial mass function (IMF) is derived from low order statistics of supersonic turbulence, neglecting gravity (e.g. gravitational fragmentation, accretion and merging). In this work the predictions of that model are tested using the largest numerical experiments of supersonic hydrodynamic (HD) and magneto-hydrodynamic (MHD) turbulence to date ($\sim 1000^3$ computational zones) and three different codes (Enzo, Zeus and the Stagger Code). The model predicts a power law distribution for large masses, related to the turbulence energy power spectrum slope, and the shock jump conditions. This power law mass distribution is confirmed by the numerical experiments. The model also predicts a sharp difference between the HD and MHD regimes, which is recovered in the experiments as well, implying that the magnetic field, even below energy equipartition on the large scale, is a crucial component of the process of turbulent fragmentation. These results suggest that the stellar IMF of primordial stars may differ from that in later epochs of star formation, due to differences in both gas temperature and magnetic field strength. In particular, we find that the IMF of primordial stars born in turbulent clouds may be narrowly peaked around a mass of order $10 M_{\odot}$, as long as the column density of such clouds is not much in excess of 10^{22} cm^{-2} .

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Old stars in young clusters: Lithium depleted low-mass stars of the Orion Nebula Cluster

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We measured lithium in a sample of low-mass stars ($\sim 0.1-0.3 M_{\odot}$) of the Orion Nebula Cluster. We find evidence for significant Li depletion in four high probability members, corresponding to nuclear ages between ~ 15 and 30 Myr. In two cases, there is excellent agreement between the mass and age based on models of Li burning and those derived from the HR diagram, reinforcing our early findings (Palla et al. 2005). For the two other stars, the nuclear age is significantly larger than the isochronal one. Several Li-depleted stars display accretion activity, veiling and emission lines. We discuss empirical evidence in favor of the old nuclear age and the implications on the star formation history of the Orion cluster.

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Protoplanet magnetosphere interactions

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Aims. In this paper, we study a simple model of an orbiting protoplanet in a central magnetospheric cavity, the entry into such a cavity having been proposed as a mechanism for halting inward orbital migration.

Methods. We have calculated the gravitational interaction of the protoplanet with the magnetosphere using a local model and determined the rate of evolution of the orbit.

Results. The interaction is found to be determined by the outward flux of MHD waves and thus the possibility of the

existence of such waves in the cavity is significant.

Conclusions. The estimated orbital evolution rates due to gravitational and other interactions with the magnetosphere are unlikely to be significant during protoplanetary disk lifetimes.

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Deuterium fractionation in the Horsehead edge

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Context. Deuterium fractionation is known to enhance the $[\text{DCO}^+]/[\text{HCO}^+]$ abundance ratio over the $\text{D}/\text{H} \sim 10^{-5}$ elemental ratio in the cold and dense gas typically found in pre-stellar cores.

Aims. We report the first detection and mapping of very bright $\text{DCO}^+ \text{J}=3-2$ and $\text{J}=2-1$ lines (3 and 4 K respectively) towards the Horsehead photodissociation region (PDR) observed with the IRAM-30m telescope. The DCO^+ emission peaks close to the illuminated warm edge of the nebula ($< 50''$ or ~ 0.1 pc away).

Methods. Detailed nonlocal, non-LTE excitation and radiative transfer analyses have been used to determine the prevailing physical conditions and to estimate the DCO^+ and H^{13}CO^+ abundances from their line intensities.

Results. A large $[\text{DCO}^+]/[\text{HCO}^+]$ abundance ratio (≥ 0.02) is inferred at the DCO^+ emission peak, a condensation shielded from the illuminating far-UV radiation field where the gas must be cold (10-20 K) and dense ($\geq 2 \times 10^5 \text{ cm}^{-3}$). DCO^+ is not detected in the warmer photodissociation front, implying a lower $[\text{DCO}^+]/[\text{HCO}^+]$ ratio ($< 10^{-3}$).

Conclusions. According to our gas phase chemical predictions, such a high deuterium fractionation of HCO^+ can only be explained if the gas temperature is below 20 K, in good agreement with DCO^+ excitation calculations.

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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 focusing 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 to the newly formed stars and cannot 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.

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Probing the initial conditions of High Mass Star formation – I. Deuteration and depletion in high mass pre/protocluster clumps

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UltraCompact HII regions are signposts of high mass star formation. Since high-mass star formation occurs in clusters, one expects to find even earlier phases of massive star formation in the vicinity of UltraCompact HII regions. Here, we study the amount of deuteration and depletion toward pre/protocluster clumps found in a wide-field (10×10 arcmin) census of clouds in 32 massive star-forming regions that are known to harbour UCHII regions. We find that 65% of the observed sources have strong NH_2D emission and more than 50% of the sources exhibit a high degree of deuteration, ($0.1 \leq \text{NH}_2\text{D}/\text{NH}_3 \leq 0.7$), 0.7 being the highest observed deuteration of NH_3 reported to date. Our search for NHD_2 in two sources did not result in a detection. The enhancement in deuteration coincides with moderate CO depletion onto dust grains. There is no evidence of a correlation between the two processes, though an underlying correlation cannot be ruled out as the depletion factor is very likely to be only a lower limit. In summary, we find CO depletion and high deuteration towards cold cores in massive star forming regions. Therefore, these are good candidates for sources at the early phases of massive star formation. While our sensitive upper limits on NHD_2 do not prove the predictions of the gas-phase and grain chemistry models wrong, an enhancement of $\approx 10^4$ over the cosmic D/H ratio from NH_2D warrants explanation.

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Production of H_3^+ via photodissociation of organic molecules in interstellar clouds

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We present experimental results obtained from photoionization and photodissociation processes of abundant interstellar $\text{CH}_3\text{-X}$ type organic molecules like methanol (CH_3OH), methylamine (CH_3NH_2) and acetonitrile (CH_3CN) as alternative route for the production of H_3^+ in interstellar and star-forming environments. The measurements were taken at the Brazilian Synchrotron Light Laboratory (LNLS), employing soft X-ray photons with energies between 200 and 310 eV and time-of-flight (TOF) mass spectrometry. Mass spectra were obtained using the photoelectron-photoion coincidence techniques. Absolute averaged cross-sections for H_3^+ production by soft X-rays were determined. We have found that, among the channels leading to molecular dissociation, the H_3^+ yield could reach values up to 0.7 per cent for single photoionization process and up to 4 per cent for process involving double photoionization. The H_3^+ photoproduction cross-section due to the dissociation of the studied organic molecules by photons over the C1s edge (200-310 eV) were about $0.2\text{-}1.4 \times 10^{-18} \text{ cm}^2$. Adopting the typical X-ray luminosity $L_X \gtrsim 10^{31} \text{ erg s}^{-1}$ which best fit the observational data for AFGL 2591 we derive an estimative for the H_3^+ photoproduction rate due to methyl compound dissociation process. The highest value for the H_3^+ column density from methanol dissociation by soft X-rays, assuming a steady state scenario, was about 10^{11} cm^2 , which gives the fraction of the photoproduced H_3^+ of about 0.05 per cent, as in the case of dense molecular cloud AFGL 2591. Despite the extreme small value,

this represent a new and alternative source of H_3^+ into dense molecular clouds and it is not been considered as yet in interstellar chemistry models.

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The interpretation of water emission from dense interstellar clouds

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Context. Existing SWAS observations and future HIFI/Herschel data require a clear sense of the information content of water emission and absorption lines.

Aims. We investigate whether the ground-state transition of ortho- H_2O ($1_{10} \rightarrow 1_{01}$) at 557 GHz can be used to measure the column density throughout an interstellar cloud.

Methods. We make use of a multi-zone escape probability code suitable for treating molecular line emission.

Results. For low abundances, i.e., $X(\text{H}_2\text{O}) \lesssim 10^{-9}$, the intensity of the $1_{10} \rightarrow 1_{01}$ transition scales with the total column density of H_2 . However, this relationship breaks down with increasing abundance, i.e., optical depth, due to line trapping and - for $T_{\text{dust}} \gtrsim 25$ K, $X(\text{H}_2\text{O}) \lesssim 10^{-8}$ and $n \sim 10^4 \text{ cm}^{-3}$ - absorption of the dust continuum.

Conclusions. An observed decline in intensity per column density, expected if H_2O is a surface tracer, does not necessarily mean that the water is absent in the gas phase at large column densities, but can be caused by line trapping and subsequent collisional de-excitation. To determine the amount of water vapor in the interstellar medium, multiple line measurements of optically thin transitions are needed to disentangle radiative transfer and local excitation effects.

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Modeling Spitzer Observations of VV Ser. II. An Extended Quantum-heated Nebula and a Disk Shadow

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We present mid-infrared Spitzer IRAC and MIPS images of the UX Orionis star VV Ser and the surrounding cloud. The $5.6\text{-}70\mu\text{m}$ images show bright, localized, and nebulous emission extended over $4'$ centered on VV Ser. This nebulosity is due to transiently heated grains excited by UV photons emitted by VV Ser. Imprinted on the nebulosity is a wedge-shaped dark band, centered on the star. We interpret this as the shadow cast by the inner regions of a near-edge-on disk, allowing the PAHs to be excited only outside of this shadow. We extend an axisymmetric radiative transfer model of the VV Ser disk described in a companion paper to include quantum-heated PAH molecules and very small grains (VSGs) in the thermal cooling approximation. The presence of a disk shadow strongly constrains the inclination as well as the position angle of the disk. The nebulosity at $5.6\text{-}8.0\mu\text{m}$ and the 2175 \AA absorption feature seen in an archival spectrum from the IUE can be fit using only PAHs, consistent with the main carrier of the 2175 \AA feature being due to the graphite-like structure of the PAHs. The PAH component is found to be relatively smoothly distributed in the cloud, while the population of VSGs emitting at $20\text{-}70\mu\text{m}$ is strongly concentrated $\sim 50''$ to the southeast of VV Ser. Depending on the adopted PAH opacity, the abundance of PAHs in the surrounding cloud is constrained to $5\% \pm 2\%$ of the total dust mass. Although relatively rare, quantum-heated nebulosities surrounding single, well-defined stars are well-suited for gaining unique insights into the physics of very small particles in molecular

clouds.

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Deep Spitzer spectroscopy of the ‘Flying Saucer’ edge-on disk: Large grains beyond 50 AU

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We present deep Spitzer-IRS low-resolution ($\lambda/\Delta\lambda \sim 100$) 5-35 μm spectroscopy of the edge-on disk “the Flying Saucer” (2MASS J16281370-2431391) in the Ophiuchus molecular cloud. The spectral energy distribution exhibits the characteristic two-peak shape predicted for a circumstellar disk viewed very close to edge-on. The short-wavelength peak is entirely due to photons scattered off the surface of the disk, while the long-wavelength peak is due to thermal emission from the disk itself. The Spitzer spectrum represents the first spectroscopic detection of scattered light out to 15 μm from a bona-fide, isolated edge-on disk around a T Tauri star. The depth and the wavelength of the mid-infrared “valley” of the SED give direct constraints on the size distribution of large grains in the disk. Using a 2D continuum radiative transfer model, we find that a significant amount of 5-10 μm -sized grains is required in the surface layers of the disk at radii of 50-300 AU. The detection of relatively large grains in the upper layers implies that vertical mixing is effective, since grain growth models predict the grains would otherwise settle deep in the disk on short time scales. Additionally, we *tentatively* detect the 9.66 μm S(3) line of H₂ and the 11.2 μm emission feature due to PAHs.

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Helium abundance and ionization structure in the Orion nebula: radio recombination lines observations

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Results of the Ori A HII region mapping based on hydrogen (H), helium (He) and carbon (C) Radio Recombination lines (RRL) are presented. Observations were made with the same angular resolution (2') using the 32m VLBI dish of Medicina (Italy, 22.4 GHz) and the Pushchino RT-22 dish (Russia, 36.5 GHz). The behaviour of the ionized helium abundance, y^+ , with distance from the center shows that the He⁺ zone size is smaller than that of H⁺. Such a behaviour is different for the core and for the envelope, as well as for different directions from the center. The helium abundance, $N(\text{He})/N(\text{H}) = 10.0(\pm 0.8)\%$, is measured. Derived line radial velocities, their widths and y^+ data support the well-known “blister-type” structure of this HII region. LTE electron temperatures (7800-9600 K) are also measured.

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He I Emission in the Orion Nebula and Implications for Primordial Helium Abundance

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We apply a recently developed theoretical model of helium emission to observations of both the Orion Nebula and a sample of extragalactic H II regions. In the Orion analysis, we eliminate some weak and blended lines and compare theory and observation for our reduced line list. With our best theoretical model we find an average difference between theoretical and observed intensities $\langle I_{pred}/I_{obs} - 1 \rangle = 6.5\%$. We argue that both the red and blue ends of the spectrum may have been inadequately corrected for reddening. For the 22 highest quality lines, with $3499\text{\AA} \leq \lambda \leq 6678\text{\AA}$, our best model predicts observations to an average of 3.8%. We also perform an analysis of the reported observational errors and conclude that they have been underestimated. In the extragalactic analysis, we demonstrate the likelihood of a large systematic error in the reported data and discuss possible causes. This systematic error is at least as large as the errors associated with nearly all attempts to calculate the primordial helium abundance from such observations. Our Orion analysis suggests that the problem does not lie in the theoretical models. We demonstrate a correlation between equivalent width and apparent helium abundance of lines from extragalactic sources that is most likely due to underlying stellar absorption. Finally, we present fits to collisionless case B He I emissivities as well as the relative contributions due to collisional excitations out of the metastable $2s^3S$ term.

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A Survey for Young Spectroscopic Binary K7-M4 Stars in Ophiuchus

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This paper describes a high-resolution, infrared spectroscopic survey of young, low-mass stars that is designed to identify and characterize pre-main-sequence spectroscopic binaries. This is the first large infrared radial velocity survey of very young stars to date. The frequency and mass ratio distribution of the closest, low-mass binaries bear directly on models of stellar, brown dwarf, and planetary mass companion formation. Furthermore, spectroscopic binaries can provide mass ratios and ultimately masses, independent of assumptions, needed to calibrate models of young star evolution. I present the initial results from observations of a uniform sample of 33 T Tauri M stars in the Ophiuchus molecular cloud. The average mass of this sample is less than that of other young star radial velocity surveys of similar scope by a factor of ~ 2 . Almost every star was observed at 3-4 epochs over 3 yr with the 10 m Keck II telescope and the facility infrared spectrometer NIRSPEC. An internal precision of 0.43 km s^{-1} was obtained with standard cross-correlation calibration techniques. Four of the targets are newly discovered spectroscopic binaries, one of which is located in a subarcsecond, hierarchical quadruple system. Three other subarcsecond visual binaries were also serendipitously identified during target acquisition. The spectroscopic multiplicity of the sample is comparable to that of earlier type, pre-main-sequence objects. Therefore, there is no dearth of young, low-mass spectroscopic binary stars, at least in the Ophiuchus region.

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The impact of magnetic fields on single and binary star formation

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We have performed magnetohydrodynamic (MHD) simulations of the collapse and fragmentation of molecular cloud cores using a new algorithm for MHD within the smoothed particle hydrodynamics (SPH) method, that enforces the zero magnetic divergence constraint. We find that the support provided by magnetic fields over thermal pressure alone has several important effects on fragmentation and the formation of binary and multiple systems, and on the properties of massive circumstellar discs. The extra support suppresses the tendency of molecular cloud cores to fragment due to either initial density perturbations or disc fragmentation. Furthermore, unlike most previous studies, we find that magnetic pressure plays the dominant role in inhibiting fragmentation rather than magnetic tension or magnetic braking. In particular, we find that if the magnetic field is aligned with the rotation axis of the molecular cloud core, the effects of the magnetic field on fragmentation and disc structure are almost entirely due to magnetic pressure, while if the rotation axis is initially perpendicular to the magnetic field, magnetic tension plays a greater role and can

actually aid fragmentation. Despite these effects, and contrary to several past studies, we find that strongly-perturbed molecular cloud cores are able to fragment to form wide binary systems even in the presence of quite strong magnetic fields. For massive circumstellar discs, we find that slowing of the collapse caused by the magnetic support decreases the mass infall rate on to the disc and, thus, weakens gravitational instabilities in young massive circumstellar discs. This not only reduces the likelihood that they will fragment, but also decreases the importance of spiral density waves in providing angular momentum transport and in promoting planet formation.

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<http://xxx.lanl.gov/abs/astro-ph/0702410>

Movies and high resolution figures at <http://www.astro.ex.ac.uk/people/dprice/pubs/magsf/index1.html>

The detection of protostellar condensations in Infrared Dark Cloud cores

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Infrared Dark Clouds (IRDCs) are a distinct class of interstellar molecular cloud identified as dark extinction features against the bright mid-infrared Galactic background. Here we present high-angular resolution millimeter continuum images obtained with the IRAM Plateau de Bure Interferometer toward four high-mass (200–1800 M_{\odot}) IRDC cores that show evidence for active high-mass star formation ($M > 8 M_{\odot}$). We detect twelve bright (> 7 mJy), compact ($< 2''$, < 0.024 pc) condensations toward these cores. Two of the cores (G024.60+00.08 MM1 and G024.60+00.08 MM2) are resolved into multiple protostellar condensations while one core (G022.35+00.41 MM1) shows two condensations. The remaining core (G024.33+00.11 MM1) contains a single, compact protostellar condensation with a very rich molecular spectrum, indicating that this is a hot molecular core associated with an early stage in the formation of a high-mass protostar. The derived gas masses for these condensations suggest that each core is forming at least one high-mass protostar ($M_{gas} > 8 M_{\odot}$), and three cores are also forming lower-mass protostars ($M_{gas} \sim 2\text{--}5 M_{\odot}$). A comparison of the ratios of the gas masses (M_G) to the Jeans masses (M_J) for IRDCs, cores, and condensations, provides broad support for the idea of hierarchical fragmentation. The close proximity of multiple protostars of disparate mass indicates that these IRDCs are in the earliest evolutionary states in the formation of stellar clusters.

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Early-type stars in the core of the young open cluster Westerlund 2

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Aims. The properties of the early-type stars in the core of the Westerlund 2 cluster are examined in order to establish a link between the cluster and the very massive Wolf-Rayet binary WR 20a as well as the H II complex RCW 49.

Methods. Photometric monitoring as well as spectroscopic observations of Westerlund 2 are used to search for light variability and to establish the spectral types of the early-type stars in the cluster core.

Results. The first light curves of the eclipsing binary WR 20a in B and V filters are analysed and a distance of 8 kpc is inferred. Three additional eclipsing binaries, which are probable late O or early B-type cluster members, are discovered, but none of the known early O-type stars in the cluster displays significant photometric variability above 1% at the $1\text{-}\sigma$ level. The twelve brightest O-type stars are found to have spectral types between O3 and O6.5, significantly earlier than previously thought.

Conclusions. The distance of the early-type stars in Westerlund 2 is established to be in excellent agreement with the distance of WR 20a, indicating that WR 20a actually belongs to the cluster. Our best estimate of the cluster distance thus amounts to 8.0 ± 1.4 kpc. Despite the earlier spectral types, the currently known population of early-type stars in Westerlund 2 does not provide enough ionizing photons to account for the radio emission of the RCW 49 complex. This suggests that there might still exist a number of embedded early O-stars in RCW 49.

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The eccentricity-mass distribution of exoplanets: signatures of different formation mechanisms?

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We examine the distributions of eccentricity and host star metallicity of exoplanets as a function of their mass. Planets with $M \sin i \gtrsim 4 M_J$ have an eccentricity distribution consistent with that of binary stars, while planets with $M \sin i \lesssim 4 M_J$ are less eccentric than binary stars and more massive planets. In addition, host star metallicities decrease with planet mass. The statistical significance of both of these trends is only marginal with the present sample of exoplanets. To account for these trends, we hypothesize that there are two populations of gaseous planets: the low-mass population forms by gas accretion onto a rock-ice core in a circumstellar disk and is more abundant at high metallicities, and the high-mass population forms directly by fragmentation of a pre-stellar cloud. Planets of the first population form in initially circular orbits and grow their eccentricities later, and may have a mass upper limit from the total mass of the disk that can be accreted by the core. The second population may have a mass lower limit resulting from opacity-limited fragmentation. This would roughly divide the two populations in mass, although they would likely overlap over some mass range. If most objects in the second population form before the pre-stellar cloud becomes highly opaque, they would have to be initially located in orbits larger than ~ 30 AU, and would need to migrate to the much smaller orbits in which they are observed. The higher mean orbital eccentricity of the second population might be caused by the larger required intervals of radial migration, and the brown dwarf desert might be due to the inability of high-mass brown dwarfs to migrate inwards sufficiently in radius.

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Photopolarimetric Activity and Circumstellar Environment of the T Tauri Star CO Ori

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We present the results of simultaneous *UBVRI* photometric and polarimetric observations of the classical T Tauri star CO Ori carried out at the Crimean Astrophysical Observatory during the 18 years between 1986 and 2004. We show that the changes of linear polarization accompanying the star's brightness variations are typical for UX Ori stars. This suggests that the brightness variations of the star are mainly due to changes of the circumstellar extinction caused by the non-uniform structure of the circumstellar environment and "optimal" orientation of the circumstellar disk relative to an observer, whose line of sight crosses the atmosphere of the disk. We determine the star's intrinsic polarization caused by scattering of light in the circumstellar disk. The polarization position angle indicates the orientation of the disk's symmetry axis in the sky plane. Our analysis of an archival light curve confirms the cyclical character of the photometric activity of CO Ori. The refined period of the cycle is 12.4 years. The existence of such activity cycles of UX Ori stars indicates to considerable deviations of their circumstellar disks from axial symmetry, that can be a reflection of either binarity or the process of the planet formation.

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An XMM-Newton view of the young open cluster NGC 6231 III. Optically faint X-ray sources

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We discuss the properties of the X-ray sources with faint optical counterparts in the very young open cluster NGC 6231. From their positions in the H-R diagram, we find that the bulk of these objects probably consists of low-mass pre-main sequence stars with masses in the range 0.3 to 3.0 M_{\odot} . The age distribution of these objects indicates that low-mass star formation in NGC 6231 started more than 10 Myr ago and culminated in a starburst-like event about 1 to 4 Myr ago when the bulk of the low-mass PMS stars as well as the massive cluster members formed. We find no evidence for a spatial age gradient that could point towards a sequential star formation process. Only a few X-ray sources have counterparts with a reddening exceeding the average value of the cluster or with infrared colours indicating the presence of a moderate near-IR excess. The X-ray spectra of the brightest PMS sources are best fitted by rather hard thermal plasma models and a significant fraction of these sources display flares in their light curve. The X-ray brightest flaring sources have decay times between 2 and 16 ks. The X-ray selected PMS stars in NGC 6231 have $\log L_X/L_{\text{bol}}$ values that increase strongly with decreasing bolometric luminosity and can reach a saturation level ($\log L_X/L_{\text{bol}} \sim -2.4$) for non-flaring sources and even more extreme values during flares.

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Evolution of brown dwarf disks: A Spitzer survey in Upper Scorpius

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We have carried out a Spitzer survey for brown dwarf disks in the ~ 5 Myr old Upper Scorpius (UpSco) star forming region, using IRS spectroscopy from 8 to 12 μm and MIPS photometry at 24 μm . Our sample consists of 35 confirmed very low mass members of UpSco. Thirteen objects in this sample show clear excess flux at 24 μm , explained by dust emission from a circum-sub-stellar disk. The spectral energy distributions (SEDs) of the remaining objects are consistent with pure photospheric emission. Objects without excess emission either have no disks at all or disks with inner opacity holes of at least ~ 5 AU radii. Our disk frequency of $37 \pm 9\%$ is higher than what has been derived previously for K0-M5 stars in the same region (on a 1.8σ confidence level), suggesting a mass-dependent disk lifetime in UpSco. The clear distinction between objects with and without disks as well as the lack of transition objects shows that disk dissipation inside 5 AU occurs rapidly, probably on timescales of $< 10^5$ years. For the objects with disks, most SEDs are uniformly flat with flux levels of a few mJy, well modeled as emission from dusty disks affected by dust settling to the midplane, which also provides indirect evidence for grain growth. The silicate feature around 10 μm is either absent or weak in our SEDs, arguing for a lack of hot, small dust grains. Compared with younger objects in Taurus, brown dwarf disks in UpSco show less flaring. By comparing SEDs of stars and brown dwarfs in UpSco, we find that dust settling is not a strong function of mass in this region. Taken together, these results clearly demonstrate that we see disks in an advanced evolutionary state: Dust settling and grain growth are ubiquitous in circum-sub-stellar disks at ages of 5 Myr, arguing for planet forming processes in brown dwarf disks. For almost all our targets, results from high-resolution spectroscopy and high-spatial resolution imaging have been published before,

thus providing a large sample of brown dwarfs for which information about disks, accretion, and binarity is available. We find that nine out of 13 objects with disks do not accrete significantly. Hence, dusty disks can persist although the continuous accretion has stopped or dropped below measurable levels. Four objects with disks are binaries, three of them with (projected) separations < 30 AU. These objects likely harbour small disks truncated by the companion.

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The excitation within the molecular hydrogen jets of the protostellar outflow HH 212

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The near-infrared twin jets emanating from the HH 212-mm protostar are remarkable for their symmetry. By performing integral field spectroscopy with the UIST imager-spectrometer on UKIRT, we investigate the chains of bright knots and arcs within the jets to gain insight into the underlying physics and dynamics. We obtain numerous images associated with line emission from vibrationally-excited molecular hydrogen and the [Fe II] line at $1.64 \mu\text{m}$. This allows us to study the spatial variation in excitation of the inner knots and outer bow-shaped objects. We find that the excitation properties are consistent with outward-moving bow shocks close to the plane of the sky. However, there is a gradient in excitation transverse to the jet axis across the inner knots on the scale of 0.1 arcseconds. This C-shaped inner symmetry suggests a transverse source motion rather than precession, possibly related to the jet bending and the transverse gradient in radial velocity. Moreover, the bow models predict that the iron emission should peak further ahead of the molecular emission than actually observed. This leads us to propose that each inner knot consists of two closely-spaced asymmetric bows, as found for the outer bows which clearly occur in distinct pairs, well-separated in a lower density environment. The weak inter-knot emission may then be generated within oblique shock waves resulting from the deflection of fluid across asymmetric bow flanks.

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VLBA Observations of G5.89-0.39: OH Masers and Magnetic Field Structure

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We present VLBA observations of 1667 MHz OH maser emission from the massive star formation region G5.89-0.39. The observations were phase-referenced, allowing the absolute positions of the masers to be obtained. The 1667 MHz masers have radial velocities that span $\sim 50 \text{ km s}^{-1}$ but show little evidence of tracing the bipolar molecular outflow, as has been claimed in previous studies. We identify 23 Zeeman pairs through comparison of masers in left and right circular polarization. Magnetic field strengths range from -2 to $+2$ mG, and an ordered reversal in magnetic field direction is observed toward the southern region of the UC H II region. We suggest that the velocity and magnetic field structure of the 1667 MHz masers can be explained in the context of a model in which the masers arise in a neutral shell just outside a rapidly expanding ionized shell.

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A Simultaneous Optical and X-ray Variability Study of the Orion Nebula Cluster. II. A Common Origin in Magnetic Activity

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We present a statistical analysis of simultaneous optical and X-ray light curves, spanning 600 ks, for 814 pre-main-sequence (PMS) stars in the Orion Nebula Cluster. The aim of this study is to establish the relationship, if any, between the sites of optical and X-ray variability, and thereby to elucidate the origins of X-ray production in PMS stars. In a previous paper we showed that optical and X-ray variability in PMS stars are very rarely time-correlated. Here, using time-averaged variability indicators to examine the joint occurrences of optical and X-ray variability, we confirm that the two forms of variability are not directly causally related. However, a strong and highly statistically significant correlation is found between optical variability and X-ray luminosity. As this correlation is found to be independent of accretion activity, we argue that X-ray production in PMS stars must instead be intimately connected with the presence and strength of optically variable, magnetically active surface regions (i.e. spots) on these stars. Moreover, because X-ray variability and optical variability are rarely time-correlated, we conclude that the sites of X-ray production are not exclusively co-spatial with these regions. We argue that solar-analog coronae, heated by topologically complex fields, can explain these findings.

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Arcsecond-Resolution Submillimeter HCN Imaging of the Binary Protostar IRAS 16293-2422

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With the Submillimeter Array (SMA) we have made high angular-resolution ($\sim 1'' = 160$ AU) observations of the protobinary system IRAS 16293-2422 in the $J = 4 - 3$ lines of HCN and HC^{15}N , and in the continuum at 354.5 GHz. The HCN (4-3) line was also observed using the JCMT to supply missing short spacing information. Submillimeter continuum emission is detected from the individual binary components of Source A in the South-East and Source B in the North-West with a separation of $\sim 5''$. The optically-thin HC^{15}N (4-3) emission taken with the SMA has revealed a compact (~ 500 AU) flattened structure (P.A. = -16°) associated with Source A. This compact structure shows a velocity gradient along the projected minor axis, which can be interpreted as an infalling gas motion. Our HCN image including the short-spacing information shows an extended (~ 3000 AU) circumbinary envelope as well as the compact structure associated with Source A, although the P.A. of the compact structure ($= -45^\circ$) seen in the HCN emission is slightly different from that of the HC^{15}N emission. A toy model consisting of a flattened structure with radial infall towards a $1 M_\odot$ central star reproduces the HCN/ HC^{15}N position-velocity diagram along the minor axis of the HC^{15}N emission. In the extended envelope there is also a North-East (Blue) to South-West (Red) velocity gradient across the binary alignment, which is likely to reflect gas motion in the swept-up dense gas associated with the molecular outflow from Source A. At Source B, there is only a weak compact structure with much narrower line widths ($\sim 2 \text{ km s}^{-1}$) seen in the optically-thin HC^{15}N emission than that at Source A ($> 10 \text{ km s}^{-1}$), and there is no clearly defined bipolar molecular outflow associated with Source B. These results imply the different evolutionary stages between Source A

and B in the common circumbinary envelope. Our study demonstrates the importance of adding short spacing data to interferometer data in order to probe the detailed structure and kinematics from extended (> 3000 AU) envelopes to inner compact (< 500 AU) structures around low-mass protostars.

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The Inner Rim of YSO Disks: Effects of dust grain evolution.

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Dust-grain growth and settling are the first steps towards planet formation. An understanding of dust physics is therefore integral to a complete theory of the planet formation process. In this paper, we explore the possibility of using the dust evaporation front in YSO disks ('the inner rim') as a probe of the dust physics operating in circumstellar disks. The geometry of the rim depends sensitively on the composition and spatial distribution of dust. Using radiative transfer and hydrostatic equilibrium calculations we demonstrate that dust growth and settling can curve the evaporation front dramatically (from a cylindrical radius of about 0.5 AU in the disk mid-plane to 1.2 AU in the disk upper layers for an A0 star). We compute synthetic images and interferometric visibilities for our representative rim models and show that the current generation of near-IR long-baseline interferometers (VLTI, CHARA) can strongly constrain the dust properties of circumstellar disks, shedding light on the relatively poorly understood processes of grain growth, settling and turbulent mixing.

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<http://xxx.lanl.gov/abs/astro-ph/0702044>

A multiwavelength study of the ultracompact HII region associated with IRAS 20178+4046

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We present a multiwavelength study of the ultra compact HII region associated with IRAS 20178+4046. This enables us to probe the different components associated with this massive star forming region. The radio emission from the ionized gas was mapped at 610 and 1280 MHz using the Giant Metrewave Radio Telescope (GMRT), India. We have used 2MASS JHK_s data to study the nature of the embedded sources associated with IRAS 20178+4046. Submillimetre emission from the cold dust at 450 and 850 μm was studied using JCMT-SCUBA. The high-resolution radio continuum maps at 610 and 1280 MHz display compact spherical morphology. The spectral type of the exciting source is estimated to be \sim B0.5 from the radio flux densities. However, the near-infrared (NIR) data suggest the presence of several massive stars (spectral type earlier than O9) within the compact ionized region. The multiwavelength study of this star forming complex reveals an interesting scenario where we see the presence of different evolutionary stages in star formation. The ultra compact HII region coinciding with the southern cloud core is at a later stage of evolution compared to the northern core which is likely to be a candidate protocluster. Submillimetre emission shows the presence of two dense cloud cores which are probably at different evolutionary stages. The total mass of the cloud is estimated to be $\sim 700 - 1500 M_{\odot}$ from the submillimetre emission at 450 and 850 μm .

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astro-ph/0702712

OMC-1: A Cool Arching Filament in a Hot Gaseous Cavity: Geometry, Kinematics, Magnetic Vectors, and Pressure Balance

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We have assembled data on large (Galactic shell), middle (filament), and small (protostar) scales. OMC-1 is embedded in a hot cavity. Here we have made multiconstituent (gas/dust/field) homogeneous maps of the central part of the OMC-1 filament, covering an area of $2' \times 2'$. We find here that the vertical filament has a turbulent pressure about equal to the magnetic pressure; its total pressure roughly equals that in the surrounding medium. The magnetic field crosses the filament with an estimated strength of 300-350 μG in the sky plane. It could be an “externally wrapped” U-shaped magnetic field going around the filament (due to a large shock front traveling in the cavity), or else an internally generated “helical” field (of unknown origin). Near the OMC-1 map center, we map the low-velocity outflow near IRc2-source I, with a pattern of blue south-southwest gas and red north-northeast gas. Our James Clerk Maxwell Telescope data yield a plane-of-sky field of 2.4-2.6 mG across the outflow; this strength nearly equals the published Zeeman line-of-sight data. Farther out, the Zeeman data show a negative magnetic field, possibly suggesting a pole-on dipolar field.

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Effective medium theories for irregular fluffy structures: aggregation of small particles

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We study the extinction efficiencies as well as scattering properties of particles of different porosity. Calculations are performed for porous pseudospheres with small size (Rayleigh) inclusions using the discrete dipole approximation. Five refractive indices of materials covering the range from $1.20 + 0.00i$ to $1.75 + 0.58i$ were selected. They correspond to biological particles, dirty ice, silicate, amorphous carbon and soot in the visual part of spectrum. We attempt to describe the optical properties of such particles using Lorenz-Mie theory and a refractive index found from some effective medium theory (EMT) assuming the particle is homogeneous. We refer to this as the effective model.

It is found that the deviations are minimal when utilizing the EMT based on the Bruggeman mixing rule. Usually the deviations in extinction factor do not exceed $\sim 5\%$ for particle porosity $\mathcal{P} = 0 - 0.9$ and size parameters $x_{\text{porous}} = 2\pi r_{\text{s,porous}}/\lambda \lesssim 25$. The deviations are larger for scattering and absorption efficiencies and smaller for particle albedo and asymmetry parameter. Our calculations made for spheroids confirm these conclusions. Preliminary consideration shows that the effective model represents the intensity and polarization of radiation scattered by fluffy aggregates quite well. Thus, the effective models of spherical and non-spherical particles can be used to significantly simplify computations of the optical properties of aggregates containing only Rayleigh inclusions.

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Interstellar Absorption-Line Evidence for High-Velocity Expanding Structures in the Carina Nebula Foreground

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The extreme, high-velocity interstellar absorption-line profiles toward η Carinae and 16 neighboring stars in Trumpler 16 are examined, including several new sight lines observed in the ultraviolet with the Hubble Space Telescope or in the optical from the Magellan and European Southern Observatories. No two sight lines are identical, but many velocity components are in common. When the velocity scale is shifted to a standard of rest defined by the Carina Nebula emission lines, the symmetries between negative and positive velocities are striking; at least 15 distinct “shells” can be recognized. This circumstance suggests that the complex expanding structures are predominantly in front of the ionizing cluster. There may be a relationship to indications of a supernova remnant in this direction, including a recent Chandra X-Ray Observatory image. Interpretations in terms of high-energy phenomena generated by ongoing star formation possibly on the near side of the giant H II region are also discussed.

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Asymmetry and Variability in the HH 30 Circumstellar Disk

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We consider optical and near-infrared images of the edge-on disk surrounding the young stellar object HH 30 taken with the Hubble Space Telescope at 18 epochs from 1994 to 2005. These images allow us to study asymmetry and variability in the disk. The lateral brightness asymmetry in the upper nebula, first seen to strongly vary in 1998, continues to show significant variability throughout the period of our observations. The lateral asymmetry is not uniformly distributed between both sides of the disk; the upper nebula appears brighter on its north-northwest side at 12 epochs, nearly symmetric at four epochs, and brighter on its east-southeast side at only two epochs. This and other evidence indicate that the lateral asymmetry has both static and variable components. The lateral asymmetry shares the overall continuum color of the nebula and is weaker in emission lines than in the continuum. We have searched for periodicity in the sense of the lateral asymmetry. While some possible periods can be excluded, there is no convincing evidence for any specific period. We also consider the lower counternebula. It is as a whole less variable than the upper nebula and shows no significant lateral variability. We discuss several possible mechanisms that might explain these phenomena. Periodic illumination or shadowing models remain viable at periods less than 1 yr, but further observations are required to firmly establish them.

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The Bipolar Outflow toward G5.89-0.39

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We present high-resolution observations of G5.89-0.39 in CO(1-0), ¹³CO(1-0), C¹⁸O(1-0), and HCO⁺(1-0). We characterize the G5.89-0.39 outflow using the ¹³CO emission. The outflow is found to be young, massive, and powerful. We conclude that (1) the outflow is nearly along the line of sight, (2) there is dynamical evidence for entrainment of ambient interstellar material into the outflow, (3) the mass entrainment rate is $\sim 4 \times 10^{-3} M_{\odot} \text{ yr}^{-1}$, (4) in the blue lobe, only 27% of the outflow mass is due to entrainment, and (5) expansion of the outflow lobes perpendicular to the

flow axis is occurring at $\sim 1-10 v_{sound}$. A neutral and ionized outflow tracer are compared. Watson and coworkers predicted that if entrainment through the Kelvin-Helmholtz shear instability adds significantly to the outflow mass, a difference in the turbulent velocity widths of neutral and ionized outflow tracers could be measurable. We cannot conclude that the Kelvin-Helmholtz shear instability is the physical process causing this entrainment, but it may operate at a level below our detection limit.

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The Fragmenting Superbubble Associated with the H II Region W4

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New observations at high latitudes above the H II region W4 show that the structure formerly identified as a chimney candidate, an opening to the Galactic halo, is instead a superbubble in the process of fragmenting and possibly evolving into a chimney. Data at high Galactic latitudes ($b > 5^\circ$) above the W3/W4 star-forming region at 1420 and 408 MHz Stokes I (total power) and 1420 MHz Stokes Q and U (linear polarization) reveal an egg-shaped structure with morphological correlations between our data and the H α data of Dennison, Topasna, and Simonetti. Polarized intensity images show depolarization extending from W4 up the walls of the superbubble, providing strong evidence that the radio continuum is generated by thermal emission coincident with the H α emission regions. We conclude that the parts of the H II region hitherto known as W4 and the newly revealed thermal emission are all ionized by the open cluster OCl 352. At an assumed distance of 2.35 kpc, the ovoid structure is 164 pc wide and extends 246 pc above the midplane of the Galaxy. The shell's emission decreases in total intensity and polarized intensity in various locations, appearing to have a break at its top and another on one side. Using a geometric analysis of the depolarization in the shell's walls, we estimate that a magnetic field line-of-sight component of 3-5 μ G exists in the shell. We explore the connection between W4 and the Galactic halo, considering whether sufficient radiation can escape from the fragmenting superbubble to ionize the kiloparsec-scale H loop discovered by Reynolds, Sterling and Haffner.

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Discovery of a Bipolar Outflow from 2MASSW J1207334-393254 a 24 M_{Jup} Brown Dwarf

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The 24 M_{Jup} brown dwarf 2MASS1207-3932 has for some time been known to show clear signs of classical T Tauri-like accretion. Through analysis of its oxygen forbidden emission we have discovered that it is driving a bipolar outflow. Blue and red-shifted components to the [OI] λ 6300 forbidden emission line are seen at velocities of - 8kms⁻¹ and +4kms⁻¹ (on either side of the systemic velocity). Spectro-astrometry recovers the position of both components relative to the BD, at $\sim 0''08$ (in opposing directions). A position velocity diagram of the line region supports the spectro-astrometric results. The H α and HeI λ 6678 lines were also analysed. These line regions are not offset with respect to the continuum ruling out the presence of spectro-astrometric artifacts and underlining the validity of the [OI] λ 6300 results. The low radial velocity of the outflow, and relatively large offsets, are consistent with 2MASS1207-3932 having a near edge-on disk, as proposed by Scholz et al. 2MASS1207-3932 is now the smallest mass galactic

object known to drive an outflow. The age of the TW Hydrae Association (~ 8 Myr) also makes this one of the oldest objects with a resolved jet. This discovery not only highlights the robustness of the outflow mechanism over an enormous range of masses but also suggests that it may even be feasible for young giant planets with accretion disks to drive outflows.

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Protoplanetary disk turbulence driven by the streaming instability: Linear evolution and numerical methods

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We present local simulations that verify the linear streaming instability that arises from aerodynamic coupling between solids and gas in protoplanetary disks. This robust instability creates enhancements in the particle density in order to tap the free energy of the relative drift between solids and gas, generated by the radial pressure gradient of the disk. We confirm the analytic growth rates found by Youdin & Goodman (2005) using grid hydrodynamics to simulate the gas and, alternatively, particle and grid representations of the solids. Since the analytic derivation approximates particles as a fluid, this work corroborates the streaming instability when solids are treated as particles. The idealized physical conditions – axisymmetry, uniform particle size, and the neglect of vertical stratification and collisions – provide a rigorous, well-defined test of any numerical algorithm for coupled particle-gas dynamics in protoplanetary disks. We describe a numerical particle-mesh implementation of the drag force, which is crucial for resolving the coupled oscillations. Finally we comment on the balance of energy and angular momentum in two-component disks with frictional coupling. A companion paper details the non-linear evolution of the streaming instability into saturated turbulence with dense particle clumps.

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<http://arxiv.org/abs/astro-ph/0702625>

Temperature fluctuations in H II regions: t^2 for the two-phase model

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Aims. We investigate temperature fluctuations in HII regions in terms of a two-phase model, which assumes that the nebular gas consists of a hot and a cold phase.

Methods. We derive general formulae for $T([\text{OIII}])$, the $[\text{OIII}]$ forbidden line temperature, and $T(\text{HI})$, the hydrogen Balmer jump temperature, in terms of the temperatures of the hot and cold phases, T_h and T_c .

Results. For large temperature differences, the values of t^2 required to account for the observed difference between $T([\text{OIII}])$ and $T(\text{HI})$ are much lower than those deduced using the classical formulae that assume random and small amplitude temperature fluctuations. One should therefore be cautious when using a two-phase model to account for empirically derived t^2 values. We present a correction of a recent work by Giammanco & Beckman, who use a two-phase model to estimate the ionization rate of HII regions by cosmic rays. We show that a very small amount of cold gas is sufficient to account for t^2 values typically inferred for HII regions.

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Abstracts of recently accepted major reviews

Extra-Solar Kuiper Belt Dust Disks

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The dust disks observed around mature stars are evidence that planetesimals are present in these systems on spatial scales that are similar to that of the asteroids and the KBOs in the Solar System. These dust disks (a.k.a. “debris disks”) present a wide range of sizes, morphologies and properties. It is inferred that their dust mass declines with time as the dust-producing planetesimals get depleted, and that this decline can be punctuated by large spikes that are produced as a result of individual collisional events. The lack of solid state features indicate that, generally, the dust in these disks have sizes greater than approximately 10 μm , but exceptionally, strong silicate features in some disks suggest the presence of large quantities of small grains, thought to be the result of recent collisions. Spatially resolved observations of debris disks show a diversity of structural features, such as inner cavities, warps, offsets, brightness asymmetries, spirals, rings and clumps. There is growing evidence that, in some cases, these structures are the result of the dynamical perturbations of a massive planet. Our Solar System also harbors a debris disk and some of its properties resemble those of extra-solar debris disks. From the cratering record, we can infer that its dust mass has decayed with time, and that there was at least one major “spike” in the past during the Late Heavy Bombardment. This offers a unique opportunity to use extra-solar debris disks to shed some light in how the Solar System might have looked in the past. Similarly, our knowledge of the Solar System is influencing our understanding of the types of processes which might be at play in the extra-solar debris disks.

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send preprint request to amaya@astro.princeton.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), *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).

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High-energy processes in low-mass protostars – an X-ray to radio multi-wavelength perspective

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Ph.D dissertation directed by: Karl Menten

Ph.D degree awarded: February 2007

High-energy processes in protostars remain poorly understood. Only after the recently finished Chandra Orion Ultra-deep Project (COUP), statistically significant information on X-ray emission from Young Stellar Objects (YSOs) has been obtained. For an understanding of the mechanisms responsible for the X-ray emission, multi-wavelength correlations of flares, especially in the radio regime, are necessary and have become an active field of research. Magnetic fields cause several high-energy phenomena in the coronae of YSOs mainly due to magnetic reconnection which are observable in a wide wavelength range from nonthermal centimetric radio emission to X-rays. In this work, these processes were probed using a variety of very different methods which can be grouped into three major topics:

X-ray to radio multi-wavelength variability of Young Stellar Objects The *Coronet* cluster in the nearby R CrA dark cloud offers the rare opportunity to study a compact cluster of several very young protostars which are detected at radio- and X-ray wavelengths. Initially, a study focusing separately on X-ray and radio variability of these sources was conducted. Subsequently, in August 2005, the same region was studied in the first simultaneous X-ray, radio, near-infrared, and optical monitoring campaign of YSOs. Several observatories were observing simultaneously, namely the *Chandra* X-ray Observatory, the VLA, as well as telescopes with optical and near-infrared detectors in Chile and South Africa. Remarkable intra-band variability but no clearly correlated variability was found. This most importantly suggests that there is no direct link between the X-ray and optical/infrared emission and supports the notion that accretion is *not* an important source for the X-ray emission of these YSOs.

Combining the *Chandra* X-ray data collected in the course of the multi-wavelength campaign with previous archival data, one of the deepest X-ray datasets ever obtained of a star-forming region is obtained and discussed.

Radio emission from protostars Looking for compact nonthermal centimetric radio emission, high-sensitivity Very-Long-Baseline Interferometry (VLBI) observations of four nearby protostars were carried out, yielding the currently most sensitive data of such sources. Weak compact emission was found in the VLBI data of the class 0/I binary YLW 15 VLA 2, constraining the size of its corona to $< 0.4 \times 0.1$ AU. Since this source is part of a binary system with observed orbital motion, further VLBI observations will allow to quickly determine the orbit very accurately. The observed sources apparently were showing quiescent radio emission on the larger scales probed by the Very Large Array (VLA). Until now, only very few radio flares of YSOs have been observed in detail. In further work, two such examples are presented and analyzed: a flaring, deeply embedded protostar in Orion and a flaring binary T Tauri system whose activity is due to inter-binary coronal interaction.

The earliest stages: Magnetic fields in molecular clouds While mapping molecular clouds in polarized dust continuum emission has become a standard technique, the potentially more powerful technique using the “Goldreich-Kylafis” effect has been only rarely used until now. This effect predicts weakly linearly polarized molecular line emission under certain circumstances. By choosing different transitions, it is possible to probe the magnetic field direction in different regions in a molecular cloud core, and additionally one gets information along the line of sight for optically thin emission lines. The XPOL correlation polarimeter at the IRAM 30m telescope was used in a search for such linearly polarized emission in several bright molecular transition lines towards prominent star-forming regions. The combined effects of instrumental polarization and extended emission were simulated for a thorough interpretation of the results. In one case, the observed polarization exceeds the simulated instrumental value.

Millimeter and Centimeter Radio Observations toward the High-Mass Star Forming Region OMC1S

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Ph.D dissertation directed by: Luis F. Rodriguez & Paul Ho

Ph.D degree awarded: November 2006

In this study I mainly present centimeter and millimeter continuum and molecular line (Very Large Array and Submillimeter Array) observations with a very high angular resolution toward the high-mass star forming region OMC1 South located in the Orion Nebula. However, on the 3.6 cm band I also present observations of whole Nebula.

The OMC1S region seems to be the youngest, and most active zone star formation within the nebula, showing extremely young and well collimated molecular outflows and at least a half-dozen extended and powerful Herbig-Haro flows emanating from it. I report that most these outflows appers to be driving for a cluster of about 10 young stellar objects (with strong millimeter and submillimeter continuum emission) that are associated with B-type ZAMS stars located on this region. I discussed their nature on terms of optically thick hyper-compact HII regions.

In addition to this work I also present observations of ten luminous IRAS high-mass star forming regions (selected from the 69 high-mass protostellar objects of Sridharan et al. (2002)) located in the inner part of our Galaxy using the Very Large Array. I discuss the characteristics of these sources based mostly on their spectral indices and find that their natures are diverse. Some features indicate that the mm emission is dominated by dust from disks or envelopes. Toward other components, the mm emission appears to be dominated by free-free radiation, both from ionized outflows or from optically thick H II regions.

I therefore conclude that our findings are consistent with the accretion scenario, in which a dynamical collapse of molecular clumps results in the formation of disks and well collimated molecular outflows, which then leads to the formation of a massive stellar core.

<ftp://ftp.astrosmo.unam.mx/pub/l.zapata/thesis.pdf>

New Jobs

Postdoctoral Fellowship on Young Stellar Objects, their Surroundings and Jets

INAF - Osservatorio Astronomico di Palermo (Italy) will appoint one fellow in the area of "Young Stellar Objects, their Surroundings and Jets", under a Marie Curie Transfer of Knowledge grant. The fellowship is expected to start before the end of September 2007 (negotiable) and to last 24 months. **The successful candidate is expected to have experience on data analysis and emission processes in the optical and/or infrared and/or radio bands.**

Candidates should have a PhD or at least four years of full-time research experience at postgraduate level in a relevant field. In either case the candidate cannot have more than ten years of research experience.

Gross salary is fixed at 3889.25 Euro per month, for the duration of the contract, plus a mobility allowance.

Female candidates are explicitly encouraged to apply.

For eligibility and application details please check the PHOENIX website
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All documents should arrive by June 30, 2007 at:

INAF - Osservatorio Astronomico di Palermo
Marie Curie Fellowship Selection (PHOENIX)
Piazza del Parlamento 1
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For further information contact:

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or visit

<http://www.astropa.unipa.it/~orlando/PHOENIX>

International Post-Doctoral Fellowship on Star Formation

The INAF – Arcetri Astrophysical Observatory (Florence, Italy) intends to award one post-doctoral fellowship in the field of star formation. The fellow is expected to focus his/her activity on observations of OB star forming regions at high angular resolution. In particular, he/she will participate in the investigation of the outflow/infall phenomena in the proximity of newly born high-mass stars. Good knowledge of radio interferometric techniques is requested, possibly from centimeter to sub-millimeter wavelengths, and preference will be given to candidates with good expertise in Very Long Baseline Interferometry.

Information on the activity of the Arcetri Observatory and, in particular, of the Star Formation Group may be found on the web page <http://www.arcetri.astro.it>

Applicants must have a Ph.D. or equivalent. The gross yearly salary will be 30,000 Euro. The fellowship will be granted for one year and will not entail social benefits or medical insurance: each fellow will be requested to cover himself/herself with basic medical insurance. No special application forms are required. The applicants should send a CV and a list of publications to the above submission address and should arrange for two letters of recommendation to be sent separately to the same address. E-mail submission is accepted. Applications should arrive in Arcetri no later than April 30, 2007. The starting date will be as early as possible before August 31, 2007.

Application deadline: April 30, 2007

Contact person: Riccardo Cesaroni

INAF – Osservatorio Astrofisico di Arcetri

phone: +39 055 2752215 - fax: +39 055 220039

e-mail: cesa@arcetri.astro.it

Studentships available within the Research Training Network (RTN) ORIGINS

PhD Positions in Cosmochemistry

RESEARCH TRAINING NETWORK: Seven Marie Curie Fellowship (Early Stage Training) leading to a doctoral degree are available in the EU funded research network ORIGINS that comprises 8 European labs. The goal of ORIGINS is to elucidate the origins of Solar System(s) using a wide range of approaches (experimental, observational, theoretical) and techniques (SEM, TEM, MC-ICPMS, Raman spectroscopy, SIMS). The Early Stage Training Network ORIGINS provides PhD students with the opportunity for state-of-the-art research training in the different laboratories of the participating network members. The specific projects will be decided in discussion with the successful applicants, and will form part of a training programme designed, together with other participating Institutions, to meet the needs of the students.

SCIENTIFIC AIMS: Meteorites and micrometeorites will be studied in great detail to decipher the first million years of our Solar System. Special attention will be paid to the astrophysical context of our Sun's formation, the physics of the protoplanetary disk and the chronology of the first million years.

The 7 positions are available at the following institutions: * Natural History Museum London (London, UK)
Muséum National d'Histoire Naturelle (Paris, France)
Museo Nazionale dell'Antartide (Siena, Italy)
Imperial College London (UK)
Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse (Orsay, France)
Centre de Recherches Pétrographiques et Géochimiques (Nancy, France)
Zentrallabor für Geochronologie and Institut für Mineralogie (Münster, Germany)

STARTING DATE: Starting date can be anytime from January 1st 2007 depending on the specific academic rules of the respective country.

SALARY: Salaries depend on different parameters (marital status, country of residence) and follow the rules imposed by the EC. Marie Curie Fellowships have substantial benefits, both in salary and in mobility and family allowances. The duration of the Fellowships is 3 years.

ELIGIBILITY: The normal eligibility requirements of Marie Curie Fellowships apply. A condition of a Marie Curie Fellowship is that the applicant is not already resident in the host country, and will also spend some time in one or more of the other participating Institutes. The applicant must be a National of the EU or of an Associated State. Exceptionally, other nationalities may be considered. The applicant must also satisfy the requirements to register as a doctoral student at the host institution. The applicant should have a good command of both written and spoken English.

CONTACT: Please contact Dr Sara Russell (sarr@nhm.ac.uk) or Dr Matthieu Gounelle (gounelle@mnhn.fr) who will redirect you to the laboratories of interest.

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

Second Announcement

Massive Star Formation: Observations confront Theory

to be held from September 10th to 14th 2007 in Heidelberg/Germany.

Web-site, registration, deadlines and accommodation

Additional information on this meeting can be found at

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

The registration is open now (accessible from above WWW-address), and the early registration deadline for talks, posters and attendance is 31st of May 2007.

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 MIPS GAL) 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, 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. There will be ample room for contributed talks and poster presentations. 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 speaker and tentative title

Lori Allen: Clustered star formation

Kate Brooks: Observational overview

Jay Gallagher: Extragalactic star formation
Oliver Krause: Surveys of the Galactic plane
Mordecai-Mark Mac Low: Feedback
Barbara Whitney: Radiative transfer processes in MSF
Friedrich Wyrowski: Initial conditions
Harold Yorke: Theoretical overview

Invited speaker and tentative titles

Tom Abel: The first massive stars
John Bally: Outflows
Bob Benjamin: Galactic structure and star formation rate
Arian Bik: Infrared view of disks
Leo Blitz: From atomic to molecular gas
Ed Churchwell: Bubbling galactic disk
Lise Deharveng: Triggered star formation
Don Figer (tbc): Starburst clusters
Doug Gies: Binaries
Eva Grebel: Star formation in dwarf galaxies
Lincoln Greenhill: Orion revisited
Eric Keto: Accretion through HCHII regions
Richard Klein: Future of theory and simulations
Mark Krumholz: Turbulent accretion models
Susanna Lizano: Theory of HCHII
Margaret Meixner (tbc): SAGE legacy project
Karl Menten: Masers
Frederique Motte: Submm surveys of massive star-forming regions
Alison Sills: Stellar collision theory
Steve Stahler: Competitive accretion and coalescence
Juergen Steinacker: 3D radiative transfer
Floris v.d. Tak: Chemistry
Andrew Walsh: Surveys of southern hot cores
Sydney Wolff: Rotation and evolution of angular momentum
Qizhou Zhang: cm to submm view of disks

Panel discussions and confirmed participants

- Theoretical models and observational constraints for high-mass star formation (moderator: H. Zinnecker): Chris McKee, Ian Bonnell, ...
- 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.

Additional information about location, travel, tourism and the city of Heidelberg can also be found on our web-page <http://www.mpia.de/MSF07/>. If you have not received the announcements directly yet and want to be added to the email-list for additional announcements about the conference, just write an email to beuther@mpia.de.

JENAM-2007: EAS SYMPOSIUM S3
Violent Phenomena in Young Stars
Yerevan, Armenia, 20-22 August 2007

The registration form and call for abstracts (20-min contributed talks and posters) are now open on
http://www.aras.am/JENAM-2007/reg_form.php

JENAM is the Joint European and National Astronomy Meeting organized each year in one of the European countries jointly by the European Astronomical Society and one of the national astronomical societies. JENAM-2007 “Our non-stable Universe” will take place on 20-25 August 2007 in Yerevan (Armenia) and will be the 15th Annual Meeting of the European Astronomical Society (EAS) and the 6th Annual Meeting of the Armenian Astronomical Society (ArAS). JENAM consists of a number of EAS Symposia and Special Sessions on various aspects of modern astronomy.

Full information about JENAM-2007 can be found at:

JENAM-2007 web page at <http://www.aras.am/JENAM-2007/index.htm>

Mirror page at EAS: <http://www2.iap.fr/eas/Jenam07/index.htm>

Deadlines

Abstracts for contributed talks and posters: May 1, 2007

Travel Grant Applications : May 1, 2007

Early Registration (200 euros for EAS members, 240 euros for other participants) : June 1, 2007

Hotel reservations: June 1, 2007

Final Submission of Abstracts of accepted papers for the Abstracts book: June 30, 2007.

Rationale: Explosive events, energetic ejections and extremes in variability characterise the temperamental behaviour of young stars. With the recent expansion in our knowledge through the discovery of gigantic jets on degree scales and the study of detailed features on sub-arcsecond scale, we may now relate cause and effect: the cause of the violent phenomena and the feedback effect on the enveloping cloud.

The recent discoveries of new examples of extremely rare FU Ori type stars may yield insights into the role of stellar multiplicity and environment in jet formation and help clarify the whole picture of eruptive phenomena in YSOs. Wide field cameras and near-infrared interferometry have stimulated new searches of HH jets and embedded stars and clusters, which are about to substantially increase our understanding. Modern 3D spectral methods reveal complex inner structures of the jets and give new information about the jet - molecular outflow - ambient medium interaction, opening the possibility to work on more realistic 3D models of jet propagation. High spatial resolution imaging and spectroscopy with space telescopes, as well as ground based interferometry improve our knowledge about launching and collimation mechanisms.

Objectives: The symposium will provide an ideal platform to review what remains of our earlier models and bring together new ideas at this critical crossroads. The Byurakan Observatory was one of the locations where the modern ideas concerning early stellar evolution were started to form about 60 years ago; so the JENAM meeting in Armenia is the appropriate place to consider their present development.

Program schedule

August 20, Monday: Sessions 1 – 4

August 21, Tuesday: Sessions 5 – 7

August 22, Wednesday: Session 8

- invited talks of 30 minutes, including 5 minutes for questions

- contributed talks of 20 minutes.

Sessions and invited talks:

Session 1. Opening. Accretion and eruption processes in YSO

Tigran Magakian (Armenia) - 60 years of YSO studies in Byurakan
Jerome Bouvier (France) - CTTS variability and accretion/ejection

Session 2. YSO activity in various wavelengths.

Manuel Guedel (Switzerland): X-ray view of YSO

Session 3. FUor and EXor type objects

Bo Reipurth (USA): FUor and EXor Eruptions
Sergej A. Lamzin (Russia): Current models of FUors

Session 4. Physical properties of jets: observations and models

John Bally (USA): Irradiated jets
Tom Ray (Ireland): Observations of jet structure and dynamics (To be confirmed)

Session 5. Disk winds, stellar winds and origin of flows

Christian Fendt (Germany): Models of jets.
Sylvie Cabrit (France) The origin of jets: observational constraints vs theoretical predictions.

Session 6. Jet propagation and interaction with ISM

Chris Davis (UK): Infrared Jets and wide-field views
Michael Smith (UK): Jet penetration, evolution and statistics

Session 7. Outflows formation in massive stars, binaries and brown dwarfs

Riccardo Cesaroni (Italy): Jets from high mass stars and maser activity
Ray Jayawardhana (Canada): Variable Accretion and Outflow in Young Brown Dwarfs

Session 8. Joint discussion and perspectives of further studies

Roland Gredel (Germany): Future observational prospects

Scientific Organizing Committee: Francesca Bacciotti, Sylvie Cabrit, Manuel Guedel, Sergei A. Lamzin, Tigran Yu. Magakian (chair), Tigran A. Movsessian, Bo Reipurth, Michael D. Smith

CONTACT ADDRESSES FOR JENAM-2007:

Postal Address: JENAM-2007, Armenian Astronomical Society (ArAS), Byurakan Astrophysical Observatory (BAO), Byurakan 378433, Aragatzotn province, Republic of Armenia.

Phone: +374-10-580656 (Areg Mickaelian); Fax: +374-10-580656

E-mail: jenam2007@aras.am

WWW: <http://www.aras.am/JENAM-2007/index.htm> ;
<http://www2.iap.fr/eas/Jenam07/index.htm> (mirror site at EAS)

SOC Co-Chairmen: Joachim Krautter (Germany), Areg Mickaelian (Armenia)

LOC: jenam2007@aras.am, LOC Chairman: Areg Mickaelian (Armenia)

For an inquiry and discussion of the details of the individual EAS symposia and JENAM special sessions, please contact the SOC Chairs and the Conveners of the corresponding sessions.

For S3 Symposium:

Tigran Magakian (Armenia):

E-mail: tigmag@sci.am
Phone: +374-10-526136

Workshop on the Chronology of Meteorites and the Early Solar System

November 5-7, 2007 Kauai, Hawaii

Conveners Joel Baker, Victoria University of Wellington, New Zealand; Martin Bizzarro, Geological Institute, Denmark; Klaus Keil, University of Hawaii; Alexander N. Krot, University of Hawaii; Edward R.D. Scott, University of Hawaii.

Hosted by University of Hawaii at Manoa (Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, and the Institute for Astronomy)

MEETING LOCATION AND DATE

The workshop on the Chronology of Meteorites and the Early Solar System will be held November 5-7, 2007, at the Sheraton Kauai Resort, 2440 Hoonani Road, Poipu Beach, Koloa, Hawaii (800-782-9488, Rate Plan SET No. 338304; www.sheraton-kauai.com).

PURPOSE AND SCOPE

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 ^{26}Al - ^{26}Mg , ^{60}Fe - ^{60}Ni , ^{10}Be - ^{10}B , ^{41}Ca - ^{41}K , ^{182}Hf - ^{182}W , ^{53}Mn - ^{53}Cr 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 cosmochemistry such as LA-MC-ICPMS, MC-ICPMS, SIMS and TIMS. An important goal of the workshop is to identify outstanding questions and establish future research directions.

MEETING FORMAT

The three-day 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 review papers or regular article in *Geochimica et Cosmochimica Acta*. All papers will be subject to the normal GCA review process.

SPECIAL EVENTS

The workshop will honor the outstanding contributions of C.J. Allègre, G.W. Lugmair, L.E. Nyquist, D.A. Papanastassiou, and G.J. Wasserburg to our understanding of the chronology of the early solar system. Their achievements will be honored with a reception and invited talks.

CONTACT INFORMATION For further information regarding the format and scientific objectives of the meeting, contact Martin Bizzarro Geological Institute of Denmark Phone: 45 35 32 24 21 Fax: 45 35 32 24 99 E-mail: bizzarro@geol.ku.dk

Alexander N. Krot Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science University of Hawai'i at Manoa Phone: 808-956-3900 Fax: 808-956-6322 E-mail: sasha@higp.hawaii.edu

For information regarding meeting logistics and accommodations, contact Mary Cloud Lunar and Planetary Institute Phone: 281-486-2143 Fax: 281-486-2125 e-mail: cloud@lpi.usra.edu

SCHEDULE

July 3, 2007 Second announcement with call for abstracts, registration form, etc. posted on this website August 3, 2007 Abstract deadline September 14 Final announcement, program, and abstracts posted on this website September 21, 2007 Pre-registration deadline October 4, 2007 Hotel reservation deadline for special room rates November 5-7, 2007 Workshop on Chronology of Meteorites and the Early Solar System

12 Questions on Star and Massive Star Cluster Formation

An ESO Workshop (Garching, Germany), July 3 to 6, 2007

Organized by: Tom Wilson and Markus Kissler-Patig

Contact: star07@eso.org

Objective: The goal is to bring together two communities: the one working on star formation (mostly galactic) and the one working on the formation of young massive clusters (mostly extra-galactic). We will link galactic with extra-galactic work, optical/NIR techniques with sub-mm/mm/radio ones, the formation of stars with the one of massive star clusters - observations and theory. Views will be exchanged on topics such as the earliest phases of star and star cluster formation, ultra-compact and ultra-dense HII regions, embedded massive star and star clusters, stages at which stars and clusters emerge in the NIR and the optical, ending with young massive clusters observed in starburst.

The Format: The format is bold and new, aiming to focus attention on the critical 12 questions in this area. Each question will be addressed by all speakers in a dedicated 1.5-2h session including a 20 min introduction and several 10-15 min contributions to finish in a 30 min general discussion (with accompanying posters).

How were the Questions chosen? We called (until Dec 15th 2006) for proposals of questions around which the program would be built. The question was supposed to be: 1) of interest to both communities: star formation and star cluster formation; 2) focussed enough that it can be interestingly debated in 1.5-2h.

Tom Wilson and Markus Kissler-Patig relied then less on their wisdom and more on some local experts who got the ca. 40 questions (with authors remaining anonymous) and were asked to select the 12 most suited ones for the workshop. (Thanks to Arjan Bik, Sabine Mengel, Fernando Comeron, Michael Sterzik, Monika Petr-Gotzens, Thomas Stanke, Silvia Leurini, Dieter Nuernberger, Mario van den Ancker, Mark Casali and Uli Kaueff for their great help). The resulting list of question is the program below.

What next? REGISTER!

The registration is open until April 30th. When registering, you are kindly asked to specify to which question(s) you would like to contribute, and whether you would like to do so in a short (10-15 min) presentation or by a poster. All general discussions are obviously open to everyone and you are encouraged to send single slides to the respective coordinators to support the discussion. The coordinator(s) of the question will build the final program of their session in coordination with the workshop organizers. The final programme will be posted in May.

And here are the 12 Questions (still in random order):

How are the stellar and cluster initial mass functions related and how are they influenced by the star formation history? Coordinated by Marina Rejkuba

What are the effects of stellar feedback ? Coordinated by Nate Bastian and Ralf Klessen

What is the demographics of star formation in our Galaxy and others? or more specifically, What is the statistical distribution of star formation environments and is it universal? Coordinated by Tom Megeath

How did star formation proceed in Globular Clusters? Coordinated by Francesca D'Antona

How can we merge the galactic and extragalactic views of massive star formation regions derived from images and SEDs to a coherent physical picture? Coordinated by Juergen Steinacker

What governs proto-stellar mass accretion? Coordinated by Dirk Froebrich

Are mergers of smaller clusters a relevant step in the formation of very massive, gravitationally bound clusters? Coordinated by Bernhard Brandl

How does spiral structure effect star formation? Coordinated by Preben Grosbol

How important is "primordial" mass segregation in the context of massive star cluster formation and evolution? Coordinated by Richard de Grijs

What is the relationship between the properties of star clusters and the environments from which they form? Coordinated by Kelsey Johnson and Ian Bonnell

What are the similarities and differences between star forming objects at different scales and in different environments, in particular between the formation stages of galactic young high mass stellar associations, galactic young massive star clusters and the super massive clusters in starburst environments (with/without AGN)? To which extent are the properties of these different objects related by

simple scaling, and what are the fundamental difference between them? How does linear resolution difference between local and extragalactic sources affect this comparison? Coordinated by Emmanuel Galliano and Leonardo Bronfman

Which Physics determine the stellar upper mass limit? Coordinated by Hans Zinnecker

Scientific organizing Committee:

Marina Rejkuba European Southern Observatory, Garching Nate Bastian University College London Ralf Klessen Institut für Theoretische Astrophysik, University of Heidelberg Tom Megeath Ritter Observatory, The University of Toledo Francesca D'Antona Osservatorio Astronomico di Roma Jrgen Steinacker Max-Planck-Institut für Astronomie, Heidelberg Dirk Froebrich Centre for Astrophysics and Planetary Science, University of Kent Bernhard Brandl Sterrewacht Leiden, Leiden University Preben Grosbøl European Southern Observatory, Garching Richard de Grijs The University of Sheffield Kelsey Johnson University of Virginia Ian Bonnell The University of St. Andrews Emmanuel Galliano European Southern Observatory, Santiago Leonardo Bronfman Universidad de Chile Hans Zinnecker Astrophysikalisches Institut Potsdam

<http://www.eso.org/gen-fac/meetings/star07/>

STAR FORMATION THROUGH COSMIC TIME

A Workshop at the Kavli Institute for Theoretical Physics Aug. 6, 2007 – Dec. 7, 2007

Tom Abel, Alyssa Goodman, Chris McKee, Paolo Padoan

Star formation is at the nexus of much of modern astrophysics, ranging from cosmology to planet formation. This workshop will focus on five areas of critical importance in contemporary research on star formation:

- *Turbulence and magnetic fields in star formation.*
- *The formation of massive stars.*
- *The formation of star clusters.*
- *Evolution of galaxy-scale star formation with redshift.*
- *Primordial star formation.*

The problem of star formation is vast, and we are explicitly excluding several important aspects: Low-mass star formation will not be a focus of this workshop since it has been more extensively studied in the past; and planets, disks and jets will not be a focus in view of the very successful recent KITP workshops on these topics.

There are still a few spaces left during Sept 4 - Dec 7 for active researchers who could come for 3 weeks or longer. Further information on the workshop and applications can be found at <http://www.kitp.ucsb.edu/activities/auto2/?id=800>

CONFERENCE: A one-week conference will be held from August 13-17 on "Star Formation Through Cosmic Time." One need not be a workshop participant to attend the conference. The conference will cover the same topics of the workshop. Schedule and application form can be found at <http://www.kitp.ucsb.edu/activities/auto2/?id=913>

The MPA/ESO/MPE/USM 2007 Joint Astronomy Conference
Gas Accretion and Star Formation in Galaxies
10-14 September 2007 Garching bei München, Germany

This meeting addresses the following question: How does gas get into galaxies and what are the processes that regulate the rate at which it then turns into stars? The conference will bring together both theoreticians and observational astronomers working at different wavelengths, using different techniques, both at low and at high redshifts. A list of topics to be addressed in the conference is as follows:

- 1) HI observations of gas in and around nearby galaxies.
- 2) The relation between atomic and molecular gas.
- 3) Insights into the gas-star cycle in galaxies from new pan-chromatic data sets.
- 4) Theoretical models and empirical constraints on the global efficiency with which gas is converted into stars in galaxies.
- 5) Gas inflow mechanisms.
- 6) Feedback processes in galaxies.
- 7) The nature of the WHIM. Does gas cool from the hot phase? Insights from XMM/Chandra.
- 8) Physical constraints on gas in the vicinity of galaxies from quasar absorption lines.
- 9) Star formation in high redshift galaxies.
- 10) The relation between star forming and outflowing gas in high redshift galaxies.
- 11) The nature of high redshift Ly-alpha clouds.
- 12) Looking towards ALMA and other future facilities.

Scientific Advisory Committee:

Jacqueline Bergeron (IAP), Andi Burkert (MPIA), Chris Carilli (NRAO), Francoise Combes (ObsPM), Andy Fabian (IoA), Reinhard Genzel (MPE), Ortwin Gerhard (MPE), Tim Heckman (JHU), Guinevere Kauffmann (MPA), Rob Kennicutt (IoA), Eliot Quataert (Univ. of California, Berkeley), Piero Rosati (ESO), Renzo Sancisi (INAF), Ken Sembach (STScI), Mike Shull (Univ. of Colorado, Boulder), Ian Smail (Durham), Jonathan Tan (ETH, Zurich)

For further information please contact us at: gassf07@mpa-garching.mpg.de

<http://www.mpa-garching.mpg.de/~gassf07/>

Goldschmidt Conference 2007

19 August – 24, 2007, Cologne, Germany

<http://www.goldschmidt2007.org>

Theme 3 ” From Dust to Planets”

Session S15: From dust to planetesimals - Solar system processes and their timescales

<http://www.goldschmidt2007.org/theme03.php#T03-S02>

We would like to invite you to actively contribute to our session ”From dust to planetesimals - Solar system processes and their timescales”. Please encourage your students and colleagues to present their results in front of a world-class scientific audience.

The abstract submission deadline is April 19. Please feel free to contact us if you need further information.

Mario Trieloff (trieloff@min.uni-heidelberg.de)

Andreas Pack (a.pack@mineralogie.uni-hannover.de)

Martin Bizzarro (bizzarro@geol.ku.dk)

Short Announcements

I am writing a review on "Interstellar Polycyclic Aromatic Hydrocarbons" for Annual Review of Astronomy and Astrophysics which is scheduled to appear in Sept 2008 (volume 46). The manuscript is due mid October 2007.

I envision that this paper will review the observational characteristics of the so-called UIR bands and the inferred properties of interstellar PAHs. In addition, I hope to include a discussion on the (global) role of PAHs in the physics and chemistry of the interstellar medium and on the use of PAHs as tracers of star formation in galactic as well as extragalactic regions of star formation including era's of vigorous star formation such as associated with ULIRG phenomena and the early universe. This would be supplemented by a discussion on the origin and evolution of interstellar PAHs. I take the latter very broadly and would like to include a discussion on the relationship of PAHs with other carbonaceous compounds in space, such as diamondoids, fullerenes, and carbon-chains.

I would appreciate receiving any recent reprints or preprints on these topics.

-Xander Tielens

Catalogue of Protostars Bulletin (III)

We have updated the list of confirmed and candidate Class0 sources and their published broad-band photometric measurements, considering the literature of 2006. The online version of the list has moved since October 2006 to the University of Kent at <http://astro.kent.ac.uk/protostars/>. The full list now contains 135 objects and 2200 datapoints taken from 250 different publications. 26 further candidate Class0 objects are added to the list. See below for the complete list of added objects.

The object that was so far listed as RNO15 turned out to be a false identification in Froebrich (2005). Its correct identification is L1455-IRS4. This error is corrected in the online catalogue. In the light of this find, if:

1. your favourite source is missing
2. a paper containing broad-band photometric data is not in the list
3. you find a mistake
4. you have any further suggestions

please do not hesitate to contact df@star.kent.ac.uk. Also contact this email address if you would like to be added/removed from our mailing list.

There are some publications that certainly measure fluxes of the listed sources, but the individual fluxes are not listed in a table or provided in the text of the paper. If you are a (co-)author of such a paper, could you please provide us with the necessary data. This will greatly facilitate the usefulness of this database.

NOTE: Please remember that for security reasons we had to secure the data with a public password. The login is "proto" and the password is "star".

Table 1: List of newly added objects

B1-a	Jorgensen et al. 2006, ApJ, 645, 1246
LDN1521F	Belloche et al. 2006, 454, 51
SerG3-G6 MMS 1c/3	Djupvik et al. 2006, A&A, 458, 789
HH270 VLA1	Choi & Tang, 2006, ApJ, 648, 504
rho-Oph A-29/31/36	Koyama & Imanishi, 2006, CJAA, 6, 119
OMC5 SMM30	Johnstone & Bally, 2006, ApJ, 653, 383
L1641N SMM60/70	Johnstone & Bally, 2006, ApJ, 653, 383
CB205 SMM2/3/4	Codella et al. 2006, A&A, 457, 891
L1206 OVRO2	Beltran, 2006, A&A, 457, 865
NGC2264-C1/2/3/4/5/10/11/12	Peretto et al. 2006, A&A, 445, 979
NGC2264-D1/3/7/14	Peretto et al. 2006, A&A, 445, 979
Upcoming objects	
Lupus3 MMS	Tachihara et al. 2007, ApJ in press