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Abstracts of recently accepted papers

Locating the Launching Region of T Tauri Winds: The Case of DG Tau

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It is widely believed that T Tauri winds are driven magnetocentrifugally from accretion disks close to the central stars. The exact launching conditions are uncertain. We show that a general relation exists between the poloidal and toroidal velocity components of a magnetocentrifugal wind at large distances and the rotation rate of the launching surface, independent of the uncertain launching conditions. We discuss the physical basis of this relation and verify it using a set of numerically-determined large-scale wind solutions. Both velocity components are in principle measurable from spatially resolved spectra, as has been done for the extended low-velocity component (LVC) of the DG Tau wind by Bacciotti et al. For this particular source, we infer that the spatially resolved LVC originates from a region on the disk extending from ~ 0.3 to ~ 4.0 AU from the star, which is consistent with, and a refinement over, the rough estimate of Bacciotti et al.

Accepted by ApJ Letters

The Effects of UV Continuum and Lyman α Radiation on the Chemical Equilibrium of T Tauri Disks

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We show in this *Letter* that the spectral details of the FUV radiation fields have a large impact on the chemistry of protoplanetary disks surrounding T Tauri stars. We show that the strength of a realistic stellar FUV field is significantly lower than typically assumed in chemical calculations and that the radiation field is dominated by strong line emission, most notably Lyman α radiation. The effects of the strong Lyman α emission on the chemical equilibrium in protoplanetary disks has previously been unrecognized. We discuss the impact of this radiation on molecular observations in the context of a radiative transfer model that includes both direct attenuation and scattering. In particular, Lyman α radiation will directly dissociate water vapor and may contribute to the observed enhancements of CN/HCN in disks.

Accepted by Astrophysical Journal Letters

Preprint available at `http://xxx.lanl.gov/abs/astro-ph/0305565 or http://cfa-www.harvard.edu/~ebergin`

Multiple outflows in IRAS 19410+2336

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Plateau de Bure Interferometer high-spatial resolution CO observations combined with near-infrared H_2 data disentangle at least seven (maybe even nine) molecular outflows in the massive star-forming region IRAS 19410+2336. Position-velocity diagrams of the outflows reveal Hubble-like relationships similar to outflows driven by low-mass objects. Estimated accretion rates are of the order $10^{-4}\,M_\odot\,yr^{-1}$, sufficiently high to overcome the radiation pressure and form massive stars via disk-mediated accretion processes. The single-dish large-scale mm continuum cores fragment into several compact condensations at the higher spatial resolution of the PdBI which is expected due to the clustering in massive star formation. While single-dish data give a simplified picture of the source, sufficiently high spatial resolution resolves the structures into outflows resembling those of low-mass star-forming cores. We interpret this as further support for the hypothesis that massive stars do form via disk-accretion processes similar to low-mass stars.

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

Modeling gas-phase H_2O between 5 μm and 540 μm toward massive protostars

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We present models and observations of gas-phase H_2O lines between 5 and 540 μm toward deeply embedded massive protostars, involving both pure rotational and ro-vibrational transitions. The data have been obtained for 6 sources with both the Short and Long Wavelength Spectrometers (SWS and LWS) on board the Infrared Space Observatory (ISO) and with the Submillimeter Wave Astronomy Satellite (SWAS). For comparison, CO J=7–6 spectra have been observed with the MPIfR/SRON 800 GHz heterodyne spectrometer at the James Clerk Maxwell Telescope (JCMT). A radiative transfer model in combination with different physical/chemical scenarios has been used to model these H_2O lines for 4 sources to probe the chemical structure of these massive protostars. The results indicate that pure gas-phase production of H_2O cannot explain the observed spectra. Ice evaporation in the warm inner envelope and freeze-out in the cold outer part are important for most of our sources and occur at T ∼90–110 K. The ISO-SWS data are particularly sensitive to ice evaporation in the inner part whereas the ISO-LWS data are good diagnostics of freeze-out in the outer region. The modeling suggests that the 557 GHz SWAS line includes contributions from both the cold and the warm H_2O gas. The SWAS line profiles indicate that for some of the sources a fraction of up to 50% of the total flux may originate in the outflow. Shocks do not seem to contribute significantly to the observed emission in other H_2O lines, however, in contrast with the case for Orion. The results show that three of the observed and modeled H_2O lines, the $3_{03}-2_{12}, 2_{12}-1_{01}$, and $1_{10}-1_{01}$ lines, are good candidates to observe with the Herschel Space Observatory in order to further investigate the physical and chemical conditions in massive star-forming regions.

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http://www.strw.leidenuniv.nl/∼boonman/papers/h2o.pdf

A model for the cross section of a turbulent, radiative jet or wake

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We present an analytical model for the cross section of a turbulent, radiative jet or wake. This model is appropriate for modeling HH jets, or "wakes" left behind by "astrophysical bullets". Even though the model is very simple, it has the benign property of only having four free parameters (the outer radius of the beam, the axial velocity, the velocity at the edge of the beam, and the turbulent velocity width), which can be derived by fitting the radial velocity and line width cross sections of an observed outflow. We illustrate how to do such fits using previously published spectroscopic data of the HH 110 jet.

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The Hot Core around the low mass protostar IRAS16293-2422: Scoundrels rule!

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While warm dense gas is prevalent around low mass protostars, the presence of complex saturated molecules - the chemical inventory characteristic of Hot Cores - has remained elusive in such environments. Here we report the results of a IRAM-30m study of the molecular composition associated with the low mass protostar IRAS16293-2422. Our observations highlight an extremely rich organic inventory in this source with abundant amounts of complex O and N-bearing molecules such as formic acid, HCOOH, acetaldehyde, CH_3CHO, methyl formate, CH_3OCHO, dimethyl ether, CH_3OCH_3, acetic acid, CH_3COOH, methyl cyanide, CH_3CN, ethyl cyanide, C_2H_5CN and propyne, CH_3CCH. We compare the composition of the Hot Core around this low mass young stellar object with those around massive protostars and address the chemical processes involved in molecular complexity in regions of star formation.

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http://www-laog.obs.ujf-grenoble.fr/∼ceccarel/

New low-mass members of the Lupus 3 dark cloud: further indications of pre-main-sequence evolution strongly affected by accretion

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A spectroscopic survey of a small area at the center of the Lupus 3 star forming core has revealed four new mid-to-late M-type members, including a M7.5 brown dwarf. One of the new members, classified as M5, displays prominent forbidden lines and strong Hα emission (EW(Hα) = 410 Å), in addition to other permitted lines, and its luminosity is far below that of other members of the region with similar or later spectral types. We estimate a mass accretion rate rate of $\sim 1.4 \times 10^{-9}$ $M_\odot$ yr^{-1} for this object, although with uncertainties that do not exclude values as low as 10^{-10} $M_\odot$ yr^{-1}. Based on the Hα/[SII] ratio, the detection of HeI, and the CaII infrared triplet, we argue that most of the Hα emission is produced near the surface of the object, probably in accretion columns or at the base of jets, rather than in a low density extended region. The strong emission-line spectrum superimposed on an unusually faint photospheric continuum thus seems to be a real, intrinsic feature rather than a result of the viewing geometry caused by an edge-on disk blocking the light from the central object. Other Lupus 3 late-type members also display noticeable underluminosity, all of them having EW(Hα) > 100 Å as a result of the faint underlying continuum. We tentatively interpret these findings as evidence for the pre-main sequence evolution of objects with very low (possibly substellar) initial masses being significantly modified by accretion.

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http://www.eso.org/∼fcomeron/lupus.ps

Molecular outflows in the young open cluster IC 348

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We present a wide-field survey of the young open cluster IC 348 for molecular H_2 outflows. Outflow activity is only found at its south-western limit, where a new subcluster of embedded sources is in an early phase of its formation. If the IC 348 cluster had been built up by such subclusters forming at different times, this could explain the large age-spread that Herbig 1998 found for the IC 348 member stars. In addition to several compact groups of H_2 knots, our survey reveals a large north-south oriented outflow, and we identify the newly discovered far-infrared and mm-object IC 348 MMS as its source. New deep images in the 1–0 S(1) line of molecular hydrogen trace the HH 211 jet and counterjet as highly-collimated chains of knots, resembling the interferometric CO and SiO jets. This jet system appears rotated counter-clockwise by about 3° with respect to the prominent H_2 bow shocks. Furthermore, we resolve HH 211-mm as a double point-like source in the mm-continuum.

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A search for 85.5- and 86.6-GHz methanol maser emission

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We have used the Australia Telescope National Facility Mopra 22m millimetre telescope to search for emission from the 6_{-2}-7_{-1} E (85.5-GHz) and 7_2-6_3 A^- (86.6-GHz) transitions of methanol. The search was targeted towards 22 star formation regions which exhibit maser emission in the 107.0-GHz 3_1-4_0 A^+ methanol transition, as well as in the 6.6-GHz 5_1-6_0 A^+ transition characteristic of class II methanol maser sources. A total of 22 regions were searched at 85.5 GHz resulting in 5 detections, of which 1 appears to be a newly discovered maser. For the 86.6-GHz transition observations were made of 18 regions which yielded 2 detections, but no new maser sources. This search demonstrates that emission from the 6_{-2}-7_{-1} E and 7_2-6_3 A^- transitions is rare. Detection of maser emission from either of these transitions therefore indicates the presence of special conditions, different from those in the majority of methanol

maser sources. We have observed temporal variability in the 86.6-GHz emission towards 345.010+1.792, which along with the very narrow line width, confirms that the emission is a maser in this source.

We have combined our current observations with published data for the 6.6-, 12.1-, 85.5-, 86.6-, 107.0-, 108.8- and 156.6-GHz transitions for comparison with the maser model of Sobolev & Deguchi (1994). Both detections and nondetections are useful for setting limits on the physical conditions in star forming regions which contain methanol maser emission. This has allowed us to estimate the likely ranges of dust temperature, gas density, and methanol column density, both for typical methanol maser sources and for those sources which also show 107.0-GHz emission. The gas temperature can also be estimated for those sources exhibiting masers at 85.5 and/or 86.6 GHz.

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Young Stars and Outflows in the globule IC 1396 W

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We have observed the IC 1396 W globule in a narrow band filter centred on the 1 – 0 S(1) line of molecular hydrogen and in the J, H, K' broad-band filters. Three molecular hydrogen outflows could be identified by means of H_2 emission. The projected axes of the flows are parallel to each other. By means of the NIR images and IRAS/ISOPHOT data we could identify the driving sources of all outflows, the possible Class 0 source IRAS21246+5743 and two red objects (Class 1/2). NIR photometry reveals an embedded cluster of young stars in the globule, coinciding with FIR emission. Other young stars in the field are more or less clustered in several small groups, an indication that star formation takes place at different positions at the same time in such small globules.

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Preprints are available at: http://www.tls-tautenburg.de/research/frobrich/php/veroe.html

Jets and HH Objects in the ρ Ophiuchi Embedded Cluster

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We present results from a near-infrared 2.12 μm survey covering a large portion of the ρ Ophiuchi cloud (3 regions of $\sim 20' \times 20'$, on average, each) in an effort to improve the detection of embedded molecular hydrogen emission objects in the cloud. We complement these observations with deep optical [S II] images of 6 areas, $10' \times 10'$, each. We recovered all previously known optical jets/HH objects as well as H_2 outflows in the region and report the detection of 4 new HH objects and 13 near-infrared knots. We provide coordinates and describe the morphology of these knots, several of which are identified as belonging to the same flow based on morphological and proximity arguments. We discuss likely exciting sources. A unique association of the driving star is not always possible as several young stars lie in close proximity to these knots.

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Gravity Indicators in the Near-Infrared Spectra of Brown Dwarfs

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We investigate the sensitivity to temperature and gravity of the strong absorption features in the J- and K-band

spectra of substellar objects. We compare the spectra of giants and young M dwarfs (of low gravity) to field M and L dwarfs (of high gravity) and to model spectra from the Lyon group. We find that low-resolution spectra of M4 – M9 stars and young brown dwarfs at R $\sim$ 350 and $S/N > 70$ can determine the spectral type to a precision of $\pm$ 1 subtype, using the H_2O and CO bands, and can measure the surface gravity to $\pm$ 0.5 dex, using the atomic lines of KI and NaI. This result points toward the development of photometric spectral indices to separate low-mass members from foreground and background objects in young clusters and associations. We also emphasize the complexity of the interpretation of the empirical quantities (e.g., spectral types) in terms of the physical variables (e.g., temperature, opacities) in the cool atmospheres of young brown dwarfs.

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Natural Coronagraphic Observations of the Eclipsing T Tauri System KH 15D: Evidence for Accretion and Bipolar Outflow in a WTTS

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We present high resolution (R $\sim$ 44,000) UVES spectra of the eclipsing pre-main sequence star KH 15D covering the wavelength range 4780 to 6810 Å obtained at three phases: out of eclipse, near minimum light and during egress. The system evidently acts like a natural coronagraph, enhancing the contrast relative to the continuum of hydrogen and forbidden emission lines during eclipse. At maximum light the Hα equivalent width was $\sim$2 Å and the profile showed broad wings and a deep central absorption. During egress the equivalent width was much higher ($\sim$70 Å) and the broad wings, which extend to $\pm$ 300 km/s, were prominent. During eclipse totality the equivalent width was less than during egress ($\sim$40 Å) and the high velocity wings were much weaker. Hβ showed a somewhat different behavior, revealing only the blue-shifted portion of the high velocity component during eclipse and egress. [OI] $\lambda\lambda$6300, 6363 lines are easily seen both out of eclipse and when the photosphere is obscured and exhibit little or no flux variation with eclipse phase. Our interpretation is that KH 15D, although clearly a weak-line T Tauri star by the usual criteria, is still accreting matter from a circumstellar disk, and has a well-collimated bipolar jet. As the knife-edge of the occulting matter passes across the close stellar environment it is evidently revealing structure in the magnetosphere of this pre-main sequence star with unprecedented spatial resolution. We also show that there is only a small, perhaps marginally significant, change in the velocity of the K7 star between the maximum light and egress phases probed here.

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Mapping Observations of DNC and $HN^{13}C$ in Dark Cloud Cores

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We present results of mapping observations of the DNC, $HN^{13}C$, and $H^{13}CO^+$ lines (J=1-0) toward 4 nearby dark cloud cores, TMC-1, L1512, L1544, and L63, along with observations of the DNC and $HN^{13}C$ lines (J=2-1) toward selected positions. By use of statistical equilibrium calculations based on the LVG model, the H_2 densities are derived

to be (1.4-5.5)$\times 10^5$ cm^{-3}, and the [DNC]/[HN^{13}C] ratios are derived to be 1.25-5.44 with a typical uncertainty by a factor of 2. The observed [DNC]/[HNC] ratios range from 0.02 to 0.09, assuming the [^{12}C]/[^{13}C] ratio of 60. Distributions of DNC and HN^{13}C are generally similar to each other, whereas the distribution of H^{13}CO$^+$ is more extended than those of DNC and HN^{13}C, indicating that they reside in an inner part of the cores than HCO$^+$. The [DNC]/[HN^{13}C] ratio is rather constant within each core, although a small systematic gradients are observed in TMC-1 and L63. Particularly, no such systematic gradient is found in L1512 and L1544, where a significant effect of depletion of molecules is reported toward the central part of the cores. This suggests that the [DNC]/[HNC] ratio would not be very sensitive to depletion factor, unlike the [DCO$^+$]/[HCO$^+$] ratio. On the other hand, the core to core variation of the [DNC]/[HNC] ratio, which range an order of magnitude, is more remarkable than the variation within each core. These results are interpreted qualitatively by a combination of three competing time-dependent processes; gas-phase deuterium fractionation, depletion of molecules onto grain surface, and dynamical evolution of a core.

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A Disk Census for Young Brown Dwarfs

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Recent surveys have identified sub-stellar objects down to planetary masses in nearby star-forming regions. Reliable determination of the disk frequency in young brown dwarfs is of paramount importance to understanding their origin. Here we report the results of a systematic study of infrared L'-band (3.8μm) disk excess in $\sim$50 spectroscopically confirmed objects near and below the sub-stellar boundary in several young clusters. Our observations, using the ESO Very Large Telescope, Keck I and the NASA Infrared Telescope Facility, reveal that a significant fraction of brown dwarfs harbor disks at a very young age. Their inner disk lifetimes do not appear to be vastly different from those of disks around T Tauri stars. Our findings are consistent with the hypothesis that sub-stellar objects form via a mechanism similar to solar-mass stars.

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Rotational periods of very young brown dwarfs and very low-mass stars in Cha I

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We have studied the photometric variability of very young brown dwarfs and very low-mass stars (masses well below 0.2 M$_\odot$) in the Cha I star forming region. We have determined photometric periods in the Gunn i and R band for the three M6.5–M7 type brown dwarf candidates Cha Hα 2, Cha Hα 3 and Cha Hα 6 of 2.2 to 3.4 days. These are the longest photometric periods found for any brown dwarf so far. If interpreted as rotationally induced they correspond to moderately fast rotational velocities, which is fully consistent with their $v \sin i$ values and their relatively large radii. We have also determined periods for the two M5–M5.5 type very low-mass stars B 34 and CHXR 78C. In addition to the Gunn i and R band data, we have analysed JHK$_S$ monitoring data of the targets, which have been taken a few weeks earlier and confirm the periods found in the optical data. Upper limits for the errors in the period determination are between 2 and 9 hours. The observed periodic variations of the brown dwarf candidates as well as of the T Tauri stars

are interpreted as modulation of the flux at the rotation period by magnetically driven surface features, on the basis of a consistency with $v \sin i$ values as well as (R-i) color variations typical for spots. Furthermore, the temperatures even for the brown dwarfs in the sample are relatively high (> 2800 K) because the objects are very young. Therefore, the atmospheric gas should be sufficiently ionized for the formation of spots on one hand and the temperatures are too high for significant dust condensation and hence variabilities due to clouds on the other hand. A comparison with rotational properties of older brown dwarfs shows that most of the acceleration of brown dwarfs takes place within the first 30 Myr or less. If magnetic braking plays a role this suggests that the disk dissipation for brown dwarfs occurs between a few Myrs and 36 Myr.

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For preprints via ftp or WWW: http://www.xray.mpe.mpg.de/∼viki/publications.html or astro-ph/0305397

The features of UV-continuum energy distribution of T Tauri stars.

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We analysed HST/STIS UV spectra of BP Tau, GW Ori, T Tau and RY Tau and found the kink in the vicinity of 2000 Å on the curve $F^c_\lambda(\lambda)$, described continuum energy distribution. Apparently the presence of the kink means, that UV-continuum of these stars consists of two components: emission of optically thick gas with $T < 8000$ K and emission of the gas with essentially larger temperature. Bolometrical luminosity of the hot component is much lower than luminosity of the low-temperature one, but hot gas emission dominates shortward $\lambda \simeq 1800$ Å. Earlier other authors draw similar conclusion for some CTTSs analysing low resolution IUE spectra, but we demonstrate, that the continuum level for short wavelengths can is determined with large errors from these spectra.

We demonstrate for three of investigated stars (BP Tau, GW Ori, T Tau), that accretion shock emission alone can not explain observed UV continuum energy distribution. In the case of BP Tau we argue that more than 90 % of emission continuum longward 2000 Å is originated outside the accretion shock, probably in the inner region of the accretion disk. Earlier we draw similar conclusion for 6 other CTTS. This result leads us to believe that "high-temperature" continuum can be related with emission of chromosphere of the disk, while we can not exclude, that it is originated in stellar chromosphere.

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The Formation of Stellar Clusters in Turbulent Molecular Clouds: Effects of the Equation of State

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We study the effect of varying the equation of state on the formation of stellar clusters in turbulent molecular clouds, using three-dimensional, smoothed particle hydrodynamics simulations. Our results show that the equation of state helps determine how strongly self-gravitating gas fragments. The degree of fragmentation decreases with increasing polytropic exponent γ in the range $0.2 < \gamma < 1.4$, although the total amount of mass accreted onto collapsed fragments appears to remain roughly constant through that range. Low values of γ are expected to lead to the formation of dense clusters of low-mass stars, while $\gamma > 1$ probably results in the formation of isolated and massive stars. Fragmentation and collapse ceases entirely for $\gamma > 1.4$ as expected from analytic arguments. The mass spectrum of overdense gas clumps is roughly log-normal for *non*-self-gravitating turbulent gas, but changes to a power-law under the action of gravity. The spectrum of collapsed cores, on the other hand, remains log-normal for $\gamma \leq 1$, but flattens markedly for $\gamma > 1$. The density PDFs approach log-normal, with widths that decrease with increasing γ. Primordial gas may have effective $\gamma > 1$, in which case these results could help explain why models of the formation of the first stars tend to

produce isolated, massive objects.

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An HST/WFPC2 Survey for Brown Dwarf Binaries in the αPersei and the Pleiades Open Clusters

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We present the results of a high-resolution imaging survey for brown dwarf binaries in two open clusters. The observations were carried out with the Wide Field Planetary Camera 2 onboard the Hubble Space Telescope. Our sample consists of 8 brown dwarf candidates in αPersei and 25 brown dwarf candidates in the Pleiades. We have resolved 4 binaries in the Pleiades with separations in the range 0.094–0.058 arcsec, corresponding to projected separations between 11.7 AU and 7.2 AU. No binaries were found among the αPersei cluster targets. Three of the binaries have proper motions consistent with cluster membership in the Pleiades cluster, and for one of them we report the detection of H_α in emission and LiI absorption obtained from Keck II/ESI spectroscopy. One of the binaries does not have a proper motion consistent with Pleiades membership. We estimate that brown dwarf binaries wider than 12 AU are less frequent than 9% in the αPersei and Pleiades clusters. This is consistent with an extension to substellar masses of a trend observed among stellar binaries: the maximum semimajor axis of binary systems decreases with decreasing primary mass. We find a binary frequency of 2 binaries over 13 brown dwarfs with confirmed proper motion membership in the Pleiades, corresponding to a binary fraction of 15^{+15}_{-5}% . These binaries are limited to the separation range 7-12 AU and their mass ratios are larger than 0.7. The observed properties of Pleiades brown dwarf binaries appear to be similar to their older counterparts in the solar neighborhood. The relatively high binary frequency ($\geq$ 10%), the bias to separations smaller than about 15 AU and the trend to high mass ratios (q$\geq$0.7) are fundamental properties of brown dwarfs. Current theories of brown dwarf formation do not appear to provide a good description of all these properties.

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Fragmentation of a Molecular Cloud Core versus Fragmentation of the Massive Protoplanetary Disk in the Main Accretion Phase

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The fragmentation of molecular cloud cores a factor of 1.1 denser than the critical Bonnor-Ebert sphere is examined though three-dimensional numerical simulations. A nested grid is employed to resolve fine structure down to 1 AU while following the entire structure of the molecular cloud core of radius 0.14 pc. A barotropic equation of state is assumed to take account of the change in temperature during collapse, allowing simulation of the formation of the first core. A total of 225 models are shown to survey the effects of initial rotation speed, rotation law, and amplitude of bar mode perturbation. The simulations show that the cloud fragments whenever the cloud rotates sufficiently slowly to allow collapse but fast enough to form a disk before first-core formation. The latter condition is equivalent to $\Omega_0 t_{\rm ff} \gtrsim 0.05$, where Ω_0 and $t_{\rm ff}$ denote the initial central angular velocity and the freefall time measured from the central density, respectively. Fragmentation is classified into six types: *disk-bar*, *ring-bar*, *satellite*, *bar*, *ring*, and *dumbbell* types according to the morphology of collapse and fragmentation. When the outward decrease in initial

angular velocity is more steep, the cloud deforms from spherical at an early stage. The cloud deforms into a ring only when the bar mode ($m = 2$) perturbation is very minor. The ring fragments into two or three fragments via *ring-bar* type fragmentation and into at least three fragments via *ring* type fragmentation. When the bar mode is significant, the cloud fragments into two fragments via either *bar* or *dumbbell* type fragmentation. These fragments eventually merge due to their low angular momenta, after which several new fragments form around the merged fragment via *satellite* type fragmentation. This satellite type fragmentation may be responsible for observed wide range of binary separation.

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`http://meric.i.hosei.ac.jp/~matsu/fragment03/`

Binary and Multiple Star Formation in Magnetic Clouds: Bar Growth and Fragmentation

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In the standard scenario of isolated low-mass star formation, strongly magnetized molecular clouds are envisioned to condense gradually into dense cores, driven by ambipolar diffusion. Once the cores become magnetically supercritical, they collapse to form stars. Previous studies based on this scenario are limited to axisymmetric calculations leading to single supercritical core formation. The assumption of axisymmetry has precluded a detailed investigation of cloud fragmentation, generally thought to be a necessary step in the formation of binary and multiple stars. In a series of papers, we studied the non-axisymmetric evolution of initially magnetically subcritical clouds, using a two-dimensional magnetohydrodynamic code based on the physically motivated thin-disk approximation. We found that such clouds become unstable to non-axisymmetric perturbations after the supercritical cores are formed due to ambipolar diffusion. In this paper, we focus on the evolution of clouds perturbed by an $m = 2$ mode of a modest fractional amplitude of 5%, with an eye on binary and multiple star formation. We show that for a wide range of initial cloud parameters, the $m = 2$ mode grows nonlinearly into a bar during the isothermal collapse after the supercritical core formation. The instability is driven by the domination of the magnetically-diluted gravity over the combined thermal and magnetic pressure gradient in the supercritical cores. Such gravity-dominated cores can break up into fragments during or after the isothermal phase of cloud evolution.

The outcome of fragmentation depends on the initial cloud conditions, such as the magnetic field strength, rotation rate, amount of cloud mass (relative to thermal Jeans mass) and mass distribution. It is classified into three different types: (1) *separate core formation*, in which the bar ($m = 2$) mode breaks up into two separate cores during the isothermal collapse, with a core separation of order 10^4 AU, (2) *bar fragmentation*, in which the $m = 2$ mode evolves into a needle-like, opaque "first bar" (at a density $n \gtrsim 10^{12}$ cm^{-3}), which breaks up into multiple fragments with initial masses of order 10^{-2} M$_\odot$ and separations of order 10^2-10^3 AU, and (3) *disk fragmentation*, in which the bar growth remains slow during the isothermal collapse and the central region evolves into a rapidly rotating, opaque "first disk", which breaks up into several self-gravitating blobs with separations less than the disk size ($\lesssim 10^2$ AU). These three types of fragmentation loosely correspond to the empirical classification of embedded binary and multiple systems of Looney, Mundy, & Welch, based on millimeter dust continuum observations. The well-studied starless core, L1544, appears to belong to the bar fragmentation type. We expect it to produce a highly elongated, opaque bar at the center in the future, which should break up into fragments of initial masses in the substellar regime.

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High resolution observations of the hot core in G29.96–0.02

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We present high angular resolution observations obtained with the Owens Valley and the IRAM Plateau de Bure millimeter-wave interferometers toward the hot core in G29.96–0.02. We observed the ground state CH_3CN(6–5), $CH_3^{13}CN$(6–5), vibrationally excited (v_8=1) CH_3CN(6–5), and the $C^{18}O$(1–0) rotational transitions, as well as the 2.7 mm continuum emission. Our continuum maps show evidence of a compact source barely resolved whose diameter we estimate to be about 0.06 pc and whose emission mechanism is dominated by thermal emission from warm dust. Both the ground state and the v_8=1 methyl cyanide lines, as well as other serendipituosly detected molecular transitions, arise from a compact source at the same position as the 2.7 mm continuum emission. The $C^{18}O$ observations sample the structure and kinematics of the molecular surroundings of the hot core and from the $C^{18}O$ data we estimate a gas mass of about $1.1\,10^3$ $M_\odot$ in a region with a diameter of 0.32 pc, corresponding to an average number density of about 10^6 cm^{-3}. Our data show evidence of both a temperature and density gradient in the hot core and its molecular surroundings. The density gradient, in particular, is consistent with the infalling scenario suggested by the presence of an East-West oriented velocity gradient, which is however of opposite sign in CH_3CN and $C^{18}O$. We tentatively interpret the $C^{18}O$ velocity gradient as associated with infall, whereas the CH_3CN gradient, consistent with that measured in NH_3 by Cesaroni et al. (1998), is likely to trace a massive rotating disk.

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The First Detailed Look at a Brown Dwarf Disk

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The combination of mid-infrared and recent submm/mm measurements allows us to set up the first comprehensive spectral energy distribution (SED) of the circumstellar material around a young Brown Dwarf. Simple arguments suggest that the dust is distributed in the form of a disk. We compare basic models to explore the disk parameters. The modeling shows that a flat disk geometry fits well the observations. A flared disk explains the SED *only* if it has a puffed-up inner rim and an inner gap much larger than the dust sublimation radius. Similarities and differences with disks around T Tauri stars are discussed.

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Mid-infrared images of the star forming region GGD 14 (IRAS 06084-0611)

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Mid-infrared images at 8.7, 9.7 and 12.5 μm are presented of the star forming region GGD 14 associated with the source IRAS 06084-0611. In an area of ∼30" around the IRAS position, two mid-infrared sources were found. One was identified with the cometary compact HII region VLA 1 and the second with the faint and unresolved radio continuum source VLA 4. The mid-infrared morphology of VLA 1 is very similar to that of the radio continuum suggesting a direct interaction between the ionized gas and the dust. The infrared source associated with VLA 4 shows a large infrared excess and its derived infrared luminosity is $L_{1-20\,\mu\mathrm{m}} = 350 L_\odot$, indicating the presence of a young star later

than B3. In addition, its spectrum between 2.47 and 11.62 μm observed by ISOPHOT shows the presence of infrared emission bands at 3.3, 6.2, 7.7, 8.6 and 11.2 μm with relative intensity ratios typical of compact HII regions. Finally, the radio continuum source VLA 2, undetected on our mid-infrared images, shows an infrared luminosity of $\sim 8.5 L_{\odot}$ confirming its nature of an embedded T-Tauri star.

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Spiral arms in accretion discs encounters

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In high density star-forming regions, encounters of protostars surrounded by accretion discs are thought to be quite likely events. There is increasing numerical and observational evidence that discs around early stars may display characteristic spiral patterns, become elliptical or display a ring structure. In this paper simulations of prograde encounters between a disc-surrounded protostar and a secondary star are used to investigate the mass transport within the disc induced by such encounters. It is demonstrated that in this context the appearance of superkeplerian velocities in the tidal tail are the key to predicting the properties like spiral arms, rings and elliptic discs. A detailed parameter study reveals the dependence of the mass transport on the actual encounter parameters and the influence of hydrodynamical effects and self-gravity on the disc dynamics. Further simulation results show that there are two different mechanisms at work to create the first two spiral arms - the first spiral arm resembles a shock-like structure, whereas the second arm (and possibly subsequent arms) is caused by a relative movement between the central star and the center of mass of the disc, caused by the mass imbalance in the disc.

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A Photometric and [SII] Survey of the Young Cluster, Roslund 4

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Optical B and V-band CCD data have been obtained for the young cluster Roslund 4 in conjunction with a large-scale photometric survey of open clusters. [SII] and off-line continuum CCD emission line imaging data have also been obtained, revealing three regions in the cluster field where shock-excited gas is present. Two Herbig-Haro-like emission features are found while a more extended emission feature, along an apparent cloud boundary, may be a result of stellar winds encountering the edge of a molecular cloud. The emission line features are located near IRAS sources with properties consistent with star forming regions. A previously published age for Roslund 4 ($\sim$10 Myr) would seemingly suggest that shocked gas features should not be present in the cluster region, but an upper limit on the age (< 4 Myr) derived from the new photometry is more consistent with their presence. Finally, the distance to Roslund 4 is found to be 1700 - 2000 pc, considerably closer than the previous published estimate.

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A Multiwavelength Study of the S106 Region II: Characteristics of the Photon Dominated Region

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The O star S106 IR powers a bright, spatially extended $10' \times 3'$ (1.75×0.5 pc at a distance of 600 pc) Photon Dominated Region (PDR) traced by our observations of FIR fine structure lines and submm molecular transitions. The [C II] 158 μm, [C I] 809 and 370 μm, CO 7→6, and CO 4→3 measurements probe the large scale (1.2 pc) PDR emission, whereas [O I] 63 μm, CN N=3→2, and CS J=7→6 observations are focussed on the immediate ($\sim 1'$ (0.2 pc)) environment of S106 IR. A hot (T> 200 K) and dense ($n > 3 \times 10^5$ cm^{-3}) gas component (emission peaks of [C II] 158 μm, CO 7→6, and CO 4→3) is found at S106 IR. Cooler gas associated with the bulk emission of the molecular cloud is characterized by two emission peaks (one close (20″east) to S106 IR and one 120″ to the west) seen in the [C I] and low-J (J_{up} <4) CO emission lines. In the immediate environment of the star, the molecular and [C I] lines show high-velocity emission due to the interaction of the cloud with the stellar wind of S106 IR.
The intensities of the FIR lines measured with the KAO are compared to those observed with the ISO LWS towards two positions, S106 IR and 120″ west. We discuss intensities and line ratios of the observed species along a cut through the molecular cloud/H II region interface centered on S106 IR. The excitation conditions ($T_{\rm ex}$, opacities, column densities) are derived from an LTE analysis. We find that the temperature at the position of S106 IR obtained from the [C I] excitation is high (>500 K), resulting in substantial population of the energetically higher $^3P_2$ state; the analysis of the mid- and high-J CO excitation confirms the higher temperature at S106 IR. At this position, the [O I] 63 μm line is the most important cooling line, followed by other atomic FIR lines ([O III] 52 μm, [C II] 158 μm) and high-J CO lines, which are more efficient coolants compared to [C I] 2→1 and 1→0. We compare the observed line ratios to plane-parallel PDR model predictions and obtain consistent results for UV fluxes spanning a range from 10^2 to $10^{3.5}$ G_0 and densities around 10^5 cm^{-3} only at positions away from S106 IR. Towards S106 IR, we estimate a density of at least 3×10^5 at temperatures between 200 and 500 K from non-LTE modelling of the CO 16→15/14→13 ratio and the CO 7→6 intensity. Our new observations support the picture drawn in the first part of this serie of papers that high-density (n>10^5 cm^{-3}) clumps with a hot PDR surface are embedded in low- to medium density gas (n≤10^4 cm^{-3}).

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VLBI observations of T Tauri South

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We report observations of the T Tauri system at 8.4 GHz with a VLBI array comprising the VLBA, VLA and Effelsberg 100m telescopes. We detected a compact source offset approximately 40 mas from the best infrared position of the T Tau Sb component. This source was unresolved, and constrained to be less than 0.5 mas in size, corresponding to 0.07 AU or 15 $R_\odot$ at a distance of 140 pc. The other system components (T Tau Sa, T Tau N) were not detected in the VLBI data. The separate VLA map contains extended flux not accounted for by the compact VLBI source, indicating the presence of extended emission on arcsecond scales. The compact source shows rapid variability, which together with circular polarization and its compact nature indicate that the observed flux arises from a magnetically-dominated region. Brightness temperatures in the MK range point to gyrosynchrotron as the emission mechanism for the steady component. The rapid variations are accompanied by dramatic changes in polarization, and we record an at times 100% polarized component during outbursts. This strongly suggests a coherent emission process, most probably an electron cyclotron maser. With this assumption it is possible to estimate the strength of the local magnetic field to be 1.5-3 kilogauss.

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A molecular line survey of the candidate massive Class 0 protostar IRAS 23385+6053

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We have carried out a molecular line survey of the candidate massive protostar IRAS 23385+6053, covering a 27.2 GHz frequency range in the 330–360 GHz atmospheric window. We detected 27 lines originating from a total of 11 species. Over a third of the identified molecular lines are from the asymmetric top molecule methanol (CH_3OH). We did not detect any emission from high-excitation lines or typical hot core tracers (e.g. CH_3CN, $HCOOCH_3$). We derive a rotation temperature and column density from the methanol emission and estimate lower limits to the beam-averaged column density of the remaining lines. Upper limits to the beam-averaged column density of selected species were determined from the non-detection of their rotation lines. We rule out the presence of a hot molecular core associated with IRAS 23385+6053 by a combination of the non-detection of CH_3CN emission and a simple bolometric luminosity approach. The molecular inventory and chemistry of IRAS 23385+6053 are contrasted to that of more evolved massive star-forming regions and the abundances predicted by recent time-dependent chemical models. The physical and chemical nature of IRAS 23385+6053 is shown to be consistent with that immediately prior to the hot molecular core stage.

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Discovery of a dust cloud next to σ Orionis

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We report on the discovery of a mid-infrared source at a projected distance of only 1200 AU from the O9.5 V star σ Orionis. The spatially resolved, fan-shaped morphology and the presence of an ionization front, as well as evidence in the spectrum for processed dust grains, all suggest that it is a proto-planetary disk being dispersed by the intense ultraviolet radiation from σ Orionis. We compute the mass budget and the photo-evaporation timescale, and discuss the possible nature of this remarkable object.

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Resolved polarization changes across Hα in the classical T Tauri star RY Tau

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We present linear Hα spectropolarimetry of the classical T Tauri star RY Tau. A change in the polarization percentage and position angle across Hα is detected, which suggests that line photons are scattered in a rotating disc. We derive the position angle from the slope of the loop in the (Q, U) diagram and find it to be 146 ± 3^o. This is perpendicular to the position angle of the disc of 48 ± 5^o as deduced from submillimeter imaging by Koerner & Sargent (1995). This finding is consistent, as scattering off the imaged millimeter disc is expected to yield a polarization signature in a direction that is rotated by 90^o from this disc. The observed spectropolarimetric behaviour of RY Tau is reminiscent of that seen in a large group of Herbig Ae stars, suggesting a common circumstellar origin of the polarized photons.

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Two Molecular Clouds near M 17

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We present fully sampled images in the $C^{18}O$ $J = 2 - 1$ line extending over $13'$ by $23'$, made with the Heinrich-Hertz-Telescope (HHT) on Mt. Graham. The HHT has a resolution of $35''$ at the line frequency. This region includes two molecular clouds. Cloud A, to the north, is more compact, while Cloud B, is to the west of the HII region M 17. Cloud B contains the well known source M 17SW. In $C^{18}O$ we find 13 maxima in Cloud A, and 39 in Cloud B. Sixteen sources in Cloud B are in M 17SW, mapped previously with higher resolution. In cloud B, sources outside M 17SW have linewidths comparable to those in M 17SW. In comparison, Cloud A has lower $C^{18}O$ line intensities and smaller linewidths but comparable densities and sizes. Maps of the cores of these clouds were also obtained in the $J = 5 - 4$ line of CS, which traces higher H_2 densities. Our images of the cores of Cloud A and B show that for $V_{lsr} \leq 20$ km s^{-1}, the peaks of the CS emission are shifted closer to the HII region than the $C^{18}O$ maxima, so higher densities are found toward the HII region. Our CS data give additional support to the already strong evidence that M 17SW and nearby regions are heated and compressed by the HII region. Our data show that Cloud A has a smaller interaction with the HII region. We surmise that M 17SW was an initially denser region, and the turn-on of the HII region will make this the next region of massive star formation. Outside of M 17SW, the only other obvious star formation region may be in Cloud A, since there is an intense mm dust continuum peak found by Henning et al. (1998), but no corresponding $C^{18}O$ maximum. If the CO/H_2 ratio is constant, the dust must have a temperature of $\sim$100K or the H_2 density is $10^6\, cm^{-3}$ or both to reconcile the $C^{18}O$ and dust data. Alternatively, if the CO/H_2 ratio is low, perhaps much of the CO is depleted.

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A fourth component in the young multiple system V 773 Tau

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I report on a new component in the pre-main sequence multiple system V 773 Tauri. This second visual companion, V 773 Tau C, with a projected separation of $\approx 0.''2$ has been detected using speckle interferometry in the near-infrared. Repeated observations from 1996 to 2002 show significant orbital motion and thus confirm the character of the new companion as a gravitationally bound star. Together with the two components of the spectroscopic binary V 773 Tau A and the previously known visual companion V 773 Tau B, the V 773 Tau system appears as a young "mini-cluster" of four T Tauri stars within a sphere of a radius less than 100 AU. V 773 Tau A, B and C form a triple system that is not hierarchic, but is apparently stable despite of this. The brightness of V 773 Tau C has probably increased over the last years, which may explain its non-detection in previous binary surveys.

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Star Formation in Massive Protoclusters in the Monoceros OB1 Dark Cloud

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We present far-infrared, submillimetre, and millimetre observations of bright *IRAS* sources and outflows that are associated with massive CS clumps in the Monoceros OB1 Dark Cloud. Individual star-forming cores are identified within each clump. We show that combining submillimetre maps, obtained with SCUBA on the JCMT, with HIRES-processed and modelled *IRAS* data is a powerful technique that can be used to place better limits on individual source contributions to the far-infrared flux in clustered regions. Three previously categorized "Class I objects" are shown to consist of multiple sources in different evolutionary stages. In each case, the *IRAS* point source dominates the flux at 12 & 25 μm. In two cases, the *IRAS* point source is not evident at submillimetre wavelengths. The submillimetre sources contribute significantly to the 60 & 100 μm fluxes, dominating the flux in the 100 μm waveband. Using fluxes derived from our technique, we present the spectral energy distribution and physical parameters for an intermediate-mass Class 0 object in one of the regions. Our new CO J=2→1 outflow maps of the three regions studied indicate complex morphology suggestive of multiple driving sources. We discuss the possible implications of our results for published correlations between outflow momentum deposition rates and "source" luminosities, and for using these derived properties to estimate the ratio of mass ejection rates to mass accretion rates onto protostars.

Accepted by MNRAS

High Angular Resolution, Sensitive CS $J = 2 - 1$ and $J = 3 - 2$ Imaging of the Protostar L1551 NE: Evidence for Outflow-Triggered Star Formation ?

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High angular resolution and sensitive aperture synthesis observations of CS ($J = 2 - 1$) and CS ($J = 3 - 2$) emissions toward L1551 NE, the second brightest protostar in the Taurus Molecular Cloud, made with the Nobeyama Millimeter Array are presented. L1551 NE is categorized as a class 0 object deeply embedded in the red-shifted outflow lobe of L1551 IRS 5. Previous studies of the L1551 NE region in CS emission revealed the presence of shell-like components open toward L1551 IRS 5, which seem to trace low-velocity shocks in the swept-up shell driven by the outflow from L1551 IRS 5. In this study, significant CS emission around L1551 NE was detected at the eastern tip of the swept-up shell from $V_{\rm lsr}$ = 5.3 km s^{-1} to 10.1 km s^{-1}, and the total mass of the dense gas is estimated to be 0.18 $\pm$ 0.02 $M_\odot$. Additionally, the following new structures were successfully revealed: a compact disklike component with a size of $\approx$ 1000 AU just at L1551 NE, an arc-shaped structure around L1551 NE, open toward L1551 NE, with a size of $\sim$ 5000 AU, i.e., a bow shock, and a distinct velocity gradient of the dense gas, i.e., deceleration along the outflow axis of L1551 IRS 5. These features suggest that the CS emission traces the post-shocked region where the dense gas associated with L1551 NE and the swept-up shell of the outflow from L1551 IRS 5 interact. Since the age of L1551 NE is comparable to the timescale of the interaction, it is plausible that the formation of L1551 NE was induced by the outflow impact. The compact structure of L1551 NE with a tiny envelope was also revealed, suggesting that the outer envelope of L1551 NE has been blown off by the outflow from L1551 IRS 5.

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http://www.nro.nao.ac.jp/%7Eyokogawa/preprint/L1551NE.pdf

Nonthermal Emission from the Arches Cluster (G0.121+0.017) and the Origin of γ-ray Emission from 3EG J1746-2851

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High resolution VLA observations of the Arches cluster near the Galactic center show evidence of continuum emission at λ3.6, 6, 20 and 90cm. The continuum emission at λ90cm is particularly striking because thermal sources generally become optically thick at longer wavelengths and fall off in brightness whereas non-thermal sources increase in brightness. It is argued that the radio emission from this unique source has compact and diffuse components produced by thermal and nonthermal processes, respectively. Compact sources within the cluster arise from stellar winds of mass-losing stars (Lang, Goss & Rodriguez 2001a) whereas diffuse emission is likely to be due to colliding wind shocks of the cluster flow generating relativistic particles due to diffuse shock acceleration. We also discuss the possibility that γ-ray emission from 3EG J1746–2851, located within 3.3′ of the Arches cluster, results from the inverse Compton scattering of the radiation field of the cluster.

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

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

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

New Jobs

Lecturer in Astrophysics

University of Exeter, School of Physics

Applications are invited for a permanent post in our dynamic and expanding School of Physics. Our research was rated excellent in the UK's Research Assessment Exercise and we are seeking to strengthen further our research programme by appointing either an observational or theoretical astrophysicist in an area which would enhance the astrophysics group's research.

The main thrust of that programme is *galactic star formation*, so the appointment would either be directly in that area or in a related field such as extra-galactic star formation, accretion phenomena, young stars or extra-solar planets.

The successful applicant will have an appropriate first degree and a PhD (or equivalent), with three years experience at postdoctoral level and a strong record of publication in international journals. In addition, experience of teaching at undergraduate level and of obtaining research contracts would be desirable. The appointee will also take on the normal duties of a lecturer with specific skills in astrophysics. As is our normal practise, teaching and administrative duties will be staged over three years to allow the appointee to develop their research base.

Salary up to £26,270pa, on a scale £23,296pa to £33,679, with accelerated increment progression. Application packs available from http://www.exeter.ac.uk/admin/personnel/vacancies; e-mail s.j.discombe@exeter.ac.uk quoting reference number 4543.

Closing date for completed applications: 31 July 2003.

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.

New Books

Modes of Star Formation and The Origin of Field Populations

Edited by Eva K. Grebel and Wolfgang Brandner

These are the proceedings of a workshop held at the Max-Planck Institute of Astronomy in Heidelberg, Germany on 9-13 October 2000. The workshop focused on the different modes of star formation observed in the local Universe with the goal of identifying the dominant processes and their pre-conditions. While star clusters stand out even in distant galaxies owing to their high concentrations of stars, the majority of stars that we observe in any given galaxy are field stars, a complex mix of stellar populations of different ages. Identifying the origin of these field populations is a recurring theme of this book. The book is dividided into 11 parts:

1. Molecular Clouds: Global Properties and Star Formation

2. Resolved Star-Forming Regions and the IMF

3. Resolved Star-Forming Regions: Large-Scale Star Formation Histories, triggers, Theory

4. Evolution from Clusters and OB Associations to Field Populations

5. Old Populations and Their Evolution

6. Modes of Star Formation in the Galactic Disk

7. Global Large-Scale Star Formation Events in Spirals

8. Star Formation and Field Populations in Irregulars and Other Dwarfs

9. Properties of nuclear Star Formation Events

10. Star Formation Processes in Interacting Galaxies

11. Conclusion

The book contains 60 papers, including the following 12 reviews:

Star Formation in Turbulent Molecular Clouds *A. Burkert*

Molecular Clouds and Star Formation in the Local Group *Y. Fukui*

The Initial Mass Function and Its Variation *(P. Kroupa*

Evolution from OB Associations and Moving Groups to the Field Population

Effects of Tidal Disruption on Inferred Galactic Star Formation Histories *S.R. Majewski et al.*

The Initial Mode of Star Formation *T. Abel, G. Bryan, M. Norman*

Implications of MOdes of Star Formation for the Overall Dynamics of Galactic Disks *B. Fuchs*

Modes of Star Formation in Spiral Galaxies *P. Hodge*

Star Formation Modes in Low-Mass Disk Galaxies *J.S. Gallagher III, L.D. Matthews*

Star-Forming Regions in Irregular Galaxies *D.A. Hunter*

Stellar Feedback, Dark Matter and Dwarf Evolution *A. Ferrara*

A Universality to Star Formation in Galaxies *B.G. Elmegreen*

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Meetings

Science with Adaptive Optics – FINAL ANNOUNCEMENT

ESO Workshop

September 16-19, 2003 – Registration deadline: June 15, 2003

Garching (near Munich), Germany

Over the past ten years, the concept of adaptive optics has matured from early experimental stages to a standard observing tool now available at many large optical and near-infrared telescope facilities. Indeed, adaptive optics has become an integral part of all present and future large telescope initiatives, and will be essential in exploiting the full potential of the large optical interferometers currently under construction. Adaptive optics has been identified as one of the key technologies for astronomy in the 21st century. Adaptive optics has already delivered exciting results covering areas from solar system astronomy (both the sun and the planetary system) over the star forming regions in the solar neighbourhood to Local Group galaxies and objects at cosmological distances. Recent highlights include:

- Evolution of small scale structures on the solar surface
- Discovery of binary asteroids and asteroids moons
- High-resolution studies of circumstellar disks around young stars
- Precise mass determination of the black hole in the Galactic Center
- Spatially resolved studies of extragalactic stellar populations

The present meeting intends to bring together users of adaptive optics from all fields of astronomy to discuss the latest scientific results obtained with diverse adaptive optics systems and to exchange ideas on how to reduce and analyse such observations.This ESO workshop aims also at educating the general astronomical community in Europe on the unique science potential of adaptive optics for all branches of astronomy. We want to bring together researchers working in many different areas of astronomy in order to provide a comprehensive picture of the utilisation of adaptive optics in astronomy. Synergy effects are expected from the comparison of different observing and data analysis strategies.

Scientific Organizing Committee:
Co-chairs: Wolfgang Brandner (MPIA), Markus Kasper (ESO)
Danielle Alloin (ESO), Laird Close (Steward Obs., Tucson, USA), Tim Davidge (Herzberg Inst., Victoria, Canada), Reinhard Genzel (MPE, Germany), Thomas Henning (MPIA, Germany), Christoph Keller (NSO Tucson, USA), Anne-Marie Lagrange (LAOG, France), Simon Morris (Durham, UK), Francois Rigaut (Gemini, USA), Daniel Rouan (Obs. de Paris, France), Hans Zinnecker (AIP, Germany)

For more details and registration, see **http://www.eso.org/aoscience03**

Symposium Secretary: Christina Stoffer

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