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Abstracts of recently accepted papers

Supersonic cloud collision - I

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It has long been suggested that shocks might play an important role in altering the form of the interstellar medium (ISM). Shocks enhance gas density and sufficiently dense regions may become self gravitating. Potential star forming clouds within larger molecular clouds, move randomly at supersonic speeds. Depending on the precollision velocity, colliding molecular clouds produce a slab that is either shock compressed or pressure confined. In a sequel of two papers (I & II), we simulate molecular cloud collision and investigate the dynamical evolution of such slabs. Shocked slabs are susceptible to hydrodynamic instabilities and in the present paper (I) we study the effect of strong shear between slab layers on the dynamic evolution of a shock compressed gas slab. Both, head-on and off-centre cloud collisions have been examined in this work. We include self gravity in all our simulations. Simulations presented here, are performed using the smoothed particle hydrodynamics (SPH) numerical scheme. Individual, pre-collision clouds are modelled as pressure confined Bonnor-Ebert spheres. However, in the interest of brevity the thermodynamic details of the problem are simplified and the gas temperature is simply evolved by a barytropic equation of state. Obviously, the gas, to some extent suffers from thermal inertial effects. However, we note that the dynamical timescale is much smaller than the local sound crossing time so that such effects should have minimum influence. Highly supersonic cloud collision produces a cold, roughly isothermal shock compressed gas slab. We find that the shocked slab is susceptible to dynamical instabilities like the gravitational instability, Kelvin-Helmholtz (KH) instability and the non-linear thin shell instability (NTSI). Growth of instabilities within the slab produces structure in it. The NTSI competes with the gravitational instability and the fate of the shocked slab apparently depends on the relative dominance of either of the two instabilities. Dominance of the NTSI causes turbulent mixing between slab layers and dissipates internal energy. Eventually the slab collapses to form a thin elongated body, aligned with the collision axis and star formation may commence in it. In contrast, the gravitational instability leads to fragmentation of the slab and forms several clumps in it.

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Supersonic cloud collision - II

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In this second paper of the sequel of two papers, we further investigate the problem of molecular cloud (MC) collision. Anathpindika (2009) (hereafter paper I) considered highly supersonic cloud collisions and examined the effect of bending and shearing instabilities on the shocked gas slab. We now consider moderately supersonic cloud collisions

(precollision cloud velocities of order 1.2 km s^{-1} to 2.4 km s^{-1}). In the current paper, we present five SPH simulations of fast head-on and/or off-centre cloud collisions to study the evolution of ram pressure confined gas slabs. The relevant thermodynamics in the problem is simplified by adopting a simple barytropic equation of state. We explore the parameter space by varying the pre-collision velocity and the temperature of the post collision gas slab. The temperature in a pressure compressed gas slab is crucial to its dynamical evolution. The pressure confined gas slabs become Jeans unstable if the average sound crossing time, t_{cr}, of putative clumps condensing out of them, is much larger than their free fall time, t_{ff}. Self gravitating clumps may spawn multiple/larger N-body star clusters. Warmer gas slabs are unlikely to fragment and may end up as diffuse gas clouds.

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HD 100453: A Link Between Gas-Rich Protoplanetary Disks and Gas-Poor Debris Disks

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HD 100453 has an IR spectral energy distribution (SED) which can be fit with a power law plus a blackbody. Previous analysis of the SED suggests that the system is a young Herbig Ae star with a gas-rich, flared disk. We reexamine the evolutionary state of the HD 100453 system by refining its age (based on a candidate low-mass companion) and by examining limits on the disk extent, mass accretion rate, and gas content of the disk environment. We confirm that HD 100453B is a common proper motion companion to HD 100453A, with a spectral type of M4.0V-M4.5V, and derive an age of 10 ± 2 Myr. We find no evidence of mass accretion onto the star. *Chandra* ACIS-S imagery shows that the Herbig Ae star has $L_{\rm x}/L_{\rm bol}$ and an X-ray spectrum similar to nonaccreting β Pic Moving Group early F stars. Moreover, the disk lacks the conspicuous Fe II emission and excess FUV continuum seen in spectra of actively accreting Herbig Ae stars, and from the FUV continuum, we find the accretion rate is $< 1.4 \times 10^{-9}$ $M_\odot$ $\rm yr^{-1}$. A sensitive upper limit to the CO J = 3-2 intensity indicates that the gas in the outer disk is likely optically thin. Assuming a [CO]/[H2] abundance of 1×10^{-4} and a depletion factor of 10^3, we find that the mass of cold molecular gas is less than ∼0.33 $M_{\rm J}$ and that the gas-to-dust ratio is no more than ∼4:1 in the outer disk. The *combination* of a high fractional IR excess luminosity, a relatively old age, an absence of accretion signatures, and an absence of detectable circumstellar molecular gas suggests that the HD 100453 system is in an unusual state of evolution between a gas-rich protoplanetary disk and a gas-poor debris disk.

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A new population of cool stars and brown dwarfs in the Lupus clouds

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Context: Most studies of the stellar and substellar populations of star-forming regions rely on using the signatures of accretion, outflows, disks, or activity characterizing the early stages of stellar evolution. However, these signatures rapidly decay with time.

Aims: We present the results of a wide-area study of the stellar population of clouds in the Lupus star-forming region. When combined with 2MASS photometry, our data allow us to fit the spectral energy distributions of over 150,000 sources and identify possible new members based on their photospheric fluxes, independent of any display of the signposts of youth.

Methods: We used the Wide Field Imager (WFI) at the La Silla 2.2m telescope to image an area of more than 6 square degrees in the Lupus 1, 3 and 4 clouds in the R_C, I_C, and $z_{\rm WFI}$ bands, selected so as to overlap with the areas observed in the Spitzer Legacy Program 'From molecular cores to planet-forming disks'. We complement our data with 2MASS photometry to sample the spectral energy distribution from 0.6 μm to 2.2 μm. We validate our method on the census of known members of the Lupus clouds, for which spectroscopic classification is available. The temperatures derived for cool objects are generally accurate, with most of the exceptions attributed to veiling, strong emission lines at short wavelengths, near-infrared excess, variability, or the presence of close companions.

Results: Considering that the dereddened fluxes of most cool ($T_{\rm eff} < 3500$ K) young stellar objects at the distance of Lupus occupy a gap between those typical both of field cool dwarfs and of background giants, we identify a new population of cool members of Lupus 1 and 3. The approximately 130 new members are only moderately concentrated toward the densest clouds, they appear to have ages in the same range as the known members, and very few show the infrared excess caused by warm disks. This population is absent in Lupus 4.

Conclusions: This new population of Lupus members seems to be composed of stars and brown dwarfs that have lost their inner disks on a timescale of a few Myr or less. Almost all these objects are in low extinction regions. We speculate that dissipation of unshielded disks caused by nearby O stars or fast collapse of the pre-(sub)stellar cores triggered by the passage of old supernova shocks may have led to disk properties and evolutionary paths very different from those resulting from the more quiescent environment provided by dense molecular clouds.

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http://www.eso.org/∼fcomeron/lupus_wfi.pdf

Radio continuum emission and water masers towards CB 54

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We present high angular resolution observations of water masers at 1.3 cm and radio continuum emission at 1.3, 3.6 and 6 cm towards the Bok globule CB 54 using the Very Large Array. At 1.3 cm, with subarsecond angular resolution,

we detect a radio continuum compact source located to the south-west of the globule and spatially coincident with a mid-infrared embedded object (MIR-b). The spectral index derived between 6 and 1.3 cm (α=0.3±0.4) is flat, consistent with optically thin free-free emission from ionized gas. We propose the shock-ionization scenario as a viable mechanism to produce the radio continuum emission observed at cm frequencies. Water masers are detected at two different positions separated by 2.3″, and coincide spatially with two mid-infrared sources: MIR-b and MIR-c. The association of these mid-IR sources with water masers confirms that they are likely protostars undergoing mass-loss, and they are the best candidate as driving sources of the molecular outflows in the region.

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Extinction Map of the Small Magellanic Cloud based on the SIRIUS and 6X 2MASS Point Source Catalogs

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In this paper, we present the first extinction map of the Small Magellanic Cloud (SMC) constructed using the color excess at near-infrared wavelengths. Using a new technique named "X percentile method", which we developed recently to measure the color excess of dark clouds embedded within a star distribution, we have derived an $E(J-H)$ map based on the SIRIUS and 6X 2MASS star catalogs. Several dark clouds are detected in the map derived from the SIRIUS star catalog, which is deeper than the 6X 2MASS catalog. We have compared the $E(J-H)$ map with a model calculation in order to infer the locations of the clouds along the line of sight, and found that many of them are likely to be located in or elongated toward the far side of the SMC. Most of the dark clouds found in the $E(J-H)$ map have counterparts in the CO clouds detected by Mizuno et al. (2001) with the NANTEN telescope. Comparison of the $E(J-H)$ map with the Virial mass derived from the CO data indicates that the dust-to-gas ratio in the SMC varies in the range $A_V/N_{\rm H} = 1$–2×10^{-22} mag H^{-1} cm^2 with a mean value of $\sim 1.5 \times 10^{-22}$ mag H^{-1} cm^2 . If the Virial mass underestimates the true cloud mass by a factor of ~ 2, as recently suggested by Bot et al. (2007), the mean value would decrease to $\sim 8 \times 10^{-23}$ mag H^{-1} cm^2 , in good agreement with the value reported by Gordon et al. (2003, 7.59×10^{-23} mag H^{-1} cm^2).

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Properties of Stellar Clusters around High-Mass Young Stars

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Twenty-six high-luminosity IRAS sources believed to be collection of stars in the early phases of high-mass star formation have been observed in the Near-IR (J, H, K_s) to characterize the clustering properties of their young stellar population and compare them with those of more evolved objects (e.g., Herbig Ae/Be stars) of comparable mass. All the observed sources possess strong continuum and/or line emission in the millimeter, being therefore associated with gas and dust envelopes. Nine sources have far-IR colors characteristic of UCHII regions while the other 17 are likely

being experiencing an evolutionary phase that precedes the Hot-Cores, as suggested by a variety of evidence collected in the past decade.
To gain insight into the initial conditions of star formation in these clusters (Initial Mass Function [IMF], Star Formation History [SFH]), and to deduce mean values for cluster ages.
For each cluster we carry out aperture photometry. We derive stellar density profiles, color-color and color-magnitude diagrams, and color (HKCF) and luminosity (KLF) functions. These two functions are compared with simulated KLFs and HKCFs from a model that generates populations of synthetic clusters starting from assumptions on the IMF, the SFH, and the Pre-MS evolution, and using the average properties of the observed clusters as boundary conditions (bolometric luminosity, dust distribution, infrared excess, extinction).
Twenty-two sources show evidence of clustering with a stellar richness indicator that varies from a few up to several tens of objects, and a median cluster radius of 0.7 pc. A considerable number of cluster members present an infrared excess characteristic of young Pre-Main-Sequence objects. For a subset of 9 detected clusters, we could perform a statistically significant comparison of the observed KLFs with those resulting from synthetic cluster models; for these clusters we find that the median stellar age ranges between $2.5 \cdot 10^5$ and $5 \cdot 10^6$ years, with evidence of an age spread of the same entity within each cluster. We also find evidence that older clusters tend to be smaller in size, in line with the fact that our clusters are on average larger than those around relatively older Herbig Ae/Be stars. Our models allow us to explore the relationship of the mass of the most massive star in the cluster with both the clusters richness and their total stellar mass. Although such relationships are predicted by several classes of cluster formation models, their detailed analysis suggests that our modeled clusters may not be consistent with them resulting from random sampling of the IMF.
Our results are consistent with a star formation which takes place continuously over a period of time which is longer than a typical crossing time.

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Stellar Clusters in the NGC 6334 Star Forming Complex

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The full stellar population of NGC 6334, one of the most spectacular regions of massive star formation in the nearby Galaxy, have not been well-sampled in past studies. We analyze here a mosaic of two *Chandra X-ray Observatory* images of the region using sensitive data analysis methods, giving a list of 1607 faint X-ray sources with arcsecond positions and approximate line-of-sight absorption. About 95% of these are expected to be cluster members, most lower mass pre-main sequence stars. Extrapolating to low X-ray levels, the total stellar population is estimated to be $20 - 30,000$ pre-main sequence stars. The X-ray sources show a complicated spatial pattern with $\sim$10 distinct star clusters. The heavily-obscured clusters are mostly associated with previously known far-infrared sources and radio HII regions. The lightly-obscured clusters are mostly newly identified in the X-ray images. Dozens of likely OB stars are found, both in clusters and dispersed throughout the region, suggesting that star formation in the complex has proceeded over millions of years. A number of extraordinarily heavily absorbed X-ray sources are associated with the active regions of star formation.

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http://www.astro.psu.edu/users/edf/NGC6334.pdf

^{26}Al and the Formation of the Solar System from a Molecular Cloud Contaminated by Wolf-Rayet Winds

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In agreement with previous work, we show that the presence of the short-lived radionuclide (SLR) ^{26}Al in the early solar system was unlikely (less than 2% a priori probability) to be the result of direct introduction of supernova (SN) ejecta into the gaseous disk during the Class II stage of protosolar evolution. We also show that Bondi-Hoyle accretion of any contaminated residual gas from the Sun's natal star cluster contributed negligible ^{26}Al to the primordial solar system. Our calculations are consistent with the absence of the oxygen isotopic signature expected with any late introduction of SN ejecta into the protoplanetary disk. Instead, the presence of ^{26}Al in the oldest solar system solids (calcium-aluminum-rich inclusions (CAIs)) and its apparent uniform distribution with the inferred canonical ^{26}Al/^{27}Al ratio of (4.5-5) $\times$ 10^{-5} support the inheritance of ^{26}Al from the Sun's parent giant molecular cloud. We propose that this radionuclide originated in a prior generation of massive stars that formed in the same molecular cloud and contaminated that cloud by Wolf-Rayet winds. We calculated the Galactic distribution of ^{26}Al/^{27}Al ratios that arise from such contamination using the established embedded cluster mass and stellar initial mass functions, published nucleosynthetic yields from the winds of massive stars, and by assuming rapid and uniform mixing into the cloud. Although our model predicts that the majority of stellar systems contain no ^{26}Al from massive stars, and that the a priori probability that the ^{26}Al/^{27}Al ratio will reach or exceed the canonical solar system value is only $\sim$6%, the maximum in the distribution of *nonzero* values is close to the canonical ^{26}Al/^{27}Al ratio. We find that the Sun most likely formed 4-5 million years (Myr) after the massive stars that were the source of ^{26}Al. Furthermore, our model can explain the initial solar system abundance of a second, co-occurring SLR, ^{41}Ca, if $\sim$5 $\times$ 10^5 yr elapsed between ejection of the radionuclides and the formation of CAIs. The presence of a third radionuclide, ^{60}Fe, can be quantitatively explained if (1) the Sun formed immediately after the first SNe from the earlier generation of stars; (2) only 5% of SN ejecta was incorporated into the molecular cloud, or (3) the radionuclide originated in an even earlier generation of stars whose contributions to other radionuclides with a shorter half-life had completely decayed.

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Protoplanetary Disk Evolution around the Triggered Star Forming Region Cepheus B

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The Cepheus B (Cep B) molecular cloud and a portion of the nearby Cep OB3b OB association, one of the most active regions of star formation within 1 kpc, have been observed with the IRAC detector on board the *Spitzer Space Telescope*. The goals are to study protoplanetary disk evolution and processes of sequential triggered star formation in the region. Out of $\sim$ 400 pre-main sequence (PMS) stars selected with an earlier *Chandra X-ray Observatory* observation, $\sim$ 95% are identified with mid-infrared sources and most of these are classified as diskless or disk-bearing stars. The discovery of the additional $>$ 200 IR-excess low-mass members gives a combined *Chandra+Spitzer* PMS sample that is almost complete down to 0.5 $M_\odot$ outside of the cloud, and somewhat above 1 $M_\odot$ in the cloud.

Analyses of the nearly disk-unbiased combined *Chandra* and *Spitzer* selected stellar sample give several results. Our major finding is a spatio-temporal gradient of young stars from the hot molecular core towards the primary ionizing O star HD 217086. This strongly supports the radiation driven implosion (RDI) model of triggered star formation in the region. The empirical estimate for the shock velocity of $\sim$ 1 km/s is very similar to theoretical models of RDI in shocked molecular clouds. The initial mass function (IMF) of the lightly obscured triggered population exhibits a standard Galactic field IMF shape. The unusually high apparent value of $>$ 70% star formation efficiency inferred from the ratio of star mass to current molecular gas mass indicates that most of the Cep B molecular cloud has been already ablated or transformed to stars. Contrary to the current RDI simulations, our findings indicate that star formation triggering by HII region shocks is not restricted to a single episode but can continue for millions of years.

Other results include: 1. agreement of the disk fractions, their mass dependency, and fractions of transition disks with other clusters; 2. confirmation of the youthfulness of the embedded Cep B cluster; 3. confirmation of the effect of suppression of time-integrated X-ray emission in disk-bearing versus diskless systems.

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Near-Infrared Light Curves of the Brown Dwarf Eclipsing Binary 2MASS J05352184–0546085: Can Spots Explain the Temperature Reversal?

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We present near-infrared JHK_S light curves for the double-lined eclipsing binary system 2MASS J05352184-0546085, in which both components have been shown to be brown dwarfs with an age of ~ 1 Myr. We analyze these light curves together with the previously published I_C-band light curve and radial velocities to provide refined measurements of the system's physical parameters. The component masses and radii are here determined with an accuracy of 2% and 1%, respectively. In addition, we confirm the previous surprising finding that the primary brown dwarf has a cooler effective temperature than its lower-mass companion. Next, we perform a detailed study of the residual variations in the out-of-eclipse phases of the light curves to ascertain the properties of any inhomogeneities (e.g. spots) on the surfaces of the brown dwarfs. Our analysis reveals two low-amplitude (~ 0.02 mag) periodic signals, one attributable to the rotation of the primary with a period of 3.293 ± 0.001 d and the other to the rotation of the secondary with a period of 14.05 ± 0.05 d. Both periods are consistent with the measured $v \sin i$ and radii. Finally, we explore the effects on the derived physical parameters of the system when spots are included in the modeling of the light curves. The observed low-amplitude rotational modulations are well fit by cool spots covering a small fraction ($\lesssim$10%) of the brown dwarfs' surfaces. Such small spots negligibly affect the physical properties of the brown dwarfs, and thus by themselves cannot explain the primary's unexpectedly low surface temperature. To mimic the observed ~ 200 K suppression of the primary's temperature, our model requires that the primary possess a very large spot coverage fraction of ~ 65%. These spots must in addition be symmetrically distributed on the primary's surface so as to not produce photometric variations larger than observed. Altogether, a spot configuration in which the primary is heavily spotted while the secondary is lightly spotted—consistent with the idea that the primary's magnetic field is much stronger than the secondary's—can explain the apparent temperature reversal and can bring the temperatures of the brown dwarfs into agreement with the predictions of theoretical models.

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Protostar formation in supersonic flows: growth and collapse of spherical cores

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We present a unified model for molecular core formation and evolution, based on numerical simulations of converging, supersonic flows. Our model applies to star formation in GMCs dominated by large-scale turbulence, and contains four main stages: core building, core collapse, envelope infall, and late accretion. During the building stage, cores form out of dense, post-shock gas, and become increasingly centrally stratified as the mass grows over time. Even for highly-supersonic converging flows, the dense gas is subsonic, consistent with observations showing quiescent cores. When the shock radius defining the core boundary exceeds $R \approx 4a(4\pi G\rho_{mean})^{-1/2}$, where a is the isothermal sound speed, a wave of collapse propagates from the edge to the center. During the building and collapse stages, density profiles can be fit by Bonnor-Ebert profiles with temperature 1.2 - 2.9 times the true value, similar to many observed

cores. As found previously for initially static equilibria, outside-in collapse leads to a Larson-Penston density profile $\rho \approx 8.86a^2/(4\pi G r^2)$. The third stage, consisting of an inside-out wave of gravitational rarefaction leading to $\rho \propto r^{-3/2}$, $v \propto r^{-1/2}$, is also similar to that for initially-static spheres, as originally described by Shu. We find that the collapse and infall stages have comparable duration, $\sim t_{ff}$, consistent with estimates for observed prestellar and protostellar (Class 0/I) cores. Core building takes longer, but does not produce high-contrast objects until shortly before collapse. The time to reach core collapse, and the core mass at collapse, decrease with increasing inflow Mach number. For all cases the accretion rate is $\gg a^3/G$ early on but sharply drops off; the final system mass depends on the duration of late-stage accretion, set by large-scale conditions in a cloud.

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What does a universal IMF imply about star formation?

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We show that the same initial mass function (IMF) can result from very different modes of star formation from very similar underlying core and/or system mass functions. In particular, we show that the canonical IMF can be recovered from very similar system mass functions, but with very different mass ratio distributions within those systems. This is a consequence of the basically log-normal shapes of all of the distributions. We also show that the relationships between the shapes of the core, system, and stellar mass functions may not be trivial. Therefore, different star formation in different regions could still result in the same IMF.

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Supernova Propagation and Cloud Enrichment: A New Model for the Origin of ^{60}Fe in the Early Solar System

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The radioactive isotope ^{60}Fe ($T_{1/2} = 1.5$ Myr) was present in the early solar system. It is unlikely that it was injected directly into the nascent solar system by a single, nearby supernova. It is proposed instead that it was inherited during the molecular cloud stage from several supernovae belonging to previous episodes of star formation. The expected abundance of ^{60}Fe in star forming regions is estimated taking into account the stochasticity of the star-forming process, and it is showed that many molecular clouds are expected to contain ^{60}Fe (and possibly ^{26}Al [$T_{1/2} = 0.74$ Myr]) at a level compatible with that of the nascent solar system. Therefore, no special explanation is needed to account for our solar system's formation.

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The Distance to a Star-Forming Region in the Outer Arm of the Galaxy

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We performed astrometric observations with the Very Long Baseline Army of WB89-437, an H_2O maser source in the Outer spiral arm of the Galaxy. We measure an annual parallax of 0.167 ± 0.006 mas, corresponding to a heliocentric distance of 6.0 ± 0.2 kpc or a Galactocentric distance of 13.4 ± 0.2 kpc. This value for the heliocentric distance is considerably smaller than the kinematic distance of 8.6 kpc. This confirms the presence of a faint Outer arm toward l = 135°. We also measured the full space motion of the object and find a large peculiar motion of ∼20 km s^{-1} toward the Galactic center. This peculiar motion explains the large error in the kinematic distance estimate. We also find that WB89-437 has the same rotation speed as the LSR, providing more evidence for a flat rotation curve and thus the presence of dark matter in the outer Galaxy.

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Star formation in Perseus. V. Outflows detected by HARP

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Molecular outflows provide an alternative method of identifying protostellar cores, complementary to recent mid-infrared studies. Continuing our studies of Perseus, we investigate whether all Spitzer-identified protostars, and particularly those with low luminosities, drive outflows and if any new protostellar cores (perhaps harbouring low-mass sources) can be identified via their outflows alone.

We have used the heterodyne array receiver HARP on JCMT to make deep ^{12}CO 3–2 maps of submm cores in Perseus, extending and deepening our earlier study with RxB and bringing the total number of SCUBA cores studied up to 83. Our survey includes 23/25 of the Dunham et al. (2008) Spitzer low-luminosity objects believed to be embedded protostars, including three VeLLOs.

All but one of the cores identified as harbouring embedded YSOs have outflows, confirming outflow detections as a good method for identifying protostars. We detect outflows from 20 Spitzer low-luminosity objects. We do not conclusively detect any outflows from IR-quiet cores, though confusion in clustered regions such as NGC1333 makes it impossible to identify all the individual driving sources. This similarity in detection rates despite the difference in search methods and detection limits suggests either that the sample of protostars in Perseus is now complete or that the existence of an outflow contributes to the Spitzer detectability, perhaps through the contribution of shocked H_2 emission in the IRAC bands. For five of the low-luminosity sources (including two previously believed to be embedded), there is no protostellar envelope detected at 350μm and the Spitzer emission is entirely due to shocks. Additionally, we detect the outflow from IRAS 03282+3035 at 850μm with SCUBA with 20-30% of the submm flux due to CO line contamination in the continuum passband.

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Intermittency of interstellar turbulence: Parsec-scale coherent structure of intense velocity-shear

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Guided by the duality of turbulence (random versus coherent motions), we seek coherent structures in the turbulent velocity field of molecular clouds, anticipating their importance in cloud evolution. We analyse a large map (40' by 20') obtained with the HERA multibeam receiver (IRAM-30m telescope) in a high latitude cloud of the Polaris Flare at an unprecedented spatial (11″) and spectral ($0.05 \mathrm{km\,s^{-1}}$) resolutions in the $^{12}\mathrm{CO}(2-1)$ line. We find that two parsec-scale components of velocities differing by $\sim 2\ \mathrm{km\,s^{-1}}$, share a narrow interface (< 0.15 pc) that appears as an elongated structure of intense velocity-shear, ~ 15 to $30\ \mathrm{km\,s^{-1}\,pc^{-1}}$. The locus of the extrema of line–centroid-velocity increments (E-CVI) in that field follows this intense-shear structure as well as that of the $^{12}\mathrm{CO}(2-1)$ high-velocity line wings. The tiny spatial overlap in projection of the two parsec-scale components implies that they are sheets of CO emission and that discontinuities in the gas properties (CO enrichment and/or increase of gas density) occur at the position of the intense velocity shear. These results disclose spatial and kinematic coherence between scales as small as 0.03 pc and parsec scales. They confirm that the departure from Gaussianity of the probability density functions of E-CVIs is a powerful statistical tracer of the intermittency of turbulence. They disclose a link between large scale turbulence, its intermittent dissipation rate and low-mass dense core formation.

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Photometric study of the OB star clusters NGC 1502 and NGC 2169 and mass estimation of their members at the University Observatory Jena

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none

In this work we present detailed photometric results of the trapezium like galactic nearby OB clusters NGC 1502 and NGC 2169 carried out at the University Observatory Jena. We determined absolute *BVRI* magnitudes of the mostly resolved components using Landolt standard stars. This multi colour photometry enables us to estimate spectral type and absorption as well as the masses of the components, which were not available for most of the cluster members in the literature so far, using models of stellar evolution. Furthermore, we investigated the optical spectrum of the components ADS 2984A and SZ Cam of the sextuple system in NGC 1502. Our spectra clearly confirm the multiplicity of these components, which is the first investigation of this kind at the University Observatory Jena.

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Searching for a link between the magnetic nature and other observed properties of Herbig Ae/Be stars and stars with debris disks

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Recently, evidence for the presence of weak magnetic fields in Herbig Ae/Be stars was found in several studies.

We seek to expand the sample of intermediate-mass pre-main sequence stars with circular polarization data to measure

their magnetic fields, and to determine whether magnetic field properties in these stars are correlated with mass-accretion rate, disk inclination, companions, Silicates, PAHs, or show a correlation with age and X-ray emission as expected for the decay of a remnant dynamo.

Spectropolarimetric observations of 21 Herbig Ae/Be stars and six debris disk stars have been obtained at the European Southern Observatory with FORS 1 mounted on the 8 m Kueyen telescope of the VLT. With the GRISM 600B in the wavelength range 3250–6215 Å we were able to cover all hydrogen Balmer lines from Hβ to the Balmer jump. In all observations a slit width of 0.4″ was used to obtain a spectral resolving power of $R \approx 2000$.

Among the 21 Herbig Ae/Be stars studied, new detections of a magnetic field were achieved in six stars. For three Herbig Ae/Be stars, we confirm previous magnetic field detections. The largest longitudinal magnetic field, $\langle B_z \rangle = -454 \pm 42$ G, was detected in the Herbig Ae/Be star HD 101412 using hydrogen lines. No field detection at a significance level of 3σ was achieved in stars with debris disks. Our study does not indicate any correlation of the strength of the longitudinal magnetic field with disk orientation, disk geometry, or the presence of a companion. We also do not see any simple dependence on the mass-accretion rate. However, it is likely that the range of observed field values qualitatively supports the expectations from magnetospheric accretion models giving support for dipole-like field geometries. Both the magnetic field strength and the X-ray emission show hints for a decline with age in the range of ∼2–14 Myrs probed by our sample supporting a dynamo mechanism that decays with age. However, our study of rotation does not show any obvious trend of the strength of the longitudinal magnetic field with rotation period. Furthermore, the stars seem to obey the universal power-law relation between magnetic flux and X-ray luminosity established for the Sun and main-sequence active dwarf stars.

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Gum 48d: An Evolved H II Region with Ongoing Star Formation

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High-mass star formation and the evolution of H II regions have a substantial impact on the morphology and star formation history of molecular clouds. The H II region Gum 48d, located in the Centaurus Arm at a distance of 3.5 kpc, is an old, well evolved H II region whose ionizing stars have moved off the main sequence. As such, it represents a phase in the evolution of H II regions that is less well studied than the earlier, more energetic, main-sequence phase. In this paper, we use multiwavelength archive data from a variety of sources to perform a detailed study of this interesting region. Morphologically, Gum 48d displays a ring-like faint H II region associated with diffuse emission from the associated photodissociation region, and is formed from part of a large, massive molecular cloud complex. There is extensive ongoing star formation in the region, at scales ranging from low to high mass, which is consistent with triggered star formation scenarios. We investigate the dynamical history and evolution of this region, and conclude that the original H II region was once larger and more energetic than the faint region currently seen. The proposed history of this molecular cloud complex is one of multiple, linked generations of star formation, over a period of 10 Myr. Gum 48d differs significantly in morphology and star formation from the other H II regions in the molecular cloud; these differences are likely the result of the advanced age of the region, and its different evolutionary status.

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The Interplay of Turbulence and Magnetic Fields in Star-Forming Regions: Simulations and Observations

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We analyze a suite of thin sheet magnetohydrodynamical simulations based on the formulation of Basu, Ciolek, Dapp & Wurster. These simulations allow us to examine the observational consequences to a star-forming region of varying the input level of turbulence (between thermal and a Mach number of 4) and the initial magnetic field strength corresponding to a range of mass to flux ratios between subcritical ($\mu_0 = 0.5$) and supercritical ($\mu_0 = 10$). The input turbulence is allowed to decay over the duration of the simulation. We compare the measured observable quantities with those found from surveying the Perseus molecular cloud. We find that only the most turbulent of simulations (high Mach number and weak magnetic field) have sufficient large-scale velocity dispersion (at $\sim$1 pc) to match that observed across extinction regions in Perseus. Generally, the simulated core ($\sim$0.02 pc) and line of sight velocity dispersions provide a decent match to observations. The motion between the simulated core and its local environment, however, is far too large in simulations with high large-scale velocity dispersion.

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Variability of young stars: Determination of rotational periods of weakline T Tauri stars in the Cepheus-Cassiopeia star-forming region

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We report on observation and determination of rotational periods of ten weak-line T Tauri stars in the Cepheus-Cassiopeia star-forming region. Observations were carried out with the Cassegrain-Teleskop-Kamera (CTK) at University Observatory Jena between 2007 June and 2008 May. The periods obtained range between 0.49 d and 5.7 d, typical for weak-line and post T Tauri stars.

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The Star Formation Law in Atomic and Molecular Gas

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We propose a simple theoretical model for star formation in which the local star formation rate in a galaxy is determined by three factors. First, the interplay between the interstellar radiation field and molecular self-shielding determines what fraction of the gas is in molecular form and thus eligible to form stars. Second, internal feedback determines the properties of the molecular clouds that form, which are nearly independent of galaxy properties until the galactic ISM pressure becomes comparable to the internal GMC pressure. Above this limit, galactic ISM pressure determines molecular gas properties. Third, the turbulence driven by feedback processes in GMCs makes star formation slow, allowing a small fraction of the gas to be converted to stars per free-fall time within the molecular clouds. We combine analytic estimates for each of these steps to formulate a single star formation law, and show that the predicted correlation between star formation rate, metallicity, and surface densities of atomic, molecular, and total gas agree well with observations.

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Molecular outflows towards O-type young stellar objects

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Context. The formation of massive stars is not well-understood and requires detailed observational studies in order to discriminate between the different proposed star formation models.
Aims. We have searched for massive molecular outflows in a sample of high-mass star forming regions, and we have characterised both the outflow properties and those of their associated molecular clumps. With a sample composed largely of more luminous objects than previous ones, this work complements analogous surveys performed by other authors by adding the missing highest luminosity sources.
Methods. The sample under study has been selected so as to favour the earliest evolutionary phases of star formation, and is composed of very luminous objects ($L_{\rm bol} > 2 \times 10^4$ $L_\odot$ and up to $\sim 10^6$ $L_\odot$), possibly containing O-type stars. Each source has been mapped in ^{13}CO(2−1) (an outflow tracer) and C^{18}O(2−1) (an ambient gas tracer) with the IRAM-30m telescope at Pico Veleta (Spain).
Results. The whole sample shows high-velocity wings in the ^{13}CO(2−1) spectra, indicative of outflowing motions. In addition, we have obtained outflow maps in 9 of our 11 sources, which display well-defined blue and/or red lobes. For these sources, the outflow parameters have been derived from the line wing ^{13}CO(2−1) emission. An estimate of the clump masses from the C^{18}O(2−1) emission is also provided and found to be comparable to the virial masses. From a comparison between our results and those found by other authors at lower masses, it is clear that the outflow mechanical force increases with the bolometric luminosity of the clump and with the ionising photon rate of the associated HII regions, indicating that high-mass stars drive more powerful outflows. A tight correlation between outflow mass and clump mass is also found.
Conclusions. Molecular outflows are found to be as common in massive star forming regions as in low-mass star forming regions. This, added to the detection of a few tentative large-scale rotating structures suggests that high-mass stars may generally form via accretion, as low-mass stars.

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Infrared Spectra of Young Stars in the R Coronae Australis Cloud

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Infrared spectra are presented for a magnitude-limited (K ¡ 12.5 mag) sample of stellar objects observed toward the R Coronae Australis molecular core. These spectra, which are used to identify young stellar objects in the cloud, include wavelengths of emission lines from [FeII] and H2, four of the Brackett series lines, and the CO bandheads, as well as photospheric absorption lines of Al, Na, Mg, Si, and Ca. For a subset of the sample, the spectra are compared to those of infrared spectral standard stars to derive spectral types and luminosity classes. By comparing their placement in the Hertzsprung-Russell diagram with theoretical pre-main sequence tracks and isochrones, we estimate the stellar masses and assess the evolutionary states of the members of this young aggregate. All of the sources classified via near-IR spectroscopy have masses in the range from 0.2-2.5 Msun. The locus of points in the H-R diagram is lower than observed for other embedded clusters (e.g. NGC 2024 and the ρ Oph core), suggesting either a more advanced evolutionary state or a difference in the intrinsic stellar birthline for very young clusters. We discuss the implications of our results for the shape of the initial mass function of the embedded cluster and the star-forming history of the cloud.

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Photometric monitoring of the young star Par 1724 in Orion

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We report new photometric observations of the $\sim 200,000$ year old naked weak-line run-away T Tauri star Par 1724, located north of the Trapezium cluster in Orion. We observed in the broad band filters B, V, R, and I using the 90 cm Dutch telescope on La Silla, the 80 cm Wendelstein telescope, and a 25 cm telescope of the University Observatory Jena in Großschwabhausen near Jena. The photometric data in V and R are consistent with a ~ 5.7 day rotation period due to spots, as observed before between 1960ies and 2000. Also, for the first time, we present evidence for a long-term 9 or 17.5 year cycle in photometric data (V-band) of such a young star, a cycle similar to that of the Sun and other active stars.

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Edge-on disk around the T Tauri star [MR81] Hα 17 NE in CrA

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Using the speckle camera SHARP at the 3.5m ESO NTT, Köhler and collaborators found an object ~ 3.5 mag fainter in K only $1.3''$ north-east of the T Tauri star [MR81] Hα17 in the Corona Australis (CrA) star-forming region, which could be either a brown dwarf or a T Tauri star with an edge-on disk. We attempt to study this faint object in detail.

We acquired deep VLT NACO near-infrared images at three epochs to determine, whether [MR81] Hα17 and the nearby faint object are comoving and to measure the infrared colors of both objects. We obtained optical and infrared spectra of both objects with the VLT using FORS and ISAAC, respectively, to determine spectral types and temperatures as well as ages and masses.

The T Tauri star [MR81] Hα17 and the faint nearby object have a projected separation of 1369.58 mas, i.e. 178 AU at 130 pc. They share the same proper motion ($\sim 5\sigma$), so that they most certainly form a bound binary pair. The apparently fainter component [MR81] Hα17 NE has a spectral type of M2e, while the apparently brighter component [MR81] Hα17 SW, the previously known T Tauri star, has a spectral type of M4-5e. We can identify a nearly edge-on disk around [MR81] Hα17 NE by visual inspection, which has a diameter of at least 30 to 50 AU. We are able to detect strong emission lines in [MR81] Hα17 NE, which are almost certainly due to ongoing accretion. The NE object is detectable only by means of its scattered light.

If both objects are co-eval (2-3 Myr) and located at the same distance ($\sim$ 130 pc as CrA), then the apparently fainter [MR81] Hα17 NE is more massive (primary) component with a nearly edge-on disk and the apparently brigther component [MR81] Hα17 SW is less massive (companion). Both are low-mass T Tauri stars with masses of ~ 0.5 and 0.23 ± 0.05 $M_\odot$, respectively.

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The initial conditions of isolated star formation – IX. Akari mapping of an externally heated pre-stellar core

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We present observations of L1155 and L1148 in the Cepheus molecular cloud, taken using the Far Infrared Surveyor (FIS) instrument on the Akari satellite. We compare these data to submillimetre data taken using the Submillimetre Common-User Bolometer Array (SCUBA) camera on the James Clerk Maxwell Telescope (JCMT), and far-infrared data taken with the imaging photo-polarimeter (ISOPHOT) camera on board the Infrared Space Observatory (ISO) satellite. The Akari data cover a similar spectral window and are consistent with the ISO data. All of the data show a relation between the position of the peak of emission and the wavelength for the core of L1155. We interpret this as a temperature gradient. We fit modified blackbody curves to the spectral energy distributions at two positions in the core and see that the central core in L1155 (L1155C) is approximately 2 degrees warmer at one edge than it is in the centre. We consider a number of possible heating sources and conclude that the A6V star BD+67 1263 is the most likely candidate. This star is at a distance of 0.7 pc from the front of L1155C in the plane of the sky. We carry out radiative transfer modelling of the L1155C core including the effects from the nearby star. We find that we can generate a good fit to the observed data at all wavelengths, and demonstrate that the different morphologies of the core at different wavelengths can be explained by the observed 2 degree temperature gradient. The L1148 core exhibits a similar morphology to that of L1155C, and the data are also consistent with a temperature gradient across the core. In this case, the most likely heating source is the star BD197053. Our findings illustrate very clearly that the apparent observed morphology of a pre-stellar core can be highly dependent on the wavelength of the observation, and that temperature gradients must be taken into account before converting images into column density distributions. This is important to note when interpreting Akari and Spitzer data and will also be significant for Herschel data.

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Cosmic-ray ionization of molecular clouds

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Context. Low-energy cosmic rays are a fundamental source of ionization for molecular clouds, influencing their chemical, thermal and dynamical evolution.
Aims. The purpose of this work is to explore the possibility that a low-energy component of cosmic-rays, not directly measurable from the Earth, can account for the discrepancy between the ionization rate measured in diffuse and dense interstellar clouds.
Methods. We collect the most recent experimental and theoretical data on the cross sections for the production of H_2^+ and He^+ by electron and proton impact, and we discuss the available constraints on the cosmic-ray fluxes in the local interstellar medium. Starting from different extrapolations at low energies of the demodulated cosmic-ray proton and electron spectra, we compute the propagated spectra in molecular clouds in the continuous slowing-down approximation taking into account all the relevant energy loss processes.

Results. The theoretical value of the cosmic-ray ionization rate as a function of the column density of traversed matter is in agreement with the observational data only if either the flux of cosmic-ray electrons or of protons increases at low energies. The most successful models are characterized by a significant (or even dominant) contribution of the electron component to the ionization rate, in agreement with previous suggestions. However, the large spread of cosmic-ray ionization rates inferred from chemical models of molecular cloud cores remains to be explained.
Conclusions. Available data combined with simple propagation models support the existence of a low-energy component (below ~ 100 MeV) of cosmic-ray electrons or protons responsible for the ionization of molecular cloud cores and dense protostellar envelopes.

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Predictions of polarized dust emission from interstellar clouds: spatial variations in the efficiency of radiative torque alignment

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Polarization carries information about the magnetic fields in interstellar clouds. The observations of polarized dust emission are used to study the role of magnetic fields in the evolution of molecular clouds and the initial phases of star formation. Therefore, it is important to understand how different cloud regions contribute to the observed polarized signal.
We study the grain alignment with realistic simulations, assuming the radiative torques to be the main mechanism. The aim is to study the efficiency of the grain alignment as a function of cloud position and to study the observable consequences of these spatial variations.
Our results are based on the analysis of model clouds derived from MHD simulations of super-Alfvénic magnetized turbulent flows. The continuum radiative transfer problem is solved with Monte Carlo methods to estimate the three-dimensional distribution of dust emission and the radiation field strength. The anisotropy of the radiation field is taken into account explicitly. We also examine the effect of grain growth in cores both to the observed polarization and to the inferred magnetic field.
Using the assumptions of Cho & Lazarian, our findings are generally consistent with their results. However, the anisotropy factor is lower than their assumption of $\gamma = 0.7$, and thus radiative torques are less efficient. Compared with our previous paper, P/I relations are steeper. Without grain growth, the magnetic field of the cores is poorly recovered above a few $A_{\rm V}$. If grain size is doubled, the polarized dust emission can trace the magnetic field lines possibly up to $A_{\rm V} \sim 10$ magnitudes. However, many of the prestellar cores may be too young for grain coagulation to play a major role. The inclusion of direction dependent radiative torque efficiency weakens the alignment. Even with doubled grain size, we would not expect to probe the magnetic field past a few magnitudes in $A_{\rm V}$.

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A differentially rotating disc in a high-mass protostellar system

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A strong signature of a circumstellar disc around a high-mass protostar has been inferred from high resolution methanol maser observations in NGC7538-IRS1 N. This interpretation has however been challenged with a bipolar outflow proposed as an alternative explanation. We compare the two proposed scenarios for best consistency with the observations.

Using a newly developed formalism we model the optical depth of the maser emission at each observed point in the map and LOS velocity for the two scenarios. We find that if the emission is symmetric around a central peak in both space and LOS velocity then it has to arise from an edge-on disc in sufficiently fast differential rotation. Disc models successfully fit 100 independent measurement points in position-velocity space with 4 free parameters to an overall accuracy of 3-4%. Solutions for Keplerian rotation require a central mass of at least 4 solar masses. Close to best-fitting models are obtained if Keplerian motion is assumed around a central mass equaling 30 solar masses as inferred from other observations. In contrast we find that classical bipolar outflow models cannot fit the data, although could be applicable in other sources. Our results strongly favour the differentially rotating disc hypothesis to describe the main feature of the 12.2 (and 6.7) GHz methanol maser emission in NGC7538 IRS1 N. Furthermore, for Keplerian rotation around a 30 solar masses protostar we predict the position and velocity at which tangentially amplified masers should be detected in high dynamic range observations. Also, our model predicts the amplitude of the proper motion of some of the maser features in our data. Confirmation of a large central mass would strongly support the idea that even the highest mass stars (¿20 solar masses) form via accretion discs, similar to low-mass stars. Finally we note that our new formalism can readily be used to distinguish between discs and outflows for thermal emitting line sources as well as masers.

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Recurrent gas accretion by massive star clusters, multiple stellar populations and mass thresholds for spheroidal stellar systems

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We explore the gravitational influence of pressure supported stellar systems on the internal density distribution of a gaseous environment. We conclude that compact massive star clusters with masses $\gtrsim 10^6\ M_\odot$ act as cloud condensation nuclei and are able to accrete gas recurrently from a warm interstellar medium which may cause further star formation events and account for multiple stellar populations in the most massive globular and nuclear star clusters. The same analytical arguments can be used to decide whether an arbitrary spherical stellar system is able to keep warm or hot interstellar material or not. These mass thresholds coincide with transition masses between pressure supported galaxies of different morphological types.

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Benchmark problems for continuum radiative transfer. High optical depths, anisotropic scattering, and polarisation

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Aims. Solving the continuum radiative transfer equation in high opacity media requires sophisticated numerical tools. In order to test the reliability of such tools, we present a benchmark of radiative transfer codes in a 2D disc configuration.

Methods. We test the accuracy of seven independently developed radiative transfer codes by comparing the temperature

structures, spectral energy distributions, scattered light images, and linear polarisation maps that each model predicts for a variety of disc opacities and viewing angles. The test cases have been chosen to be numerically challenging, with midplane optical depths up 10^6, a sharp density transition at the inner edge and complex scattering matrices. We also review recent progress in the implementation of the Monte Carlo method that allow an efficient solution to these kinds of problems and discuss the advantages and limitations of Monte Carlo codes compared to those of discrete ordinate codes.

Results. For each of the test cases, the predicted results from the radiative transfer codes are within good agreement. The results indicate that these codes can be confidently used to interpret present and future observations of protoplanetary discs.

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The Extended Environment of M17: A Star Formation History

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M17 is one of the youngest and most massive nearby star-formation regions in the Galaxy. It features a bright H II region erupting as a blister from the side of a giant molecular cloud (GMC). Combining photometry from the *Spitzer* Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE) with complementary infrared (IR) surveys, we identify candidate young stellar objects (YSOs) throughout a $1.5^\circ \times 1^\circ$ field that includes the M17 complex. The long sightline through the Galaxy behind M17 creates significant contamination in our YSO sample from unassociated sources with similar IR colors. Removing contaminants, we produce a highly reliable catalog of 96 candidate YSOs with a high probability of association with the M17 complex. We fit model spectral energy distributions to these sources and constrain their physical properties. Extrapolating the mass function of 62 intermediate-mass YSOs ($M_* > 3\ M_\odot$), we estimate that >1000 stars are in the process of forming in the extended outer regions of M17. The remaining 34 candidate YSOs are found in a 0.17 deg^2 field containing the well-studied M17 H II region and photodissociation region (PDR), where bright diffuse mid-IR emission drastically reduces the sensitivity of the GLIMPSE point-source detections. By inspecting IR survey images from *IRAS* and GLIMPSE, we find that M17 lies on the rim of a large shell structure $\sim$0.5° in diameter ($\sim$20 pc at 2.1 kpc). We present maps of ^{12}CO and ^{13}CO (J = 2 - 1) emission observed with the Heinrich Hertz Telescope. The CO emission shows that the shell is a coherent, kinematic structure associated with M17, centered at $v = 19$ km s^{-1}. The shell is an extended bubble outlining the PDR of a faint, diffuse H II region several Myr old. We identify a group of candidate ionizing stars within the bubble. YSOs in our catalog are concentrated around the bubble rim, providing evidence that massive star formation has been triggered by the expansion of the bubble. The formation of the massive cluster ionizing the M17 H II region itself may have been similarly triggered. We conclude that the star formation history in the extended environment of M17 has been punctuated by successive waves of massive star formation propagating through a GMC complex.

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Dense cores in the Pipe Nebula: an improved core mass function

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In this paper we derive an improved core mass function (CMF) for the Pipe Nebula from a detailed comparison between measurements of visual extinction and molecular-line emission. We have compiled a refined sample of 201 dense cores toward the Pipe Nebula using a 2-dimensional threshold identification algorithm informed by recent simulations of dense core populations. Measurements of radial velocities using complimentary $C^{18}O$ (1–0) observations enable us to cull out from this sample those 43 extinction peaks that are either not associated with dense gas or are not physically associated with the Pipe Nebula. Moreover, we use the derived $C^{18}O$ central velocities to differentiate between single cores with internal structure and blends of two or more physically distinct cores, superposed along the same line-of-sight. We then are able to produce a more robust dense core sample for future follow-up studies and a more reliable CMF than was possible previously. We confirm earlier indications that the CMF for the Pipe Nebula departs from a single power-law like form with a break or knee at $M \sim 2.7 \pm 1.3$ $M_{\odot}$. Moreover, we also confirm that the CMF exhibits a similar shape to the stellar IMF, but is scaled to higher masses by a factor of ~ 4.5. We interpret this difference in scaling to be a measure of the star formation efficiency ($22 \pm 8\%$). This supports earlier suggestions that the stellar IMF may originate more or less directly from the CMF.

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Surprisingly Weak Magnetism on Young Accreting Brown Dwarfs

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We have measured the surface magnetic flux on four accreting young brown dwarfs and one nonaccreting young very low mass (VLM) star utilizing high-resolution spectra of absorption lines of the FeH molecule. A magnetic field of 1-2 kG had been proposed for one of the brown dwarfs, Two Micron All Sky Survey (2MASS) J1207334-393254, because of its similarities to higher mass T Tauri stars as manifested in accretion and the presence of a jet. We do not find clear evidence for a kilogauss field in any of our young brown dwarfs but do find a 2 kG field on the young VLM star. Our 3σ upper limit for the magnetic flux in 2MASS J1207334-393254 just reaches 1 kG. We estimate the magnetic field required for accretion in young brown dwarfs given the observed rotations, and find that fields of only a few hundred gauss are sufficient for magnetospheric accretion. This predicted value is less than our observed upper limit. We conclude that magnetic fields in young brown dwarfs are a factor of 5 or more lower than in young stars of about one solar mass, and in older stars with spectral types similar to our young brown dwarfs. It is interesting that, during the first few million years, the fields scale down with mass in line with what is needed for magnetospheric accretion, yet no such scaling is observed at later ages within the same effective temperature range. This scaling is opposite to the trend in rotation, with shorter rotation periods for very young accreting brown dwarfs compared with accreting solar-mass objects (and very low Rossby numbers in all cases). We speculate that in young objects a deeper intrinsic connection may exist between magnetospheric accretion and magnetic field strength, or that magnetic field generation in brown dwarfs may be less efficient than in stars. Neither of these currently has an easy physical explanation.

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The alignment of the polarization of HAe/Be stars with the interstellar magnetic field

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We present a study of the correlation between the direction of the symmetry axis of the circumstellar material around intermediate mass young stellar objects and that of the interstellar magnetic field. We use CCD polarimetric data on 100 Herbig Ae/Be stars. A large number of them shows intrinsic polarization, which indicates that their circumstellar envelopes are not spherical. The interstellar magnetic field direction is estimated from the polarization of field stars. There is an alignment between the position angle of the Herbig Ae/Be star polarization and that of the field stars for the most polarized objects. This may be an evidence that the ambient interstellar magnetic field plays a role in shaping the circumstellar material around young stars of intermediate mass and/or in defining their angular momentum axis.

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Tracing the potential planet-forming regions around seven pre-main sequence stars

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We investigate the nature of the innermost regions with radii of several AUs of seven circumstellar disks around pre-main-sequence stars, T Tauri stars in particular. Our object sample contains disks apparently at various stages of their evolution. Both single stars and spatially resolved binaries are considered. In particular, we search for inner disk gaps as proposed for several young stellar objects (YSOs). When analyzing the underlying dust population in the atmosphere of circumstellar disks, the shape of the 10 μm feature should additionally be investigated. We performed interferometric observations in N band ($8 - 13\,\mu$m) with the Mid-Infrared Interferometric Instrument (MIDI) at the Very Large Telescope Interferometer (VLTI) using baseline lengths of between 54 m and 127 m. The data analysis is based on radiative-transfer simulations using the Monte Carlo code MC3D by modeling simultaneously the spectral energy distribution (SED), N band spectra, and interferometric visibilities. Correlated and uncorrelated N band spectra are compared to investigate the radial distribution of the dust composition of the disk atmosphere. Spatially resolved mid-infrared (MIR) emission was detected in all objects. For four objects (DR Tau, RU Lup, S CrA N, and S CrA S), the observed N band visibilities and corresponding SEDs could be simultaneously simulated using a parameterized active disk-model. For the more evolved objects of our sample, HD 72106 and HBC 639, a purely passive disk-model provides the closest fit. The visibilities inferred for the source RU Lup allow the presence of an inner disk gap. For the YSO GW Ori, one of two visibility measurements could not be simulated by our modeling approach. All uncorrelated spectra reveal the 10 μm silicate emission feature. In contrast to this, some correlated spectra of the observations of the more evolved objects do not show this feature, indicating a lack of small silicates in the inner versus the outer regions of these disks. We conclude from this observational result that more evolved dust grains can be found in the more central disk regions.

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Testing the Evolutionary Sequence of High Mass Protostars with CARMA

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We present 1" resolution CARMA observations of the 3 mm continuum and 95 GHz CH_3OH masers toward 14 candidate high mass protostellar objects (HMPOs). Dust continuum emission is detected toward seven HMPOs, and CH_3OH masers toward 5 sources. The 3 mm continuum sources have diameters $< 2 \times 10^4$AU, masses between 21 and 1200 $M_\odot$, and volume densities $> 10^8\,cm^{-3}$. Most of the 3 mm continuum sources are spatially coincident with compact HII regions and/or water masers, and are presumed to be formation sites of massive stars. A strong correlation exists

between the presence of 3 mm continuum emission, 22 GHz H_2O masers, and 95 GHz CH_3OH masers. However, no 3 mm continuum emission is detected toward ultracompact HII regions lacking maser emission. These results are consistent with the hypothesis that 22 GHz H_2O masers and CH_3OH masers are signposts of an early phase in the evolution of an HMPO before an expanding HII region destroys the accretion disk.

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The Evolution of Massive YSOs in the LMC: Part I. Identification and Spectral Classification

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We present and categorize *Spitzer* IRS spectra of 294 objects in the Large Magellanic Cloud (LMC) to create the largest and most complete catalog of massive young stellar object (YSO) spectra in the LMC. Target sources were identified from infrared photometry and multi-wavelength images indicative of young, massive stars highly enshrouded in their natal gas and dust clouds. Several objects have been spectroscopically identified as non-YSOs and have features similar to more evolved stars such as red supergiants, asymptotic giant branch (AGB), and post-AGB stars. Our sample primarily consists of 277 objects we identify as having spectral features indicative of embedded YSOs. The remaining sources are comprised of 7 C-rich evolved sources, 8 sources dominated by broad silicate emission, and 1 source with multiple broad emission features. Those with YSO-like spectra show a range of spectral features including polycyclic aromatic hydrocarbon emission, deep silicate absorption, fine-structure lines, and ice absorption features. Based upon the relative strengths of these features, we have classified the YSO candidates into several distinct categories using the widely-used statistical procedure known as principal component analysis. We propose that these categories represent a spectrum of evolutionary stages during massive YSO formation. Using our catalog we put statistical constraints on the relative evolutionary timescale of processes involved in massive star formation. We conclude that massive pre-main sequence stars spend a majority (possibly as high as 90%) of their massive, embedded lives emitting in the UV. Half of the sources in our study have features typical of compact HII regions, suggesting that massive YSOs can create a detectable compact HII region half-way through the formation time present in our sample. This study also provides a check on commonly used source-selection procedures including the use of photometry to identify YSOs. We determine a high success rate ($> 95\%$) of identifying objects with YSO-like spectra can be achieved through careful use of infrared color magnitude diagrams, spectral energy distributions, and image inspections.

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The influence of winds on the time-dependent behaviour of self-gravitating accretion discs

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We study the effects of winds on the time evolution of isothermal, self-gravitating accretion discs by adopting a radius-dependent mass-loss rate because of the existence of the wind. Our similarity and semi-analytical solution

describes time evolution of the system in the slow accretion limit. The disc structure is distinct in the inner and outer parts, irrespective of the existence of the wind. We show that the existence of wind will lead to a reduction of the surface density in the inner and outer parts of the disc in comparison to a no-wind solution. Also, the radial velocity significantly increases in the outer part of the disc, however, the accretion rate decreases due to the reduced surface density in comparison to the no-wind solution. In the inner part of the disc, mass loss due to the wind is negligible according to our solution. But the radial size of this no-wind inner region becomes smaller for stronger winds.

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Magnetothermal condensation modes including the effects of charged dust particles

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We study thermal instability in a magnetized and partially ionized plasma with charged dust particles. Our linear analysis shows that the growth rate of the unstable modes in the presence of dust particles strongly depends on the ratio of the cooling rate and the modified dust-cyclotron frequency. If the cooling rate is less than the modified dust-cyclotron frequency, then the growth rate of the condensation modes does not modify due to the existence of the charged dust particles. But, when the cooling rate is greater than (or comparable to) the modified dust-cyclotron frequency, the growth rate of unstable modes increases because of the dust particles. Also, the wavenumber of the perturbations corresponding to the maximum growth rate shifts to the smaller values (larger wavelengths) as the cooling rate becomes larger than the modified dust-cyclotron frequency. We show that the growth rate of the condensation modes increases with the electrical charge of the dust particles.

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Far-Infrared Observations of the Very Low Luminosity Embedded Source L1521F-IRS in the Taurus Star-Forming Region

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We investigate the environment of the very low luminosity object L1521F-IRS using data from the Taurus *Spitzer* Legacy Survey. The MIPS 160 μm image shows both extended emission from the Taurus cloud and emission from multiple cold cores over a $1^\circ \times 2^\circ$ region. Analysis shows that the cloud dust temperature is 14.2 ± 0.4 K and the extinction ratio is $A_{160}/A_K = 0.010 \pm 0.001$ up to $A_V \sim 4$ mag. We find $\kappa_{160} = 0.23 \pm 0.046$ cm^2 g^{-1} for the specific opacity of the gas-dust mixture. Therefore, for dust in the Taurus cloud we find that the 160 μm opacity is significantly

higher than that measured for the diffuse interstellar medium, but not too different from dense cores, even at modest extinction values. Furthermore, the 160 μm image shows features that do not appear in the *IRAS* 100 μm image. We identify six regions as cold cores, i.e., colder than 14.2 K, all of which have counterparts in extinction maps or $C^{18}O$ maps. Three of the six cores contain embedded young stellar objects, which demonstrates the cores are sites of current star formation. We compare the effects of L1521F-IRS on its natal core and find there is no evidence for dust heating at 160 or 100 μm by the embedded source. From the infrared luminosity $L_{\rm TIR} = 0.024\ L_\odot$ we find $L_{\rm bol_{int}} =$ 0.034-0.046 $L_\odot$, thus confirming the source's low luminosity. Comparison of L1521F-IRS with theoretical simulations for the very early phases of star formation appears to rule out the first core collapse phase. The evolutionary state appears similar to or younger than the class 0 phase, and the estimated mass is likely to be substellar.

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Evidence for CO depletion in the inner regions of gas-rich protoplanetary disks

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We investigate the physical properties and spatial distribution of Carbon Monoxide (CO) gas in the disks around the Herbig Ae/Be stars HD 97048 and HD 100546. Using high-spectral-resolution 4.588-4.715 μm spectra containing fundamental CO emission taken with CRIRES on the VLT, we probe the circumstellar gas and model the kinematics of the emission lines. By using spectro-astrometry on the spatially resolved targets, we constrain the physical size of the emitting regions in the disks. We resolve, spectrally and spatially, the emission of the ^{13}CO v(1-0) vibrational band and the ^{12}CO $v = 1-0, v = 2-1, v = 3-2$ and $v = 4-3$ vibrational bands in both targets, as well as the ^{12}CO $v = 5-4$ band in HD 100546. Modeling of the CO emission with a homogeneous disk in Keplerian motion, yields a best fit with an inner and outer radius of the CO emitting region of 11 and $\geq$ 100 AU for HD 97048. HD 100546 is not fit well with our model, but we derive a lower limit on the inner radius of 8 AU. The fact that gaseous [OI] emission was previously detected in both targets at significantly smaller radii suggests that CO may be effectively destroyed at small radii in the surface layers of these disks.

Accepted by A&A

http://arxiv.org/abs/0810.3417

Possible magnetic field variability during the 6.7 GHz methanol maser flares of G09.62+0.20

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Polarization of maser emission contains unique information on the magnetic field in the densest regions of massive star formation. Magnetic field induced Zeeman-splitting has been measured for the strongest known 6.7 GHz methanol maser, which arises in the massive star-forming region G09.62+0.20. This maser is one of a handful of periodically flaring methanol masers. Magnetic field measurements can possibly provide insights into the elusive mechanism responsible for this periodicity. The 100-m Effelsberg telescope was used to monitor the 6.7 GHz methanol masers of G09.62+0.20, in weekly intervals, for just over a two-month period during which one of the maser flares occurred. With the exception of a two-week period during the peak of the maser flare, we measure a constant magnetic field of

$B_{||} \approx 11 \pm 2$ mG in the two strongest maser components of G09.62+0.20 that are separated by more than 200 AU. In the two-week period coinciding exactly with the peak of the maser flare of the strongest maser feature, we measure a sharp decrease and possible reversal of the Zeeman-splitting. While the two phenomena are clearly related, the Zeeman-splitting decrease occurs only close to the flare maximum. Intrinsic magnetic field variability is thus unlikely to be the reason for the maser variability. The exact cause of both variabilities is still unclear, but it could be related to either background amplification of polarized emission or the presence of a massive protostar with a close-by companion. However, the variability in the splitting between the right- and left-circular polarizations could also be caused by non-Zeeman effects related to the radiative transfer of polarized maser emission. In this case we can place limits on the magnetic field orientation and the maser saturation level.

Accepted by A&A

http://arxiv.org/abs/0904.4806

Multiple Bipolar Molecular Outflows from the L1551 IRS5 Protostellar System

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The multiple protostellar system L1551 IRS5 exhibits a large-scale bipolar molecular outflow that spans ∼1.5 pc on both the NE (redshifted) and SW (blueshifted) sides of the system. We have studied this outflow within ∼4000 AU of its driving source(s) with the SubMillimeter Array. Our CO(2–1) image at ∼4" (∼560 AU) resolution reveals three distinct components: 1) an X-shaped structure spanning ∼20" from center with a similar symmetry axis and velocity pattern as the large-scale outflow; 2) an S-shaped structure spanning ∼10" from center also with a similar symmetry axis but opposite velocity pattern to the large-scale outflow; and 3) a compact central component spanning ∼1.4" from center again with a similar symmetry axis and velocity pattern as the large-scale outflow. The X-shaped component likely comprises the limb-brightened walls of a cone-shaped cavity excavated by the outflows from the two main protostellar components. The compact central component likely comprises material within this cavity newly entrained by one or both outflows from the two main protostellar components. The S-shaped component mostly likely comprises a precessing outflow with its symmetry axis inclined in the opposite sense to the plane of the sky than the other two components, taking the S-shaped component out of the cone-shaped cavity along most if not all of its entire length. This outflow may be driven by a recently reported candidate third protostellar component in L1551 IRS5, whose circumstellar disk is misaligned relative to the two main protostellar components. Gravitational interactions between this protostellar component and its likely more massive northern (and perhaps also southern) neighbor(s) may be causing the circumstellar disk and hence outflow of this component to precess.

Accepted by ApJ

http://lanl.arxiv.org/abs/0904.2079

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.

Postdoctoral positions: Herschel/DUNES and Herschel/GASPS

Two Postdoctoral positions are available at the Universidad Autonoma de Madrid to work in the frame of the Herschel Open Time Key Programmes DUNES ("Dust Around Nearby Stars", - http://www.mpia-hd.mpg.de/DUNES/ - PI: Eiroa) and GASPS ("Gas in Protoplanetary Systems", - http://www.laeff.inta.es/projects/herschel/ - PI: Dent).

The selected candidates will participate intensively in the Herschel data reduction and analysis, and ancillary data. In particular, the candidate assigned to DUNES will have a high responsibility concerning data reduction. It is also expected an active collaboration with team members of both programmes, in particular with those developing theoretical models. Daily work will be carried out in very close collaboration with team members located in Madrid and involved in both programmes, which include staff at UAM, LAEFF, and ESAC. Opportunities to develop independent astrophysical research in circumstellar disks and related areas are not excluded.

Interested persons should have a PhD in Astrophysics. Experience in far-IR observations including continuum and line data reduction and analysis is a clear factor of merit; formation and knowledge in dust and/or gas models of disks is also a clear asset.

One of the positions will start on July 1st and will extend for 2 years and a half. The second position is open from June 1st and should be filled not later than September or October 1st. The duration of this second position is also 2 years and a half. In any case, selection of candidates will continue untill the positions are filled.

Gross yearly salary for both positions is around 27000 - 27500 euros

Applicants should send a curriculum vitae, brief statement of research, interests and plans, and arrange for three letters of reference to be sent to: Carlos Eiroa, Dpto. Fisica Teorica, Universidad Autonoma de Madrid, Cantoblanco, 28049 Madrid, Spain. Applications can also be sent by e-mail to: carlos.eiroa *at* uam.es

Software Developers: James Webb Space Telescope Mid-InfraRed Instrument (MIRI)

The Dublin Institute for Advanced Studies, is offering two contract positions as part of a US/European team to develop software for the Mid-InfraRed Instrument (MIRI).

Areas of interest Two contract posts are currently available as part of a US/European team to develop software for the Mid-InfraRed Instrument (MIRI). MIRI will be flown on the James Webb Space Telescope (NASA and ESA's planned successor to the Hubble Space Telescope), which is due for launch in 2013. It is essential that applicants have a PhD in Astrophysics or a related subject. They should also have relevant experience with astronomical data processing and knowledge of C++ and a scripting language, such as Python, are advantageous. Successful applicants may expect to carry out their own astronomical research programme in addition to their MIRI workload. Initial contracts will be for a two-year period. Applications, to include a CV, publication list, a short description of research interests, and the contact details of two referees should be sent, ideally as a single PDF file by e-mail to eflood@cp.dias.ie (with a cc to tom.ray@dias.ie) quoting "MIRI Software Developers" in the subject field, to arrive on or before 31 May 2009. The positions will remain open until filled and are available from mid-2009. The Institute is an equal opportunity employer.

The fellowship is offered subject to the general Irish public service regulations and employment legislation (e.g. regarding maternity leave, holiday entitlements, etc.) and includes generous pension provision. Further details are available at http://www.dias.ie/lang/en/commun/vacancy_Astro.html#Software_Developers_MIRI

Lectureships/Senior Lectureships/Associate Professorships in Star Formation or Extra-solar Planets (University of Exeter, UK)

Applications are invited for up to two lectureships/associate professorships in a further expansion of the Astrophysics Group in the School of Physics at the University of Exeter. This Group currently comprises 8 permanent academic staff, with more than 20 post-doctoral researchers and PhD students. 95% of research from the School of Physics has been classified as being of international quality in the Research Assessment Exercise (RAE).

Our current research programme consists of both observational and theoretical studies of galactic star formation and extra-solar planets, and thus we seek applicants directly in these areas, or in a related field. We particularly encourage applications from candidates with ongoing active observational programmes at optical/ infrared and/or (sub-) millimetre wavelengths, with the goal of exploiting major future facilities including ALMA, JWST, and E-ELT.

The successful applicants will have full competitive access to facilities available to UK astronomers, including the VLT and Gemini, as well as high-performance computing resources at Exeter. The Group leads CONSTELLATION, the EC-funded Research Training Network of 12 European teams working on the origin of stellar masses, and is also involved in CoRoT and eSTAR.

Applicants will have a proven world-class research track record, an appropriate first degree and a PhD. They will be able to demonstrate an independent research programme, which will strengthen and complement the existing team at the University. Applicants will have a strong record in attracting research funding, or demonstrable potential to attract such funding as well as enthusiasm for delivering undergraduate programmes.

Appointments at a more senior level will be considered for applicants of appropriate experience, details of which are contained within our application pack.

Appointments will be made within the following salary range: Associate Professor £50,816 – £53,650 pa with access to further contribution points rising to £64,060; Senior Lecturer £38,757 – £44,930 pa with access to further contribution points rising to £52,086; Lecturer £31,513 – £35,469 pa with access to further contribution points rising to £38,757.

Informal enquiries may be made to Professor Matthew Bate (telephone: +44 (0)1392 725 513; email: mbate *at* astro.ex.ac.uk).

Application packs are available from http://www.exeter.ac.uk/working/prospective/vacancies/ or by contacting hradmin *at* exeter.ac.uk

Applications should quote reference E06. The closing date for completed applications is 12 noon on 1 June 2009.

The University of Exeter is an equal opportunity employer and promotes diversity in its workforce and, whilst all applicants will be judged on merit alone, is particularly keen to consider applications from groups currently underrepresented in the workforce.

Extrasolar Planets and Astrobiology

Caleb A. Scharf

This is a textbook that aims at bringing the new field of extrasolar planets into the classroom, in the context of astrobiology. The author is an astronomer, and so the emphasis is heavily on the astronomical aspects. The book will work well as a textbook for an advanced undergraduate course, and will provide the students with a broad overview of exoplanets as well as the necessary background material in many associated disciplines. Each chapter is completed with a list of suggested reading and a set of problems. The author also maintains a website (http://www.astro.columbia.edu/EXPA/EXPA/Extrasolar_planets_and_astrobiology.html) with continuously updated information on new major results related to the subjects of the book.

The following lists the chapters of the book:

6. Planetary Radiation, Comparative Planetology, Biosignatures, and Daisyworld
6.1 Introduction
6.2 The Reflectivity of a Planet: Albedo
6.3 The Thermal Characteristics of a Planet
6.4 Interpreting Reflected Light from Planets
6.5 Total Observed Flux
6.6 Comparative Planetology
6.7 The Impact of Life: Biosignatures
6.8 The Impact of Life: Feedback
6.9 Variations
6.10 Concluding Thoughts

7. Cosmochemistry, Dust, and Prebiotic Molecules
7.1 Introduction
7.2 Elements and Materials
7.3 The Origin of Dust
7.4 The Circumstellar Medium
7.5 Nucleation
7.6 Dust or Molecule? 7.7 Formation of Complex Molecules

8. Comets, Meteorites, and Protoplanetary Disk Structure
8.1 Introduction
8.2 Comets
8.3 Meteorites
8.4 Late-Time Impactors and early Earth Chemistry
8.5 Chemistry of the Protoplanetary Disk

9. Habitable Zones
9.1 Introduction
9.2 Water
9.3 The Classical Circumstellar Habitable Zone
9.4 Habitability through Time
9.5 Additional Factors
9.6 The Galactic Habitable Zone
9.7 The Universe and Beyond

10. Alternate Habitable Zones and Beyond
10.1 Introduction
10.2 Earth: But Not As We Know It
10.3 Moons
10.4 Elemental Constraints on Life
10.5 Speculations on the Origins of Life
10.6 Concluding Commentary and Cautions

University Science Books

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US$76.50

Available from:
http://www.uscibooks.com/

Astrochemistry Symposium at IUPAC 2009 Glasgow

The Astrochemistry Symposium will be held 2nd - 4th August 2009 as part of the 42nd IUPAC CONGRESS - Chemistry Solutions, 2-7 August 2009 at the SECC , Glasgow , Scotland , UK.

For further information please consult the web-site

www.iupac2009.org

where the scientific programme, registration, bursaries for students and young scientists, and accommodation details are now listed.

Early bird registration and POSTER abstracts must be submitted by June 5th 2009 - we welcome abstracts in areas of laboratory astrochemistry (gas phase, sample return analysis and solid state) theoretical chemistry and observational chemistry, and any aspect of chemistry research linked with astronomy.

We look forward to welcoming you to Glasgow in 2009 and putting Astrochemistry at the heart of Chemical Research in the 21st century.

Conference Plenary Speakers include Prof R Zare & Prof H Kroto

Keynote Speakers:

Eric Herbst, The Ohio State University, USA
Ewine van Dishoeck, Leiden University, The Netherlands
Bruce Kay, Pacific Northwest National Laboratory, USA
David Clary, University of Oxford, UK
Stephen Leone, University of California, Berkeley and Lawrence Berkeley National Laboratory, USA

Invited Speakers:

Ludovic Biennier, Universit de Rennes 1, France
Francois Dulieu, Universite de Cergy-Pontoise, France
Wolf Geppert, Stockholm University, Sweden
Liv Hornekaer, University of Aarhus, Denmark
Mike McCarthy, Harvard-Smithsonian Center for Astrophysics, USA
Helen Roberts, Queen's University Belfast, UK

CATALOGUE OF MOLECULAR HYDROGEN EMISSION-LINE OBJECTS (MHOs) IN OUTFLOWS FROM YOUNG STARS

We announce the availability of a general catalogue of Molecular Hydrogen Emission-Line objects (MHOs) in outflows from young stars. The catalogue is available on-line, at:

http://www.jach.hawaii.edu/UKIRT/MHCat/

It includes over 900 objects from some 170 papers spanning 30 years of infrared astronomy. Objects are grouped by region; tables for each region are available in html but also in a simple ascii format (for download and comparison with other data-sets). GIF images of each feature are also available, and a catalogue search tool is being developed.

Our aim is to publish the catalogue in its current form later this year, though also to maintain the on-line catalogue in future years, adding new objects as they are discovered.

Background:

For a number of years, astronomers have been imaging Herbig-Haro (HH) objects, jets and outflows in star forming regions in the near-infrared. The molecular hydrogen v=1-0S(1) line is a particularly powerful tracer of shock-excited features in molecular flows. Although excited in a similar way to HH objects, these molecular hydrogen emission-line objects are often too deeply embedded to be seen at optical wavelengths. They are thus not classified as HH objects, and are instead labelled in a rather hap-hazard way, often with the authors' initials. In large databases like Simbad this can lead to some ambiguity.

Our goal with this catalogue is therefore to develop a self-consistent list of Molecular Hydrogen emission-line Objects (MHOs). With guidance from the IAU Working Group on Designations we have adopted a scheme that simply lists objects sequentially, although objects are grouped by region. We use the acronym "MHO" throughout (and please note the space between the acronym and the number, e.g. MHO 1, MHO 99, etc.).

What Constitutes an MHO?

Only objects associated with outflows from young stars are included in the catalogue. We do not consider outflows from evolved stars (AGB stars or Proto-Planetary Nebulae) or extra-galactic sources. Also, objects should be spatially resolved; unresolved emission-line regions associated with an accretion disk or the base of an outflow (that were observed spectroscopically) are not listed.

MHOs should be identified in the near-infrared (1-2.5 micron) lines of molecular hydrogen. Objects detected only in other near-IR lines (e.g. [FeII]) are not included. At the present time we are also excluding objects observed only in the UV or mid-infrared.

For completeness, we have given a catalogue number to many well-known HH objects (e.g. HH 1/2 = MHO 120/125, HH 212 = MHO 499), though only if these are detected in the near-IR lines of H2. Whenever possible, we group features together in a manner consistent with the HH object catalogue.

Completeness and the Future

We have made every effort to include all known MHOs. However, there will undoubtedly be omissions and errors. We certainly welcome comments, suggestions and particularly additions from the community.

Our goal is simply to bring some order to what is a rather chaotic situation. We hope that in future researchers will use the MHO acronym when labelling new features (obviously using numbers that increment the existing catalogue - though please let us know before you do this!) and that, when helpful or convenient, the MHO designation be used for known flows.

For further details, please visit the catalogue website: http://www.jach.hawaii.edu/UKIRT/MHCat/

Also, to contribute to the catalogue or to report errors or omissions, please email: c.davis@jach.hawaii.edu

Regards,
Chris Davis
Joint Astronomy Centre, Hilo, Hawaii

Catalogue of Protostars Bulletin (V)

We have updated the list of confirmed and candidate Class0/1 sources and their published broad-band photometric measurements (http://astro.kent.ac.uk/protostars/), considering the literature of 2008.

The webpages have been re-designed (the old, non-updated pages are still available). All the data has been added into a MySQL database. Multiple objects listed under one name so far are now treated as seperate sources (e.g. SVS 13). Hence, in total 200 objects are now contained in the database.

The display pages for the indidual objects now contain 2MASS images, SIMBAD/ALADIN links, an adjustable SED plot, as well as an automatic link to the online SED fitter by Robitaille et al. (please read the documentation before using this feature).

In case

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 removed from the mailing list. Feel free to forward this email to anybody who might be interested.

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.

Dirk Froebrich

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

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

The Star Formation Newsletter is available on the World Wide Web at http://www.ifa.hawaii.edu/users/reipurth/newsletter.htm.