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Abstracts of recently accepted papers

Observational Constraints on Interstellar Grain Alignment

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We present new multicolor photopolarimetry of stars behind the Southern Coalsack. Analyzed together with multiband polarization data from the literature, probing the Chamaeleon I, Musca, Opiuchus, R CrA, and Taurus clouds, we show that the wavelength of maximum polarization (λ_{max}) is linearly correlated with the radiation environment of the grains. Using far-infrared emission data, we show that the large scatter seen in previous studies of λ_{max} as a function of A_V is primarily due to line-of-sight effects causing some A_V measurements to not be a good tracer of the extinction (radiation field strength) seen by the grains being probed. The derived slopes in λ_{max} versus A_V, for the individual clouds, are consistent with a common value, while the zero intercepts scale with the average values of the ratios of total to selective extinction (R_V) for the individual clouds. Within each cloud we do not find direct correlations between λ_{max} and R_V. The positive slope is consistent with recent developments in theory and indicating alignment driven by the radiation field. The present data cannot conclusively differentiate between direct radiative torques and alignment driven by H_2 formation. However, the small values of $\lambda_{max}(A_V = 0)$, seen in several clouds, suggest a role for the latter, at least at the cloud surfaces. The scatter in the λ_{max} versus A_V relation is found to be associated with the characteristics of the embedded YSOs in the clouds. We propose that this is partially due to locally increased plasma damping of the grain rotation caused by X-rays from the YSOs.

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Hubble Space Telescope Advanced Camera for Surveys Coronagraphic Observations of the Dust Surrounding HD 100546

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We present HST ACS coronagraphic observations of HD 100546, a B9.5 star, 103 pc away from the Sun, taken in the F435W, F606W, and F814W bands. Scattered light is detected up to 14″ from the star. The observations are consistent with the presence of an extended flattened nebula with the same inclination as the inner disk. The well-known "spiral arms" are clearly observed and trail the rotating disk material. Weaker arms never before reported are also seen. The interarm space becomes brighter, but the structures become more neutral in color at longer wavelengths, which is not consistent with models that assume that they are due to the effects of a warped disk. Along the major disk axis, the colors of the scattered light relative to the star are Δ (F435W - F606W) $\approx$ 0.0 - 0.2 mag and Δ (F435W

- F814W) ≈ 0.5 - 1 mag. To explain these colors, we explore the role of asymmetric scattering, reddening, and large minimum sizes on ISM-like grains. We conclude that each of these hypotheses by itself cannot explain the colors. The disk colors are similar to those derived for Kuiper Belt objects, suggesting that the same processes responsible for their colors may be at work here. We argue that we are observing only the geometrically thick, optically thin envelope of the disk, while the optically thick disk responsible for the far-IR emission is undetected. The observed spiral arms are then structures on this envelope. The colors indicate that the extended nebulosity is not a remnant of the infalling envelope but reprocessed disk material.

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H_2D^+ line emission in Proto-Planetary Disks

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Context. Previous studies have indicated that the 372.4 GHz ground transition of ortho-H_2D^+ might be a powerful probe of Proto-Planetary Disks. The line could be especially suited for study of the disk mid-plane, where the bulk of the mass resides and where planet formation takes place.

Aims. Provide detailed theoretical predictions for the line intensity, profile and maps expected for representative disk models.

Methods. We determine the physical and chemical structure of the disks from the model developed by Ceccarelli & Dominik (2005, A&A, 440, 583). The line emission is computed with the new radiative transfer method developed recently by Elitzur & Asensio Ramos (2006, MNRAS, 365, 779).

Results. We present intensity maps convolved with the expected ALMA resolution, which delineate the origin of the H_2D^+ 372.4 GHz line. In the disk inner regions, the line probes the conditions in the mid-plane out to radial distances of a few tens of AU, where Solar-like planetary systems might form. In the disk outermost regions, the line originates from slightly above the mid-plane. When the disk is spatially resolved, the variation of line profile across the image provides important information about the velocity field. Spectral profiles of the entire disk flux show a double peak shape at most inclination angles.

Conclusions. Our study confirms that the 372.4 GHz H_2D^+ line provides powerful diagnostics of the mid-plane of Proto-Planetary Disks. Current submillimeter telescopes are capable of observing this line, though with some difficulties. The future ALMA interferometer will have the sensitivity to observe and even spatially resolve the H_2D^+ line emission.

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The clumpy structure of the chemically active L1157 outflow

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We present high spatial resolution maps, obtained with the Plateau de Bure Interferometer, of the blue lobe of the L1157 outflow. We observed four lines at 3 mm, namely CH_3OH (2_K–1_K), HC_3N (11–10), HCN (1–0) and OCS (7–6). Moreover, the bright B1 clump has also been observed at better spatial resolution in CS (2–1), CH_3OH (2_1–1_1)A^-, and ^{34}SO (3_2–2_1). These high spatial resolution observations show a very rich structure in all the tracers, revealing a clumpy structure of the gas superimposed to an extended emission. In fact, the three clumps detected by previous IRAM-30m single dish observations have been resolved into several sub-clumps and new clumps have been detected in the outflow. The clumps are associated with the two cavities created by two shock episodes driven by the precessing jet. In particular, the clumps nearest the protostar are located at the wall of the younger cavity with a clear arch-shape form while the farthest clumps have slightly different observational characteristics indicating that they are associated to the older shock episode. The emission of the observed species peaks in different part of the lobe: the east clumps are brighter in HC_3N (11–10), HCN (1–0) and CS (2–1) while the west clumps are brighter in CH_3OH (2_K–1_K), OCS (7–6) and ^{34}SO (3_2–2_1). This peak displacement in the line emission suggests a variation of the physical conditions and/or the chemical composition along the lobe of the outflow at small scale, likely related to the shock activity and the precession of the outflow. In particular, we observe the decoupling of the silicon monoxide and methanol emission, common shock tracers, in the B1 clump located at the apex of the bow shock produced by the second shock episode.

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Millimeter dust continuum emission revealing the true mass of giant molecular clouds in the Small Magellanic Cloud

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Context. CO observations have been the best way so far to trace molecular gas in external galaxies, but in low metallicity environments the gas mass deduced could be largely underestimated due to enhanced photodissociation of the CO molecule. Large envelopes of H_2 could therefore be missed by CO observations.

Aims. At present, the kinematic information of CO data cubes are used to estimate virial masses and trace the total mass of the molecular clouds. Millimeter dust emission can also be used as a dense gas tracer and could unveil H_2 envelopes lacking CO. These different tracers must be compared in different environments.

Methods. This study compares virial masses to masses deduced from millimeter emission, in two GMC samples: the local molecular clouds in our Galaxy ($10^4 - 10^5$ $M_\odot$), and their equivalents in the Small Magellanic Cloud (SMC), one of the nearest low metallicity dwarf galaxies.

Results. In our Galaxy, mass estimates deduced from millimeter (FIRAS) emission are consistent with masses deduced from gamma ray analysis and therefore trace the total mass of the clouds. Virial masses are systematically larger (twice on average) than mass estimates from millimeter dust emission. This difference decreases toward high masses and has been reported in previous studies. This is not the case for SMC giant molecular clouds: molecular cloud masses deduced from SIMBA millimeter observations are systematically higher (twice on average for conservative values of the dust to gas ratio and dust emissivity) than the virial masses from SEST CO observations. The observed excess cannot be accounted for by any plausible change of dust properties. Taking a general form for the virial theorem, we show that a magnetic field strength of $\sim$15 μG in SMC clouds could provide additional support for the clouds and explain the difference observed.

Conclusions. We conclude that masses of SMC molecular clouds have so far been underestimated. Magnetic pressure may contribute significantly to their support.

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Cold Disks: Spitzer Spectroscopy of Disks around Young Stars with Large Gaps

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We have identified four circumstellar disks with a deficit of dust emission from their inner 1550 AU. All four stars have FG spectral type and were uncovered as part of the Spitzer Space Telescope "Cores to Disks" Legacy Program Infrared Spectrograph (IRS) first-look survey of $\sim$ 100 premain-sequence stars. Modeling of the spectral energy distributions indicates a reduction in dust density by factors of 100 - 1000 from disk radii between $\sim$0.4 and 1550 AU but with massive gas-rich disks at larger radii. This large contrast between the inner and outer disk has led us to use the term "cold disks" to distinguish these unusual systems. However, hot dust [(0.02 - 0.2)M_{moon}] is still present close to the central star (R $\leq$ 0.8 AU). We introduce the 30 μm/13 μm flux density ratio as a new diagnostic for identifying cold disks. The mechanisms for dust clearing over such large gaps are discussed. Although rare, cold disks are likely in transition from an optically thick to an optically thin state and so offer excellent laboratories for the study of planet formation.

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The substellar mass function in σ Orionis II. Optical, near-infrared and IRAC/Spitzer photometry of young cluster brown dwarfs and planetary-mass objects

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Aims. We investigate the mass function in the substellar domain down to a few Jupiter masses in the young σ Orionis open cluster (3$\pm$2 Ma, d = 360^{+70}_{-60} pc).

Methods. We have performed a deep IJ-band search, covering an area of 790 arcmin^2 close to the cluster centre. This survey was complemented with an infrared follow-up in the HK_s- and Spitzer 3.6-8.0 μm-bands. Using colour-magnitude diagrams, we have selected 49 candidate cluster members in the magnitude interval 16.1 mag < I < 23.0 mag.

Results. Accounting for flux excesses at 8.0 μm and previously known spectral features of youth, we identify 30 objects as bona fide cluster members. Four are first identified from our optical-near infrared data. Eleven have most probable masses below the deuterium burning limit which we therefore classify as candidate planetary-mass objects. The slope of the substellar mass spectrum ($\Delta N/\Delta M \approx aM^{-\alpha}$) in the mass interval 0.11 $M_\odot$ < M < 0.006$M_\odot$ is $\alpha = +0.6 \pm 0.2$. Any mass limit to formation via opacity-limited fragmentation must lie below 0.006 $M_\odot$. The frequency of σ

Orionis brown dwarfs with circumsubstellar discs is 47±9 %.

Conclusions. The continuity in the mass function and in the frequency of discs suggests that very low-mass stars and substellar objects, even below the deuterium-burning mass limit, share the same formation mechanism.

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OVRO N_2H^+ Observations of Class 0 Protostars: Constraints on the Formation of Binary Stars

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We present the results of an interferometric study of the N_2H^+ (1–0) emission from nine nearby, isolated, low-mass protostellar cores, using the OVRO millimeter array. The main goal of this study is the kinematic characterization of the cores in terms of rotation, turbulence, and fragmentation. Eight of the nine objects have compact N_2H^+ cores with FWHM radii of $1200 - 3500$ AU, spatially coinciding with the thermal dust continuum emission. The only more evolved (Class I) object in the sample (CB 188) shows only faint and extended N_2H^+ emission. The mean N_2H^+ line width was found to be $0.37\,\mathrm{km\ s^{-1}}$. Estimated virial masses range from 0.3 to $1.2\,M_\odot$. We find that thermal and turbulent energy support are about equally important in these cores, while rotational support is negligible. The measured velocity gradients across the cores range from 6 to $24\,\mathrm{km\,s^{-1}\,pc^{-1}}$. Assuming these gradients are produced by bulk rotation, we find that the specific angular momenta of the observed Class 0 protostellar cores are intermediate between those of dense (prestellar) molecular cloud cores and the orbital angular momenta of wide PMS binary systems. There appears to be no evolution (decrease) of angular momentum from the smallest prestellar cores via protostellar cores to wide PMS binary systems. In the context that most protostellar cores are assumed to fragment and form binary stars, this means that most of the angular momentum contained in the collapse region is transformed into orbital angular momentum of the resulting stellar binary systems.

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Ammonia Imaging of the Disks in the NGC 1333 IRAS 4A Protobinary System

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The NGC 1333 IRAS 4A protobinary was observed in the ammonia (2, 2) and (3, 3) lines and in the 1.3 cm continuum with a high resolution (about 1.0 arcsec). The ammonia maps show two compact sources, one for each protostar, and they are probably protostellar accretion disks. The disk associated with IRAS 4A2 is seen nearly edge-on and shows an indication of rotation. The A2 disk is brighter in the ammonia lines but dimmer in the dust continuum than its sibling disk, with the ammonia-to-dust flux ratios different by about an order of magnitude. This difference suggests that the twin disks have surprisingly dissimilar characters, one gas-rich and the other dusty. The A2 disk may be unusually active or hot, as indicated by its association with water vapor masers. The existence of two very dissimilar disks in a binary system suggests that the formation process of multiple systems has a controlling agent lacking in the isolated star formation process and that stars belonging to a multiple system do not necessarily evolve in phase with each other.

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New Photometry and Spectra of AB Doradus C: An Accurate Mass Determination of a Young Low-Mass Object with Theoretical Evolutionary Tracks

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We present new photometric and spectroscopic measurements for the unique, young, low-mass evolutionary track calibrator AB Dor C. While the new K_s photometry is similar to that we have previously published, the spectral type is found to be much earlier. Based on new H and K IFS spectra of AB Dor C from Thatte et al. (Paper I), we adopt a spectral type of M5.5 ± 1.0 for AB Dor C. This is considerably earlier than the M8 ± 1 previously estimated by Close et al. and Nielsen et al. yet is consistent with the M6 ± 1 independently derived by Luhman & Potter. However, the spectrum presented in Paper I and analyzed here is a significant improvement over any previous spectrum of AB Dor C. We also present new astrometry for the system, which further supports a 0.090 ± 0.005 $M_\odot$ mass for the system. Once armed with an accurate spectrum and K_s flux, we find L = 0.0021 ± 0.0005 $L_\odot$ and T_{eff} = 2925 K for AB Dor C. These values are consistent with a ∼ 75 Myr, 0.090 ± 0.005 $M_\odot$ object like AB Dor C according to the DUSTY evolutionary tracks. Hence, masses can be estimated from the H-R diagram with the DUSTY tracks for young low-mass objects such as AB Dor C. However, we cautiously note that underestimates of the mass from the tracks can occur if one lacks a proper (continuum-preserved) spectrum or is relying on near-infrared fluxes alone.

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Aromatic emission from the ionised mane of the Horsehead nebula

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Context. This work is conducted as part of the "SPECPDR" program dedicated to the study of very small particles and chemistry in photo-dissociation regions with the Spitzer Space Telescope (SST).

Aims. We study the evolution of the Aromatic Infrared Bands (AIBs) emitters across the illuminated edge of the Horsehead nebula and especially their survival and properties in the HII region.

Methods. We present spectral mapping observations taken with the Infrared Spectrograph (IRS) at wavelengths 5.2-38 μm. The spectra have a resolving power of $\lambda/\Delta\lambda$ = 64-128 and show the main aromatic bands, H_2 rotational lines, ionised gas lines and continuum. The maps have an angular resolution of 3.6-10.6″ and allow us to study the nebula, from the HII diffuse region in front of the nebula to the inner dense region.

Results. A strong AIB at 11.3 μm is detected in the HII region, relative to the other AIBs at 6.2, 7.7 and 8.6 μm, and up to an angular separation of ∼ 20″ (or 0.04 pc) from the ionisation front. The intensity of this band appears to be correlated with the intensity of the [NeII] at 12.8 μm and of Hα, which shows that the emitters of the 11.3 μm band are located in the ionised gas. The survival of AIB emitters in the HII region could be due to the moderate intensity of the radiation field ($G_0 \sim 100$) and the lack of photons with energy above ∼25 eV. The enhancement of the intensity of the 11.3 μm band in the HII region, relative to the other AIBs can be explained by the presence of neutral PAHs.

Conclusions. Our observations highlight a transition region between ionised and neutral PAHs observed with ideal conditions in our Galaxy. A scenario where PAHs can survive in HII regions and be significantly neutral could explain the detection of a prominent 11.3 μm band in other Spitzer observations.

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H_2 Velocity Structure in the Molecular Outflow DR 21

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We describe the velocity structure of the molecular outflow DR 21 in the 2.12 μm line of H_2. Velocity cubes were obtained of the entire outflow emission using a scanning IR Fabry-Pérot interferometer with a spectral resolution of 24 km s^{-1}. H_2 emission was detected from both the DR 21 (E) and DR 21 (W) lobes in a velocity interval (-80.82, +46.84) km s^{-1}. The most conspicuous sources found include a jet-like region and a possible counter-jet or an independent jet, an elliptical cavity and four bow-like structures. The velocity data cube was used to calculate the four velocity moment images of the outflow to study the moments along the outflow axis. Turbulence in the outflow is studied via a clump find analysis. Relations between clump parameters and kinematics allowed us to derive power-law relations in agreement with Larson's laws.

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http://www.astroscu.unam.mx/∼irene/pretiros/

A Comprehensive View of Circumstellar Disks in Chamaeleon I: Infrared Excess, Accretion Signatures and Binarity

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We present a comprehensive study of disks around 81 young low-mass stars and brown dwarfs in the nearby ∼2 Myr-old Chamaeleon I star-forming region. We use mid-infrared photometry from the *Spitzer Space Telescope*, supplemented by findings from ground-based high-resolution optical spectroscopy and adaptive optics imaging. We derive disk fractions of 52%±6% and 58^{+6}_{-7}% based on 8 μm and 24 μm colour excesses, respectively, consistent with those reported for other clusters of similar age. Within the uncertainties, the disk frequency in our sample of K3–M8 objects in Cha I does not depend on stellar mass. Diskless and disk-bearing objects have similar spatial distributions. There are no obvious transition disks in our sample, implying a rapid timescale for the inner disk clearing process; however, we find two objects with weak excess at 3–8 μm and substantial excess at 24 μm, which may indicate grain growth and dust settling in the inner disk. For a sub-sample of 35 objects with high-resolution spectra, we investigate the connection between accretion signatures and dusty disks: in the vast majority of cases (29/35) the two are well correlated, suggesting that, on average, the timescale for gas dissipation is similar to that for clearing the inner dust disk. The exceptions are six objects for which dust disks appear to persist even though accretion has ceased or dropped below measurable levels. Adaptive optics images of 65 of our targets reveal that 17 have companions at (projected) separations of 10–80 AU. Of the five $\lesssim$ 20 AU binaries, four lack infrared excess, possibly indicating that a close companion leads to faster disk dispersal. The closest binary with excess is separated by ∼ 20 AU, which sets an upper limit of ∼ 8 AU for the outer disk radius. The overall disk frequency among stars with companions (35^{+15}_{-13}%) is lower than (but still statistically consistent with) the value for the total sample.

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Near-Infrared Interferometric, Spectroscopic, and Photometric Monitoring of T Tauri Inner Disks

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We present high angular resolution observations with the Keck Interferometer, high dispersion spectroscopic observations with Keck/NIRSPEC, and near-IR photometric observations from PAIRITEL of a sample of 11 solar-type T Tauri stars in 9 systems. We use these observations to probe the circumstellar material within 1 AU of these young stars, measuring the circumstellar-to-stellar flux ratios and angular size scales of the 2.2 micron emission. Our sample spans a range of stellar luminosities and mass accretion rates, allowing investigation of potential correlations between inner disk properties and stellar or accretion properties. We suggest that the mechanism by which the dusty inner disk is truncated may depend on the accretion rate of the source; in objects with low accretion rates, the stellar magnetospheres may truncate the disks, while sublimation may truncate dusty disks around sources with higher accretion rates. We have also included in our sample objects that are known to be highly variable (based on previous photometric and spectroscopic observations), and for several sources, we obtained multiple epochs of spectroscopic and interferometric data, supplemented by near-IR photometric monitoring, to search for inner disk variability. While time-variable veilings and accretion rates are observed in some sources, no strong evidence for inner disk pulsation is found.

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HD 98800: A 10 Myr Old Transition Disk

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We present the mid-infrared spectrum, obtained with the Spitzer Infrared Spectrograph (IRS), of HD 98800, a quadruple star system located in the 10 Myr old TW Hydrae association. It has a known mid-infrared excess that arises from a circumbinary disk around the B components of the system. The IRS spectrum confirms that the disk around HD 98800B displays no excess emission below about 5.5 μm, implying an optically thick disk wall at 5.9 AU and an inner, cleared-out region; however, some optically thin dust, consisting mainly of 3 μmsized silicate dust grains, orbits the binary in a ring between 1.5 and 2 AU. The peculiar structure and apparent lack of gas in the HD 98800B disk suggests that this system is likely already at the debris disks stage, with a tidally truncated circumbinary disk of larger dust particles and an inner, second-generation dust ring, possibly held up by the resonances of a planet. The unusually large infrared excess can be explained by gravitational perturbations of the Aa+Ab pair puffing up the outer dust ring and causing frequent collisions among the larger particles.

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Statistics of Core Lifetimes in Numerical Simulations of Turbulent, Magnetically Supercritical Molecular Clouds

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We present measurements of the mean dense core lifetimes in numerical simulations of magnetically supercritical, turbulent, isothermal molecular clouds (MCs), in order to compare with observational determinations. The mean "prestellar" lifetimes are given as a function of the mean density within the cores, which in turn is determined by the density threshold $n_{\rm thr}$ used to define them. The mean lifetimes are consistent with observationally reported values, ranging from a few to several free-fall times. We also present estimates of the fraction of cores in the "prestellar", "stellar", and "failed" stages as a function of $n_{\rm thr}$. Failed cores are defined as those that do not manage to collapse, but rather re-disperse back into the environment. Due to resolution limitations, the number ratios are measured indirectly in the simulations, as either lifetime ratios (for the prestellar cores), or as time-weighted mass ratios (for the failed cores). Our approach contains one free parameter, the lifetime of a protostellar object $\tau_{\rm yso}$ (Class 0 + Class I stages), which is outside the realm of the simulations. Assuming a value $\tau_{\rm yso} = 0.46$ Myr, we obtain number ratios of starless to stellar cores ranging from 4–5 at $n_{\rm thr} = 1.5 \times 10^4$ cm^{-3} to ~ 1 at $n_{\rm thr} = 1.2 \times 10^5$ cm^{-3}, again in good agreement with observational determinations. We also find that the failed cores are generally difficult to detect, although the mass in these cores is comparable to that in stellar cores at $n_{\rm thr} = 1.5 \times 10^4$ cm^{-3}. At $n_{\rm thr} = 1.2 \times 10^5$ cm^{-3} the mass in failed cores is negligible, in agreement with recent observational suggestions that at the latter densities the cores are in general gravitationally dominated. We conclude by noting that the timescale for core contraction and collapse is virtually the same in the subcritical, ambipolar diffusion-mediated model of star formation, in the model of star formation in turbulent supercritical clouds, and in a model intermediate between the previous two, suggesting a convergence of the models at least at the level of the core lifetimes, for currently accepted values of the clouds' magnetic criticality.

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Discovery of the Pre-Main-Sequence Population of the Stellar Association LH 95 in the Large Magellanic Cloud with Hubble Space Telescope Advanced Camera for Surveys Observations

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We report the discovery of an extraordinary number of pre-main-sequence (PMS) stars in the vicinity of the stellar association LH 95 in the Large Magellanic Cloud (LMC). Using the Advanced Camera for Surveys on board the Hubble Space Telescope in wide-field mode, we obtained deep high-resolution imaging of the main body of the association and of a nearby representative LMC background field. These observations allowed us to construct the color-magnitude diagram (CMD) of the association in unprecedented detail and to decontaminate the CMD for the average LMC stellar population. The most significant result is the direct detection of a substantial population of PMS stars and their clustering properties with respect to the distribution of the higher mass members of the association. Although LH 95 represents a rather modest star-forming region, our photometry, with a detection limit of V $\lesssim$ 28 mag, reveals in its vicinity more than 2500 PMS stars with masses down to $\sim$0.3 M$_\odot$. Thus, our observations offer a new perspective on a typical LMC association: the stellar content of LH 95 is found to extend from bright OB stars to faint red

PMS stars, suggesting a fully populated initial mass function from the massive blue giants down to the subsolar mass regime.

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The oxygen isotopic composition of the Sun as a test of the supernova origin of ^{26}Al and ^{41}Ca

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Short-lived radionuclides were present in the solar protoplanetary disk in abundances much higher than in the ambient interstellar medium and require a last minute origin. Aluminium-26 ($T_{1/2}$ = 0.73 Myr) and calcium-41 ($T_{1/2}$ = 0.1 Myr) abundances in the protoplanetary disk constrain models for the origin of short-lived radionuclides because they share a common origin. It is usually assumed that these isotopes were injected into the disk from a nearby type-II supernova. Here we show that the oxygen isotopic composition of the protoplanetary disk would have shifted by several percent relative to the Sun as a result of such injection. Therefore, the supernova injection model will be tested by the anticipated measurement of the solar wind oxygen isotopic composition from the Genesis sample return mission.

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The Disk and Environment of a Young Vega Analog: HD 169142

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We trace the disk of HD 169142 (A8 Ve) from 0.57″ to 1.4″ (≈ 80200 AU projected distance) in 1.1 μm scattered light with HST NICMOS coronagraphy. The azimuthally symmetric disk has a peak azimuthally medianed surface brightness (SB) of ≈ 5 mJy arcsec^{-2} at 0.57″ from the star, and drops $\propto r^{-3}$. This radial SB profile is consistent with the presence of spatially resolved PAH emission and a Meeus group I IR SED only if the inner disk is either substantially flatter than the outer disk or partially devoid of material. Analysis of new HST ACS FUV imagery in tandem with archival IUE data indicates $\dot{M}_{acc} \leq 10^{-9}$ M$_\odot$ yr^{-1}. We estimate the age of HD 169142 to be 6^{+6}_{-3} Myr by identifying 2MASS 18242929-2946559, located 9.3″ to the southwest, as a 130 mas separation weak-line T Tauri binary that is comoving with HD 169142 at the 4 σ confidence level. We find no evidence for any additional stellar companion

in either the ACS or Chandra ACIS-S data at r $\leq 1''$. HD 169142 has previously been interpreted as a slowly rotating, chemically peculiar star. However, by combining the disk inclination and v sin i from the literature, we find that the star has $v_{equatorial} \approx 240$ km s^{-1}, making it a rapid rotator, similar to Altair or Vega. The UV data for HD 169142 are consistent with gravity darkening, while the X-ray luminosity and spectrum resembles early F stars at the age of the β Pictoris moving group, rather than mid-A stars. In this context, spectral features previously interpreted as evidence for chemical peculiarity are more likely to reflect the presence of a strong photospheric latitudinal temperature gradient. With such a gradient, HD 169142 should closely resemble Vega at the epoch of central disk clearing.

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High Spatial Resolution Observations of Two Young Protostars in the R Corona Australis Region

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We present multi-wavelength, high spatial resolution imaging of the IRS 7 region in the R Corona Australis molecular cloud. Our observations include 1.1 mm continuum and HCO$^+$ J = 3 $\rightarrow$ 2 images from the SMA, ^{12}CO J = 3 $\rightarrow$ 2 outflow maps from the DesertStar heterodyne array receiver on the HHT, 450 μm and 850 μm continuum images from SCUBA, and archival Spitzer IRAC and MIPS 24 μm images. The accurate astrometry of the IRAC images allow us to identify IRS 7 with the cm source VLA 10W (IRS 7A) and the X-ray source X_W. The SMA 1.1 mm image reveals two compact continuum sources which are also distinguishable at 450 μm. SMA 1 coincides with X-ray source CXOU J190156.4-365728 and VLA cm source 10E (IRS 7B) and is seen in the IRAC and MIPS images. SMA 2 has no infrared counterpart but coincides with cm source VLA 9. Spectral energy distributions constructed from SMA, SCUBA and Spitzer data yield bolometric temperatures of 83 K for SMA 1 and $\leq$70 K for SMA 2. These temperatures along with the submillimeter to total luminosity ratios indicate that SMA 2 is a Class 0 protostar, while SMA 1 is a Class 0/Class I transitional object (L=17 $\pm$ 6 L$_\odot$). The ^{12}CO J = 3 $\rightarrow$ 2 outflow map shows one major and possibly several smaller outflows centered on the IRS 7 region, with masses and energetics consistent with previous work. We identify the Class 0 source SMA 2/VLA 9 as the main driver of this outflow. The complex and clumpy spatial and velocity distribution of the HCO$^+$ J = 3 $\rightarrow$ 2 emission is not consistent with either bulk rotation, or any known molecular outflow activity.

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Near-Infrared Coronagraphic Observations of the T Tauri Binary System UY Aur

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We present a near-infrared image of UY Aur, a 0.9$''$ separated binary system, using the Coronagraphic Imager with Adaptive Optics on the Subaru Telescope. Thanks to adaptive optics, the spatial resolution of our image was $\sim 0.1''$ in the full width at half-maximum of the point-spread function, the highest achieved. By comparison with previous

measurements, we estimated that the orbital period is $\sim 1640 \pm 90$ yr and the total mass of the binary is $\sim 1.73 \pm 0.29$ $M_\odot$. The observed H-band magnitude of the secondary varies by as much as 1.3 mag within a decade, while that of the primary is rather stable. This inconstancy may arise from photospheric variability caused by an uneven accretion rate or from the rotation of the secondary. We detected a half-ring-shaped circumbinary disk around the binary with a bright southwestern part but a barely detectable northeastern portion. The brightness ratio is $\gtrsim 57 \pm 5$. Its inner radius and inclination are about 520 AU and $42° \pm 3°$, respectively. The disk is not uniform but has remarkable features, including a clumpy structure along the disk, circumstellar material inside the inner cavity, and an extended armlike structure. The circumstellar material inside the cavity probably corresponds to a clump or material accreting from the disk onto the binary. The armlike structure is part of the disk, created by accretion from the outer region of the disk or encounters with other stellar systems.

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Molecular hydrogen emission from discs in the η Chamaeleontis cluster

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Discs in the 6 Myr old cluster η Chamaeleontis were searched for emission from hot H_2. Around the M3 star ECHA J0843.37905, we detect circumstellar gas orbiting at $\sim$2 au. If the gas is ultraviolet excited, the ro-vibrational line traces a hot gas layer supported by a disc of mass $\sim$0.03 $M_\odot$, similar to the minimum mass solar nebula. Such a gas reservoir at 6 Myr would promote the formation and the inwards migration of gas giant planets.

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Cluster Formation in Contracting Molecular Clouds

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We explore, through a simplified, semi-analytic model, the formation of dense clusters containing massive stars. The parent cloud spawning the cluster is represented as an isothermal sphere. This sphere is in near force balance between self-gravity and turbulent pressure. Self-gravity, mediated by turbulent dissipation, drives slow contraction of the cloud, eventually leading to a sharp central spike in density and the onset of dynamical instability. We suggest that, in a real cloud, this transition marks the late and rapid production of massive stars.

We also offer an empirical prescription, akin to the Schmidt law, for low-mass star formation in our contracting cloud. Applying this prescription to the Orion Nebula Cluster, we are able to reproduce the accelerating star formation previously inferred from the distribution of member stars in the HR diagram. The cloud turns about 10 percent of its mass into low-mass stars before becoming dynamically unstable. Over a cloud free-fall time, this figure drops to 1 percent, consistent with the overall star formation efficiency of molecular clouds in the Galaxy.

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16-20 $M_{\rm Jup}$ RV companion orbiting the brown dwarf candidate Cha Hα8

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We report the discovery of a 16–20 $M_{\rm Jup}$ radial velocity companion around the very young ($\sim$3 Myr) brown dwarf candidate Cha Hα 8 (M5.75–M6.5). Based on high-resolution echelle spectra of Cha Hα 8 taken between 2000 and

2007 with UVES at the VLT, a companion was detected through RV variability with a semi-amplitude of $1.6\,\mathrm{km\,s^{-1}}$. A Kepler fit to the data yields an orbital period of the companion of 1590 days and an eccentricity of e=0.49. A companion minimum mass $M_2 \sin i$ between 16 and $20\,M_{\mathrm{Jup}}$ is derived when using model-dependent mass estimates for the primary. The mass ratio $q \equiv M_2/M_1$ might be as small as 0.2 and, with a probability of 87%, it is less than 0.4. Cha Hα 8 harbors most certainly the lowest mass companion detected so far in a close ($\sim 1\,$AU) orbit around a brown dwarf or very low-mass star. From the uncertainty in the orbit solution, it cannot completely be ruled out that the companion has a mass in the planetary regime. Its discovery is in any case an important step towards RV planet detections around BDs. Further, Cha Hα 8 is the fourth known spectroscopic brown dwarf or very low-mass binary system with an RV orbit solution and the second known very young one.

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A Radial Velocity Survey of the Cyg OB2 Association

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We conducted a radial velocity survey of the Cyg OB2 association over a 6 yr (19992005) time interval to search for massive close binaries. During this time we obtained 1139 spectra on 146 OB stars to measure mean systemic radial velocities and radial velocity variations. We spectroscopically identify 73 new OB stars for the first time, the majority of which are likely to be association members. Spectroscopic evidence is also presented for a B3 Iae classification and temperature class variation (B3B8) on the order of 1 yr for Cyg OB2 No. 12. Calculations of the initial mass function with the current spectroscopic sample yield $\Gamma = -2.2 \pm 0.1$. Of the 120 stars with the most reliable data, 36 are probable and 9 are possible single-lined spectroscopic binaries. We also identify three new and eight candidate double-lined spectroscopic binaries. These data imply a lower limit on the massive binary fraction of 30% - 42%. The calculated velocity dispersion for Cyg OB2 is 2.44 ± 0.07 km s^{-1}, which is typical of open clusters. No runaway OB stars were found.

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USco J1606-1935: An Unusually Wide Low-Mass Triple System?

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We present photometric, astrometric, and spectroscopic observations of USco J160611.9-193532 AB, a candidate ultrawide (∼1600 AU), low-mass ($M_{tot} \sim 0.4\ M_\odot$) multiple system in the nearby OB association Upper Scorpius. We conclude that both components are young, comoving members of the association; we also present high-resolution observations that show that the primary is itself a close binary system. If the Aab and B components are gravitationally bound, the system would fall into the small class of young multiple systems that have unusually wide separations as compared to field systems of similar mass. However, we demonstrate that physical association cannot be assumed purely on probabilistic grounds for any individual candidate system in this separation range. Analysis of the association's two-point correlation function shows that there is a significant probability (25%) that at least one pair of low-mass association members will be separated in projection by $\lesssim 15''$, so analysis of the wide binary population in Upper Sco will require a systematic search for all wide systems; the detection of another such pair would represent an excess at the 98% confidence level.

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Large-scale variability in the profiles of Hα and Hβ in the spectrum of the Herbig B8e star MWC 419 and a model interpretation of it

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Spectroscopic data taken with a moderate resolution spectrograph in the region of the Hα and Hβ lines are presented for the Herbig B8e star MWC 419. The spectroscopic observations were accompanied by broad band BVR photometric measurements. The observations reveal a variability in the line profiles that is typical of Herbig Ae/Be stars with signs of a strong stellar wind. The greatest changes are observed in the region of the absorption components of the line profiles, which convert the profile from a type P CygII to P CygIII, as well as in the intensities of the central emission components. A model technique is used for quantitative interpretation of this variability and it shows that the P Cyg profile conversion of the absorption component can be explained in terms of a stellar wind model in which its distribution over latitude varies on a time scale of a few days.

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PAH Strength and the Interstellar Radiation Field around the Massive Young Cluster NGC 3603

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We present spatial distribution of polycyclic aromatic hydrocarbons (PAHs) and ionized gas within the Galactic giant H II region NGC 3603. Using the IRS instrument on board the Spitzer Space Telescope, we study in particular the PAH emission features at $\sim$ 5.7, 6.2, 7.7, 8.6, and 11.3 μm, and the [Ar II] 6.99 μm, [Ne II] 12.81 μm, [Ar III] 8.99 μm, and [S IV] 10.51 μm forbidden emission lines. The observations probe both ionized regions and photodissociation regions. Silicate emission is detected close to the central cluster while silicate absorption is seen further away. We find no significant variation of the PAH ionization fraction across the whole region. The emission of very small grains (VSGs) lies closer to the central stellar cluster than emission of PAHs. The PAH/VSG ratio anticorrelates with the hardness of the interstellar radiation field suggesting a destruction mechanism of the molecules within the ionized gas, as shown for low-metallicity galaxies by Madden et al.

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Submillimeter arcsecond-resolution mapping of the highly collimated protostellar jet HH 211

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We have mapped the protostellar jet HH 211 in 342 GHz continuum, SiO ($J = 8 - 7$), and CO ($J = 3 - 2$) emission at $\sim 1''$ resolution with the Submillimeter Array (SMA). Thermal dust emission is seen in continuum at the center of the jet, tracing an envelope and a possible optically thick compact disk (with a size < 130 AU) around the protostar. A knotty jet is seen in CO and SiO as in H_2, but extending closer to the protostar. It consists of a chain of knots on each side of the protostar, with an interknot spacing of $\sim 2''-3''$ or 600$-$900 AU and the innermost pair of knots

at only $\sim 1\farcs7$ or 535 AU from the protostar. These knots likely trace unresolved internal (bow) shocks (i.e., working surfaces) in the jet, with a velocity range up to ~ 25 km s^{-1}. The two-sided mass-loss rate of the jet is estimated to be $\sim (0.7-2.8)\times10^{-6}\ M_\odot$ yr^{-1}. The jet is episodic, precessing, and bending. A velocity gradient is seen consistently across two bright SiO knots (BK3 and RK2) perpendicular to the jet axis, with $\sim 1.5\pm0.8$ km s^{-1} at $\sim 30\pm15$ AU, suggesting a presence of a jet rotation. The launching radius of the jet, derived from the potential jet rotation, is $\sim 0.15-0.06$ AU in the inner disk.

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VLBA determination of the distance to nearby star-forming regions I. The distance to T Tauri with 0.4% accuracy

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In this article, we present the results of a series of twelve 3.6-cm radio continuum observations of T Tau Sb, one of the companions of the famous young stellar object T Tauri. The data were collected roughly every two months between September 2003 and July 2005 with the Very Long Baseline Array (VLBA). Thanks to the remarkably accurate astrometry delivered by the VLBA, the absolute position of T Tau Sb could be measured with a precision typically better than about 100 micro-arcseconds at each of the twelve observed epochs. The trajectory of T Tau Sb on the plane of the sky could, therefore, be traced very precisely, and modeled as the superposition of the trigonometric parallax of the source and an accelerated proper motion. The best fit yields a distance to T Tau Sb of 147.6 ± 0.6 pc. The observed positions of T Tau Sb are in good agreement with recent infrared measurements, but seem to favor a somewhat longer orbital period than that recently reported by Duchêne et al. (2006) for the T Tau Sa/T Tau Sb system.

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New radio sources and the composite structure of component B in the very young protostellar system IRAS 16293–2422

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In this article, we report high-resolution ($\sim 0\farcs1$–$0\farcs3$), high-sensitivity ($\sim$ 50–100 μJy beam^{-1}) Very Large Array 0.7 and 1.3 cm observations of the young stellar system IRAS 16293–2422 in $\rho-$Ophiuchus. In the 0.7 cm image, component A to the south-east of the system looks like its usual binary self. In the new 1.3 cm image, however, component A2 appears to have split into two sub-components located roughly symmetrically around the original position of A2. This change of morphology is likely the result of a recent bipolar ejection, one of the very first such events observed in a low-mass source. Also in component A, a marginal detection of 0.7 cm emission associated with the submillimeter component Ab is reported. If confirmed, this detection would imply that Ab is a relatively

extended dusty structure, where grain coagulation may already have taken place. With an angular size increasing with frequency, and an overall spectra index of 2, the emission from component B to the north-west of the system is confirmed to be dominated by optically thick thermal dust emission associated with a fairly massive, nearly face-on, circumstellar disk. In the central region, however, we find evidence for a modest free-free contribution that originates in a structure elongated roughly in the east-west direction. We argue that this free-free component traces the base of the jet driving the large-scale bipolar flow at a position angle of about 110° that has long been known to be powered by IRAS 16293–2422.

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AST/RO ^{13}CO(J = 2 - 1) and ^{12}CO(J = 4 - 3) Mapping of Southern Spitzer c2d Small Clouds and Cores

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Forty molecular cloud cores in the southern hemisphere from the initial Spitzer Space Telescope Cores-to-Disks (c2d) Legacy program source list have been surveyed in ^{13}CO(2 - 1), ^{12}CO(4 - 3), and ^{12}CO(7 - 6) with the Antarctic Submillimeter Telescope and Remote Observatory (AST/RO). The cores, 10 of which contain embedded sources, are located mostly in the Vela, Ophiuchus, Lupus, Chamaeleon, Musca, and Scorpius complexes. ^{12}CO(7 - 6) emission was undetected in all 40 clouds. We present data of 40 sources in ^{13}CO(2 - 1) and ^{12}CO(4 - 3), significant upper limits of ^{12}CO(7 - 6), as well as a statistical analysis of the observed properties of the clouds. We find the typical ^{13}CO(2 - 1) line width to be 2.0 km s^{-1} for cores with embedded stars and 1.8 km s^{-1} for all others. The typical ^{12}CO(4 - 3) line width is 2.6 - 3.7 km s^{-1} for cores with known embedded sources, and 1.6 - 2.3 km s^{-1} for all others. The average ^{13}CO column density derived from the line intensities was found to be 1.9×10^{15} cm^{-2} for cores with embedded stars and 1.5×10^{15} cm^{-2} for all others. The average kinetic temperature in the molecular cores, determined through a large velocity gradient analysis of a set of nine cores, has an average lower limit of 16 K and an average upper limit of 26 K. The average molecular hydrogen density has an average lower limit of $10^{2.9}$ cm^{-3} and an average upper limit of $10^{3.3}$ cm^{-3} for all cores. For a different subset of nine cores, we have derived masses. They range from 4 to 255 $M_\odot$. Overall, our c2d sample of southern molecular cores has a range of properties (line width, column density, size, mass, embedded stars) similar to those of past studies.

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Magnetic Fields and Rotations of Protostars

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The early evolution of the magnetic field and angular momentum of newly formed protostars are studied using three-dimensional resistive MHD nested grid simulations. Starting with a Bonnor–Ebert isothermal cloud rotating in a uniform magnetic field, we calculate the cloud evolution from the molecular cloud core ($n_c \simeq 10^4$ cm^{-3}, where n_c is the central density) to the stellar core ($n_c \simeq 10^{22}$ cm^{-3}). The magnetic field strengths at the center of clouds with the same initial angular momentum but different magnetic field strengths converge to a certain value as the clouds collapse for $n_c < 10^{12} cm^{-3}$. For $10^{12} < n_c < 10^{16} cm^{-3}$, Ohmic dissipation largely removes the magnetic field from a collapsing cloud core, and the magnetic field lines, which are strongly twisted for $n_c < 10^{12} cm^{-3}$, are de-collimated. The magnetic field lines are twisted and amplified again for $n_c > 10^{16} cm^{-3}$, because the magnetic field is recoupled with warm gas. Finally, protostars at their formation epoch ($n_c \simeq 10^{21} cm^{-3}$) have magnetic fields of ∼0.1–1 kG, which is comparable to observations. The magnetic field strength of a protostar depends slightly on the angular momentum of the host cloud. A protostar formed from a slowly rotating cloud core has a stronger magnetic field. The evolution of the angular momentum is closely related to the evolution of the magnetic field. The angular momentum in a collapsing

cloud is removed by magnetic effects such as magnetic braking, outflow and jets. The formed protostars have rotation periods of 0.1–2 days at their formation epoch, which is slightly shorter than observations. This indicates that a further removal mechanism for the angular momentum, such as interactions between the protostar and the disk, wind, or jets, is important in the further evolution of protostars.

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Detection of warm molecular hydrogen in the circumstellar disk around the Herbig Ae star HD97048

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We present high resolution spectroscopic mid-infrared observations of the circumstellar disk around the Herbig Ae star HD97048 with the *VLT Imager and Spectrometer for the mid-InfraRed* (*VISIR*). We detect the S(1) pure rotational line of molecular hydrogen (H_2) at 17.035 μm arising from the disk around the star. This detection reinforces the claim that HD97048 is a young object surrounded by a flared disk at an early stage of evolution. The emitting warm gas is located within the inner 35 AU of the disk. The line-to-continuum flux ratio is much higher than expected from models of disks at local thermodynamics equilibrium. We investigate the possible physical conditions, such as a gas-to-dust mass ratio higher than 100 and different excitation mechanisms of molecular hydrogen (X-ray heating, shocks, ...) in order to explain the detection. We tentatively estimate the mass of warm gas to be in the range from 10^{-2} to nearly 1 M_{Jup}. Further observations are needed to better constrain the excitation mechanisms as well as the mass of gas.

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The Molecular Gas Environment around Two Herbig Ae/Be Stars: Resolving the Outflows of LkHa 198 and LkHa 225S

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Observations of outflows associated with pre-main-sequence stars reveal details about morphology, binarity and evolutionary states of young stellar objects. We present molecular line data from the Berkeley-Illinois-Maryland Association array and Five Colleges Radio Astronomical Observatory toward the regions containing the Herbig Ae/Be stars LkHα 198 and LkHα 225S. Single dish observations of ^{12}CO $J = 1 - 0$, ^{13}CO $J = 1 - 0$, N_2H^+ $J = 1 - 0$ and CS $J = 2 - 1$ were made over a field of $4.3' \times 4.3'$ for each species. ^{12}CO $J = 1 - 0$ data from FCRAO were combined with high resolution BIMA array data to achieve a naturally-weighted synthesized beam of $6.75'' \times 5.5''$ toward LkHα 198 and $5.7'' \times 3.95''$ toward LkHα 225S, representing resolution improvements of factors of approximately 10 and 5 over existing data. By using uniform weighting, we achieved another factor of two improvement. The outflow around LkHα 198 resolves into at least four outflows, none of which are centered on LkHα 198-IR, but even at our resolution, we cannot exclude the possibility of an outflow associated with this source. In the LkHα 225S region, we find evidence for two outflows associated with LkHα 225S itself and a third outflow is likely driven by this source. Identification of the driving sources is still resolution-limited and is also complicated by the presence of three clouds along the line of sight toward the Cygnus molecular cloud. ^{13}CO $J = 1 - 0$ is present in the environments of both stars along with cold, dense gas as traced by CS $J = 2 - 1$ and (in LkHα 225S) N_2H^+ $J = 1 - 0$. No 2.6 mm continuum is detected in either region in relatively shallow maps compared to existing continuum observations.

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SCUBA Mapping of Outer Galaxy Protostellar Candidates

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We aim to study dust properties of massive star forming regions in the outer Galaxy, in a direction opposite to the Galactic center. We present observations of six outer Galaxy point sources IRAS 01045+6505, 01420+6401, 05271+3059, 05345+3556, 20222+3541 and 20406+4555, taken with the Submillimeter Common-User Bolometer Array (SCUBA) on the James Clerk Maxwell Telescope (JCMT) at 450 and 850 μm. Single temperature greybody models are fitted to the Spectral Energy Distribution of the detected sub-mm cores to derive dust temperature, dust emissivity index and optical depth at 250 μm. The observed radial intensity profiles of the sub-mm cores were fitted with power laws to derive the indices describing the density distribution. At a resolution of 15″ all six IRAS point sources show multiple emission peaks. Only four out of fourteen detected sub-mm cores show associated mid-infrared emission. For the sub-mm cores we derive dust temperatures of 32±5 K and dust emissivity indices between 0.9 and 2.5. The density profiles of the sub-mm cores can be fitted by a single power law distribution with indices -1.5±0.3, with most cores showing an index of -1.5. This is consistent with most observations of massive star forming regions and supports predictions of models of star formation which consider non-thermal support against gravitational collapse.

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The star-forming content of the W3 giant molecular cloud

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We have surveyed a ∼0.9 square degree area of the W3 giant molecular cloud (GMC) and star-forming region in the 850-μm continuum, using the Submillimetre Common-User Bolometer Array on the James Clerk Maxwell Telescope. A complete sample of 316 dense clumps were detected with a mass range from around 13 to 2500 $M_\odot$. Part of the W3 GMC is subject to an interaction with the H ii region and fast stellar winds generated by the nearby W4 OB association. We find that the fraction of total gas mass in dense, 850-μm traced structures is significantly altered by this interaction, being around 513 per cent in the undisturbed cloud but ∼ 25 - 37 per cent in the feedback-affected region. The mass distribution in the detected clump sample depends somewhat on assumptions of dust temperature and is not a simple, single power law but contains significant structure at intermediate masses. This structure is likely to be due to crowding of sources near or below the spatial resolution of the observations. There is little evidence of any difference between the index of the high-mass end of the clump mass function in the compressed region and in the unaffected cloud. The consequences of these results are discussed in terms of current models of triggered star formation.

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The earliest phases of high-mass star formation: a 3 square degree millimeter continuum mapping of CygnusX

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Aims. Our current knowledge of high-mass star formation is mainly based on follow-up studies of bright sources found by *IRAS*, and is thus biased against its earliest phases, inconspicuous at infrared wavelengths. We therefore started searching, in an unbiased way and in the closest high-mass star-forming complexes, for the high-mass analogs of low-mass pre-stellar cores and class 0 protostars.

Methods. We have made an extensive 1.2 mm continuum mosaicing study of the Cygnus X molecular cloud complex using the MAMBO cameras at the IRAM 30 m telescope. The $\sim 3^{\circ 2}$ imaged areas cover all the high-column density ($A_{\rm V} \geq 15$ mag) clouds of this nearby (~ 1.7 kpc) cloud complex actively forming OB stars. We then compared our millimeter maps with mid-infrared images, and have made SiO(2-1) follow-up observations of the best candidate progenitors of high-mass stars.

Results. Our complete study of Cygnus X with ~ 0.09 pc resolution provides, for the first time, an unbiased census of massive young stellar objects. We discover 129 massive dense cores (*FWHM* size ~ 0.1 pc, $M_{1.2\ \rm mm} = 4 - 950$ M$_\odot$, volume-averaged density $\sim 10^5$ cm^{-3}), among which ~ 42 are probable precursors of high-mass stars. A large fraction of the Cygnus X dense cores (2/3 of the sample) remain undetected by the *MSX* satellite, regardless of the mass range considered. Among the most massive (> 40 M$_\odot$) cores, infrared-quiet objects are driving powerful outflows traced by SiO emission. Our study qualifies 17 cores as good candidates for hosting massive infrared-quiet protostars, while up to 25 cores potentially host high-luminosity infrared protostars. We fail to discover in the high-mass analogs of pre-stellar dense cores (~ 0.1 pc, $> 10^4$ cm^{-3}) in Cygnus X, but find several massive starless clumps (~ 0.8 pc, 7×10^3 cm^{-3}) that might be gravitationally bound.

Conclusions. Since our sample is derived from a single molecular complex and covers every embedded phase of high-mass star formation, it gives the first statistical estimates of their lifetime. In contrast to what is found for low-mass class 0 and class I phases, the infrared-quiet protostellar phase of high-mass stars may last as long as their better-known high-luminosity infrared phase. The statistical lifetimes of high-mass protostars and pre-stellar cores ($\sim 3 \times 10^4$ yr and $< 10^3$ yr) in Cygnus X are one and two order(s) of magnitude smaller, respectively, than what is found in nearby, low-mass star-forming regions. We therefore propose that high-mass pre-stellar and protostellar cores are in a highly dynamic state, as expected in a molecular cloud where turbulent processes dominate.

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Soon on http://www.aanda.org/index.php?option=forthcoming&Itemid=18#section_5

Pre-main-sequence stars in the young open cluster NGC 1893 II. Evidence for triggered massive star formation

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Context. The open cluster NGC 1893 illuminating the HII region IC 410 contains a moderately large population of O-type stars and is one of the youngest clusters observable in the optical range. It is suspected of harbouring a large population of pre-main-sequence (PMS) stars.

Aims. We have probed the stellar population of NGC 1893 in an attempt to determine its size and extent. In particular, we look for signs of sequential star formation.

Methods. We classify a large sample of cluster members with new intermediate-resolution spectroscopy. We used Hα slitless spectroscopy of the field to search for emission-line objects, identifying 18 emission-line PMS stars. We then combined existing optical photometry with the 2MASS $JHK_{\rm S}$ photometry to detect stars with infrared excesses, finding close to 20 more PMS candidates.

Results. While almost all stars earlier than B2 indicate standard reddening, all later cluster members show strong deviations from a standard reddening law, which we interpret in terms of infrared excess emission. Emission-line stars and IR-excess objects show the same spatial distribution, concentrating around two localised areas, the immediate vicinity of the pennant nebulae and Sim 130 and the area close to the cluster core where the rim of the molecular cloud associated with IC 410 is illuminated by the nearby O-type stars. In and around the emission nebula Sim 130, we find three Herbig Be stars with spectral types in the B1-4 range and several other fainter emission-line stars. We obtain a complete census of B-type stars by combining Strömgren, Johnson and 2MASS photometry and find a deficit of intermediate mass stars compared to massive stars. We observe a relatively extended halo of massive stars surrounding the cluster without an accompanying population of intermediate-mass stars.

Conclusions. Stars in NGC 1893 show strong indications of being extremely young. The pennant nebula Sim 130 is an area of active massive star formation, displaying very good evidence of triggering by the presence of nearby massive stars. The overall picture of star formation in NGC 1893 suggests a very complex process.

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Possible patterns in the distribution of planetary formation regions

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Eris, an object larger than Pluto, is known to reside in the transneptunian region further away than Pluto. One can wonder whether its semimajor orbital axis fits in a generalized Titius - Bode law, in the same way as Pluto does. We performed a new least-squares fit to a generalized Titius - Bode law including Eris and found that not only does Eris fit in the trend, but also the correlation coefficient improves. In addition, there is a remarkable symmetry of the location of the planetary formation regions with respect to Jupiter when the natural logarithm of the heliocentric distance is used as the metric. The issue of whether the observed patterns have some physical meaning or are due to mere chance is addressed using a Monte Carlo approach identical to that of Lynch. Although the probability of chance occurrence is highly dependent on the way in which the random configurations of synthetic planetary systems are selected, we find that in all reasonable scenarios of random planetary systems the probability of chance occurrence of the observed patterns is small (below 1 per cent in most cases). If the trend were used as a prediction tool, one might expect another planet or dwarf planet or a swarm of bodies with semimajor orbital axis of 120 $\pm$ 20 au. Simple calculations show that the protoplanetary nebula most likely had enough mass to allow the accretion of at least a dwarf planet at that distance. We also found that if the surface density of the nebula decayed with heliocentric distance (r) as a power of -2, the regular spacing in ln r in the Solar system could be a natural consequence of the existence of a threshold mass for planetary formation.

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Parametric Instability in Dark Molecular Clouds

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The present work investigates the parametric instability of parallel propagating circularly polarized Alfvén (pump)

waves in a weakly ionized molecular cloud. It is shown that the relative drift between the plasma particles gives rise to the Hall effect, resulting in the modified pump wave characteristics. Although the linearized fluid equations with periodic coefficients are difficult to solve analytically, it is shown that a linear transformation can remove the periodic dependence. The resulting linearized equations with constant coefficients are used to derive an algebraic dispersion relation. The growth rate of the parametric instability is a sensitive function to the amplitude of the pump wave as well as to the ratio of the pump and the modified dust-cyclotron frequencies. The instability is insensitive to the plasma β. The results are applied to the molecular clouds.

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Dust crystallinity in protoplanetary disks: the effect of diffusion/viscosity ratio

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The process of turbulent radial mixing in protoplanetary disks has strong relevance to the analysis of the spatial distribution of crystalline dust species in disks around young stars and to studies of the composition of meteorites and comets in our own solar system. A debate has gone on in the recent literature on the ratio of the effective viscosity coefficient ν (responsible for accretion) to the turbulent diffusion coefficient D (responsible for mixing). Numerical magneto-hydrodynamic simulations have yielded values between $\nu/D \simeq 10$ (Carballido et al. 2005, MNRAS, 358, 1055) and $\nu/D \simeq 0.85$ (Johansen & Klahr 2005, ApJ, 634, 1353). Here we present two analytic arguments for the ratio $\nu/D = 1/3$ which are based on elegant, though strongly simplified assumptions. We argue that whichever of these numbers comes closest to reality may be determined observationally by using spatially resolved mid-infrared measurements of protoplanetary disks around Herbig stars. If meridional flows are present in the disk, then we expect less abundance of crystalline dust in the surface layers, a prediction which can likewise be observationally tested with mid-infrared interferometers.

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A survey of $[D_2CO]/[H_2CO]$ and $[N_2D^+]/[N_2H^+]$ ratios towards protostellar cores

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Aims. We use observations and models of molecular D/H ratios to probe the physical conditions and chemical history of the gas and to differentiate between gas-phase and grain-surface chemical processing in star forming regions.

Methods. As a follow up to previous observations of $HDCO/H_2CO$ and DCN/HCN ratios in a selection of low-mass protostellar cores, we have measured D_2CO/H_2CO and N_2D^+/N_2H^+ ratios in these same sources. For comparison, we have also measured N_2D^+/N_2H^+ ratios towards several starless cores and have searched for N_2D^+ and deuterated formaldehyde towards hot molecular cores (HMCs) associated with high mass star formation. We compare our results with predictions from detailed chemical models, and to other observations made in these sources.

Results. Towards the starless cores and low-mass protostellar sources we have found very high N_2D^+ fractionation, which suggests that the bulk of the gas in these regions is cold and heavily depleted. The non-detections of N_2D^+ in the HMCs indicate higher temperatures. We did detect HDCO towards two of the HMCs, with abundances 1-3% of H_2CO. These are the first detections of deuterated formaldehyde in high mass sources since Turner (1990) measured $HDCO/H_2CO$ and D_2CO/H_2CO towards the Orion Compact Ridge.

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Near-infrared study of southern massive star formation regions: The case of IRAS 16571-4029 source

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Context. We present the results of a near-infrared survey of the young stellar cluster associated with the IRAS 16571-4029 source.

Aims. The main purpose of this survey is to study the cluster members and find the ionizing sources of the associated HII region.

Methods. The stellar population was studied by using color-color and color-magnitude diagrams, as well as by analysing the spectral energy distributions in the near- and mid-infrared wavelengths. The extended emission was studied by the construction of contour diagrams, which were compared with near- and mid-infrared images. We computed the corresponding number of Lyman continuum photons (using the integrated Brγ flux density) and compared it with that obtained from the 5 GHz flux density to derive a mean visual extinction.

Results. NIR observations in the direction of RCW116B reveal the presence of a young cluster of massive stars coincident with the IRAS 16571-4029 source. These observations, together with published radio data, MSX, and Spitzer images were used to determine some of the physical parameters of the region. We found 102 cluster member candidates in an area of about 3 × 3 square arcmin, the majority of them showing excess emission in the NIR. We found that IRAS 16571-4029 is formed by multiple infrared sources, all but one are associated with small groups of stars. This suggests that the fragmentation of massive molecular clouds generates the massive sub-clusters. We derived a mean visual extinction of $A_{\rm V} = 12.8^{+4.7}_{-3.2}$. This result is independent of the assumed distance and agrees with the mean visual extinction $A_{\rm V} = 14.4$, as obtained by previous spectroscopic observations of two NIR sources in the direction of the IRAS 16571-4029 source. We also compare the results obtained in this study with those obtained in previous papers in this series finding a very good correlation between the number of cluster members $N_{\rm s}$ and the cluster radius $r_{\rm c}$. The cluster radius varies from 0.2-0.3 pc (IRAS 15411-5352 and IRAS 16132-5039) until about 1 pc (IRAS 15408-5356). The youngest clusters are those associated with the RCW95 complex (IRAS 15408-5356 and IRAS 15411-5353) with ages in the range 1.5-2 $\times 10^6$ years, while the sources associated with the RCW106 (IRAS 16132-5039 , IRAS 16177-5018) and RCW116B (IRAS 16571-4029) complexes have ages in the range 2.5-3 $\times 10^6$ years. The oldest of them is the cluster associated with the RCW121 region (IRAS 17149-4029), which has an estimated age of 4.2 $\times 10^6$ years.

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Collisions between equal sized ice grain agglomerates

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Context. Following the recent insight in the material structure of comets, protoplanetesimals are assumed to have low densities and to be highly porous agglomerates. It is still unclear if planetesimals can be formed from these objects by collisional growth.

Aims. Therefore, it is important to study numerically the collisional outcome from low velocity impacts of equal sized porous agglomerates which are too large to be examined in a laboratory experiment.

Methods. We use the Lagrangian particle method Smooth Particle Hydrodynamics to solve the equations that describe the dynamics of elastic and plastic bodies. Additionally, to account for the influence of porosity, we follow a previous developed equation of state and certain relations between the material strength and the relative density.

Results. Collisional growth seems possible for rather low collision velocities and particular material strengths. The remnants of collisions with impact parameters that are larger than 50 % of the radius of the colliding objects tend to rotate. For small impact parameters, the colliding objects are effectively slowed down without a prominent compaction of the porous structure, which probably increases the possibility for growth. The protoplanetesimals, however, do not stick together for the most part of the employed material strengths.

Conclusions. An important issue in subsequent studies has to be the influence of rotation to collisional growth. Moreover, for realistic simulations of protoplanetesimals it is crucial to know the correct material parameters in more detail.

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Spitzer Observations of a 24 μm Shadow: Bok Globule CB 190

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We present Spitzer observations of the dark globule CB 190 (LDN 771). We observe a roughly circular 24 μm shadow with a 70″ radius. The extinction profile of this shadow matches the profile derived from 2MASS photometry at the outer edges of the globule and reaches a maximum of ∼32 visual magnitudes at the center. The corresponding mass of CB 190 is ∼10 $M_\odot$. Our ^{12}CO and ^{13}CO J = 2 - 1 data over a 10′ × 10′ region centered on the shadow show a temperature ∼10 K. The thermal continuum indicates a similar temperature for the dust. The molecular data also show evidence of freezeout onto dust grains. We estimate a distance to CB 190 of 400 pc using the spectroscopic parallax of a star associated with the globule. Bonnor-Ebert fits to the density profile, in conjunction with this distance, yield $\xi_{max} = 7.2$, indicating that CB 190 may be unstable. The high temperature (56 K) of the best-fit Bonnor-Ebert model is in contradiction with the CO and thermal continuum data, leading to the conclusion that the thermal pressure is not enough to prevent free-fall collapse. We also find that the turbulence in the cloud is inadequate to support it. However, the cloud may be supported by the magnetic field, if this field is at the average level for dark globules. Since the magnetic field will eventually leak out through ambipolar diffusion, it is likely that CB 190 is collapsing or in a late precollapse stage.

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Measurement of Dust Optical Properties in the Coalsack Nebula

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We have used FUSE and Voyager observations of dust-scattered starlight in the neighborhood of the Coalsack Nebula to derive the optical constants of the dust grains. The albedo is consistent with a value of 0.28 ± 0.04, and the phase function asymmetry factor with a value of 0.61 ± 0.07, throughout the spectral range from 900-1200 Å, in agreement with previous determinations as well as theoretical predictions. We have now observed two regions (Ophiuchus and Coalsack) with intense diffuse background radiation and in both cases have found that the emission is due to light from nearby hot stars scattered by a relatively thin foreground cloud, with negligible contribution from the background molecular cloud.

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A Discontinuity in the Low-Mass Initial Mass Function

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The origin of brown dwarfs (BDs) is still an unsolved mystery. While the standard model describes the formation of BDs and stars in a similar way recent data on the multiplicity properties of stars and BDs show them to have different binary distribution functions. Here we show that proper treatment of these uncovers a discontinuity of the multiplicity-corrected mass distribution in the very-low-mass star (VLMS) and BD mass regime. A continuous IMF

can be discarded with extremely high confidence. This suggests that VLMSs and BDs on the one hand, and stars on the other, are two correlated but disjoint populations with different dynamical histories. The analysis presented here suggests that about one BD forms per five stars and that the BD-star binary fraction is about 2%–3% among stellar systems.

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The Circumstellar Structure and Excitation Effects around the Massive Protostar Cepheus A HW 2

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qWe report SMA 335 GHz continuum observations with angular resolution of $\sim 0\farcs3$, together with VLA ammonia observations with $\sim 1''$ resolution toward Cep A HW 2. We find that the flattened disk structure of the dust emission observed by Patel et al. is preserved at the $0\farcs3$ scale, showing an elongated structure of $\sim 0\farcs6$ size (450 AU) peaking on HW 2. In addition, two ammonia cores are observed, one associated with a hot-core previously reported, and an elongated core with a double peak separated by $\sim 1\farcs3$ and with signs of heating at the inner edges of the gas facing HW 2. The double-peaked ammonia structure, as well as the double-peaked CH_3CN structure reported previously (and proposed to be two independent hot-cores), surround both the dust emission as well as the double-peaked SO_2 disk structure found by Jiménez-Serra et al. All these results argue against the interpretation of the elongated dust-gas structure as due to a chance-superposition of different cores; instead, they imply that it is physically related to the central massive object within a *disk-protostar-jet* system.

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An X-Ray Imaging Study of the Stellar Population in RCW 49

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We present the results of a high-resolution X-ray imaging study of the stellar population in the Galactic massive star-forming region RCW 49 and its central OB association Westerlund 2. We obtained a $\sim$ 40 ks X-ray image of a $\sim 17' \times 17'$ field using the Chandra X-Ray Observatory and deep NIR images using the Infrared Survey Facility in a concentric $\sim 8.3' \times 8.3'$ region. We detected 468 X-ray sources and identified optical, NIR, and Spitzer MIR counterparts for 379 of them. The unprecedented spatial resolution and sensitivity of the X-ray image, enhanced by optical and infrared imaging data, yielded the following results: (1) The central OB association Westerlund 2 is resolved for the first time in the X-ray band. X-ray emission is detected from all spectroscopically identified early-type stars in this region. (2) Most ($\sim$ 86%) X-ray sources with optical or infrared identifications are cluster members in

comparison with a control field in the Galactic plane. (3) A loose constraint (25 kpc) for the distance to RCW 49 is derived from the mean X-ray luminosity of T Tauri stars. (4) The cluster X-ray population consists of low-mass premain-sequence and early-type stars as obtained from X-ray and NIR photometry. About 30 new OB star candidates are identified. (5) We estimate a cluster radius of 6′ - 7′ based on the X-ray surface number density profiles. (6) A large fraction (∼ 90%) of cluster members are identified individually using complimentary X-ray and MIR excess emission. (7) The brightest five X-ray sources, two Wolf-Rayet stars and three O stars, have hard thermal spectra.

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Vortex generation in protoplanetary disks with an embedded giant planet

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Context. Vortices in protoplanetary disks can capture solid particles and form planetary cores within shorter timescales than those involved in the standard core-accretion model.

Aims. We investigate vortex generation in thin unmagnetized protoplanetary disks with an embedded giant planet with planet to star mass ratio 10^{-4} and 10^{-3}.

Methods. Two-dimensional hydrodynamical simulations of a protoplanetary disk with a planet are performed using two different numerical methods. The results of the non-linear simulations are compared with a time-resolved modal analysis of the azimuthally averaged surface density profiles using linear perturbation theory.

Results. Finite-difference methods implemented in polar coordinates generate vortices moving along the gap created by Neptune-mass to Jupiter-mass planets. The modal analysis shows that unstable modes are generated with growth rate of order $0.3\Omega_{\rm K}$ for azimuthal numbers m=4,5,6, where $\Omega_{\rm K}$ is the local Keplerian frequency. Shock-capturing Cartesian-grid codes do not generate very much vorticity around a giant planet in a standard protoplanetary disk. Modal calculations confirm that the obtained radial profiles of density are less susceptible to the growth of linear modes on timescales of several hundreds of orbital periods. Navier-Stokes viscosity of the order $\nu = 10^{-5}$ (in units of $a^2\Omega_{\rm p}$) is found to have a stabilizing effect and prevents the formation of vortices. This result holds at high resolution runs and using different types of boundary conditions.

Conclusions. Giant protoplanets of Neptune-mass to Jupiter-mass can excite the Rossby wave instability and generate vortices in thin disks. The presence of vortices in protoplanetary disks has implications for planet formation, orbital migration, and angular momentum transport in disks.

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The Cool Dark Globule CB68 and Its Associated Protostar: Geometry, Kinematics, Magnetic Vectors, and Pressure Balance

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CB68 is a nearby cool dark globule. We observed CB68 near a radial velocity around +5.5 km s^{-1} in the ^{12}CO, ^{13}CO, and C^{18}O gas in J = 3 - 2 covering a 2′ × 2′ area, and we reanalyzed previous observations of the thermal dust continuum and linear polarization near the same wavelength (850 μm), same angular resolution (14″), and same antenna. We find that the gaseous core has a disklike intensity elongation near a P.A. of 45° with a velocity gradient along that P.A.: a northeast blueshift and a southwest redshift, suggestive of a rotating gas; this gas P.A. is similar to the elongation of the dust emission near a P.A. of 45°. We map the low-velocity blue southeast outflow and red

northwest outflow; the CO gas outflow contours are elongated at a P.A. near -45′, similar to the elongation of the polarization percentage contours near -45′. We estimate the Chandrasekhar-Fermi strength of the hourglass-shaped magnetic field to be 120 - 130 μG in the sky plane. This strength is nearly a factor of 10 - 20 greater than the Zeeman line-of-sight data (7 - 10 μG) in the nearby tenuous cloud, outside CB68 proper. We deduce the energy and pressure components in the cool globule and in the hot surrounding region. We find an imbalance in pressure, which we tentatively assign to a neglected halo component (a reservoir of tenuous halo gas still infalling toward the disklike object CB68).

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A Test of Pressure Equilibrium outside and inside Some Dust-emitting Filaments and a Shell

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We have found relations characterizing two large filaments embedded in hot cavities and a shell surrounding a hot cavity. These data come from multiconstituent (gas/dust/field) homogeneous maps of the same objects modeled in the same manner. We find that the total external pressure of the cavity environment surrounding our filaments and shell is large and about equal to the total internal pressure inside the filaments and the shell. Also, we find that the filament width decreases with increasing total pressure. We expect that our work will provide a deeper insight into the origin and properties of filaments and the surrounding large-scale structure. Models of filaments neglecting a strong pressure from the outside environment would need modifications. Models requiring strong magnetism inside the filaments or shell, sufficiently strong to contain gas turbulence, do not seem to be favored by our thin filaments or shell.

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Self-regulated gravitational accretion in protostellar discs

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We present a numerical model for the evolution of a protostellar disc that has formed self-consistently from the collapse of a molecular cloud core. The global evolution of the disc is followed for several million years after its formation. The capture of a wide range of spatial and temporal scales is made possible by use of the thin-disc approximation. We focus on the role of gravitational torques in transporting mass inward and angular momentum outward during different evolutionary phases of a protostellar disc with disc-to-star mass ratio of order 0.1. In the early phase, when the infall of matter from the surrounding envelope is substantial, mass is transported inward by the gravitational torques from spiral arms that are a manifestation of the envelope-induced gravitational instability in the disc. In the late phase, when the gas reservoir of the envelope is depleted, the distinct spiral structure is replaced by ongoing irregular nonaxisymmetric density perturbations. The amplitude of these density perturbations decreases with time, though this process is moderated by swing amplification aided by the existence of the disc's sharp outer edge. Our global modelling of the protostellar disc reveals that there is typically a residual nonzero gravitational torque from these density perturbations, i.e. their effects do not exactly cancel out in each region. In particular, the net gravitational torque in the inner disc tends to be negative during first several million years of the evolution, while the outer disc has a net positive gravitational torque. Our global model of a self-consistently formed disc shows that it is also self-regulated in the late phase, so that it is near the Toomre stability limit, with a near-uniform Toomre parameter $Q \approx 1.5 - 2.0$. Since the disc also has near-Keplerian rotation, and comparatively weak temperature variation, it maintains a near-power-law surface density profile proportional to $r^{-3/2}$.

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http://www.astro.uwo.ca/∼basu/pb.htm

X-rays from massive OB stars: Thermal emission from radiative shocks

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Chandra gratings spectra of a sample of 15 massive OB stars were analyzed under the basic assumption that the X-ray emission is produced in an ensemble of shocks formed in the winds driven by these objects. Shocks develop either as a result of radiation-driven instabilities or due to confinement of the wind by relatively strong magnetic field, and since they are radiative, a simple model of their X-ray emission was developed that allows a direct comparison with observations. According to our model, the shock structures (clumps, complete or fractional shells) eventually become cold clouds in the X-ray sky of the star. As a result, it is expected that for large covering factors of the hot clumps, there is a high probability for X-ray absorption by the cold clouds, resulting in blue-shifted spectral lines. Our analysis has revealed that such a correlation indeed exists for the considered sample of OB stars. As to the temperature characteristics of the X-ray emission plasma, the studied OB stars fall in two groups: (i) one with plasma temperature limited to 0.1-0.4 keV; (ii) the other wtih X-rays produced in plasmas at considerably higher temperatures. We argue that the two groups correspond to different mechanisms for the origin of X-rays: in radiative-driven instability shocks and in magnetically-confined wind shocks, respectively.

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The Hot Inner Disk of FU Ori

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We have constructed a detailed radiative transfer disk model which reproduces the main features of the spectrum of the outbursting young stellar object FU Orionis from ~ 4000 $\mathring{A}$, to $\sim 8\mu$m. Using an estimated visual extinction $A_V \sim 1.5$, a steady disk model with a central star mass $\sim 0.3 M_\odot$ and a mass accretion rate $\sim 2 \times 10^{-4} M_\odot \mathrm{yr}^{-1}$ reproduces the spectral energy distribution of FU Ori quite well. Higher values of extinction used in previous analysis ($A_V \sim 2.1$) result in spectral energy distributions which are less well-fitted by a steady disk model, but might be explained by extra energy dissipation of the boundary layer in the inner disk. With the mid-infrared spectrum obtained by the Infrared Spectrograph (IRS) on board the *Spitzer Space Telescope*, we estimate that the outer radius of the hot, rapidly accreting inner disk is ~ 1 AU using disk models truncated at this outer radius. Inclusion of radiation from a cooler irradiated outer disk might reduce the outer limit of the hot inner disk to ~ 0.5 AU. In either case, the radius is inconsistent with a pure thermal instability model for the outburst. Our radiative transfer model implies that the central disk temperature $T_c \geq 1000$ K out to $\sim 0.5 - 1$ AU, suggesting that the magnetorotational instability can be supported out to that distance. Assuming that the ~ 100 yr decay timescale in brightness of FU Ori represents the viscous timescale of the hot inner disk, we estimate the viscosity parameter to be $\alpha \sim 0.2 - 0.02$ in the outburst state, consistent with numerical simulations of the magnetorotational instability in disks. The radial extent of the high $\dot{M}$ region is inconsistent with the model of Bell & Lin, but may be consistent with theories incorporating both gravitational and magnetorotational instabilities.

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http://arxiv.org/abs/0707.3429

Postdoctoral Research Position in Star and Planet Formation

As part of a research program on the structure and evolution of protoplanetary disks, a postdoctoral research position is available for two years (with a possible extension of one year) at Leiden Observatory, starting mid-2007.

The successful applicant will work with Dr. Michiel Hogerheijde and a group of three graduate and several undergraduate students on studying millimeter and (far) infrared observations of protoplanetary disks. In addition to collaborative research with group members, the candidate will also have the opportunity to carry our her/his own research projects. Our group uses the James Clerk Maxwell Telescope, the (enhanced) SubMillimeter Array, the Atacama Pathfinder EXperiment, the Spitzer Space Telescope, and the Herschel Space Observatory. To interpret the observations we use advanced tools to model the disk hydrodynamics, chemistry, and radiative transfer. We interact closely with the molecular astrophysics and laboratory astrophysics group of Prof. Dr. Ewine van Dishoeck, also at the Observatory of Leiden University.

Applications should include a curriculum vitae with a list of publications, a brief description of past research experience, and a brief statement of research the candidate is interested in carrying out. The applicant should also arrange for three letters of reference to be sent directly to Michiel Hogerheijde. Applications and letters of reference can be sent electronically to Michiel Hogerheijde at michiel *at* strw.leidenuniv.nl. Deadline for application and receipt of letters of reference is October 1 2007.

Moving ... ??

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X-Atlas: An Online Archive of Chandra Transmission Gratings Observations

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We announce the public release of X-Atlas, an online archive of Chandra's stellar High Energy Transmission Gratings (HETG) observations. We have compiled a database of all observations of high mass and low mass "normal stars" made with the HETG to facilitate the rapid comparison, characterization, and analysis of high-resolution stellar X-ray spectra. This database, X-Atlas, is accessible through a web interface with extensive searching, data retrieval, and interactive spectral plotting capabilities. For each target, X-Atlas also features predictions of the low-resolution ACIS-S and ACIS-I spectra convolved from the HETG data for comparison with stellar sources in archival ACIS images. Hardness ratios, quantiles, spectral fits, light curves, variability analyses, and spectral plots are provided as well. The atlas offers more than 130 observations of approximately 25 high-mass stars and 40 low-mass stars and will be updated as additional observations become public.

X-Atlas has recently expanded to include other point sources observed with HETG, including X-ray binaries, cataclysmic variables, and active galactic nuclei. Low Energy Transmission Grating (LETG) observations are currently being added as well.

A descriptive paper has been submitted to ApJS

http://cxc.harvard.edu/XATLAS/

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

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