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Abstracts of recently accepted papers

The Continuing Outburst of V1647 Orionis: Winter/spring 2011 Observations

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We present optical and near-IR observations of the young eruptive variable star V1647 Orionis which illuminates McNeil's Nebula. In late 2003, V1647 Ori was observed to brighten by around 5 mags to $r' \sim 17.7$. In early 2006 the star faded back to its quiescent brightness of $r' \sim 23$, however, in mid-2008 it brightened yet again by ~ 5 mags. Our new observations, taken in early 2011, show V1647 Ori to be in an elevated photometric state with an optical brightness similar to the value found at the start of the 2003 and 2008 outbursts. Optical images taken between 2008 and 2011 suggest that the star has remained in outburst from mid 2008 to the present. $H\alpha$ and the far-red Ca II triplet lines remain in emission with $H\alpha$ possessing a significant P Cygni profile. A self-consistent study of the accretion luminosity and rate using data taken in 2004, 2007, 2008, and 2011, indicates that when bright, V1647 Ori has values of $16 \pm 2 L_{\odot}$ and $4 \pm 2 \times 10^{-6} M_{\odot} \text{ yr}^{-1}$, respectively. We support the premise that the accretion luminosity and rate both declined by a factor 2–3 during the 5 mag fading in 2007. However, a significant part of the fading was due to either variable extinction or dust reformation. We discuss these new observations in relation to previous published data and the classification schemes for young eruptive variables.

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<http://www.ifa.hawaii.edu/~caa/papers>

Classifying structures in the ISM with Support Vector Machines: the G16.05-0.57 supernova remnant

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We apply Support Vector Machines – a machine learning algorithm – to the task of classifying structures in the Interstellar Medium. As a case study, we present a position-position velocity data cube of 12 CO J=3–2 emission towards G16.05-0.57, a supernova remnant that lies behind the M17 molecular cloud. Despite the fact that these two objects partially overlap in position-position-velocity space, the two structures can easily be distinguished by eye based on their distinct morphologies. The Support Vector Machine algorithm is able to infer these morphological distinctions, and associate individual pixels with each object at $>90\%$ accuracy. This case study suggests that similar techniques may be applicable to classifying other structures in the ISM – a task that has thus far proven difficult to automate.

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<http://xxx.lanl.gov/abs/1107.5584>

Young brown dwarfs at high cadence: Warm Spitzer time series monitoring of very low mass σ Orionis cluster members

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The continuous temporal coverage and high photometric precision afforded by space observatories have opened up new opportunities for the study of variability processes in young stellar cluster members. Of particular interest is the phenomenon of deuterium-burning pulsation in brown dwarfs (BDs) and very-low-mass stars, whose existence on 1–4 hr timescales has been proposed but not yet borne out by observations. To investigate short-timescale variability in young, low-mass objects, we carried out high-precision, high-cadence time series monitoring with the Warm *Spitzer* mission on 14 low mass stars and BDs in the ~ 3 Myr σ Orionis cluster. The flux in many of our raw light curves is strongly correlated with sub-pixel position and can vary systematically as much as 10%. We present a new approach to disentangle true stellar variability from this “pixel-phase effect,” which is more pronounced in Warm *Spitzer* observations as compared to the cryogenic mission. The light curves after correction reveal that most of the sample is devoid of variability down to the few-millimagnitude (mmag) level, on the minute to day timescales probed. However, one exceptional BD displays erratic brightness changes at the 10%–15% level, suggestive of variable obscuration by dusty material. The uninterrupted 24 hr datastream and sub-1% photometric precision enable limits on pulsation in the near-infrared. If this phenomenon is present in our light curves, then its amplitude must lie below 2–3 mmag. In addition, we present three field eclipsing binaries and one pulsator for which optical ground-based data are also available.

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<http://arxiv.org/abs/1108.1437>

New brown dwarfs in the south part of the Upper Scorpius Association

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This paper presents the results of a search for brown dwarfs in the Upper Scorpius Association using data from the UKIRT Infrared Deep Sky Survey (UKIDSS) Galactic Cluster Survey. Candidate young brown dwarfs were first chosen by their position in colour magnitude diagrams with further selection based on proper motions to ensure Upper Scorpius membership. Proper motions were derived by comparing UKIDSS and 2MASS data. Using that method we identify 19 new brown dwarfs in the southern part of the association. In addition there are up to 8 likely members with slightly higher dispersion velocity. The ratio of brown dwarfs to stars was found to be consistent with other areas in Upper Scorpius. It was also found to be similar to other results from young clusters with OB associations, and lower than those without, suggesting the brown dwarf formation rate may be a function of environment.

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Detection of a Bipolar Molecular Outflow Driven by a Candidate First Hydrostatic Core

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We present new 230 GHz Submillimeter Array observations of the candidate first hydrostatic core Per-Bolo 58. We

report the detection of a 1.3 mm continuum source and a bipolar molecular outflow, both centered on the position of the candidate first hydrostatic core. The continuum detection has a total flux density of 26.6 ± 4.0 mJy, from which we calculate a total (gas and dust) mass of $0.11 \pm 0.05 M_{\odot}$ and a mean number density of $2.0 \pm 1.6 \times 10^7 \text{ cm}^{-3}$. There is some evidence for the existence of an unresolved component in the continuum detection, but longer-baseline observations are required in order to confirm the presence of this component and determine whether its origin lies in a circumstellar disk or in the dense inner envelope. The bipolar molecular outflow is observed along a nearly due east-west axis. The outflow is slow (characteristic velocity of 2.9 km s^{-1}), shows a jet-like morphology (opening semi-angles $\sim 8^{\circ}$ for both lobes), and extends to the edges of the primary beam. We calculate the kinematic and dynamic properties of the outflow in the standard manner and compare them to several other protostars and candidate first hydrostatic cores with similarly low luminosities. We discuss the evidence both in support of and against the possibility that Per-Bolo 58 is a first hydrostatic core, and we outline future work needed to further evaluate the evolutionary status of this object.

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The Bolocam Galactic Plane Survey. VII. Characterizing the Properties of Massive Star-Forming Regions

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We present the results of a GBT survey of $\text{NH}_3(1,1)$, $(2,2)$, $(3,3)$ lines towards 631 Bolocam Galactic Plane Survey (BGPS) sources at a range of Galactic longitudes in the inner Galaxy. We have detected the $\text{NH}_3(1,1)$ line towards 72% of our targets (456), demonstrating that the high column density features identified in the BGPS and other continuum surveys accurately predict the presence of dense gas. We have determined kinematic distances and resolved the distance ambiguity for all BGPS sources detected in NH_3 . The BGPS sources trace the locations of the Scutum and Sagittarius spiral arms, with the number of sources peaking between $R_{\text{Gal}} \sim 4 - 5$ kpc. We measure the physical properties of each source and find that depending on the distance, BGPS sources are primarily clumps, with some cores and clouds. We have examined the physical properties as a function of Galactocentric distance, and find a mean gas kinetic temperature of 15.6 K, and that the NH_3 column density and abundance decrease by nearly an order of magnitude between $R_{\text{Gal}} \sim 3 - 11$ kpc. Comparing sources at similar distances demonstrates that the physical properties are indistinguishable, which suggests a similarity in clump structure across the Galactic disk. We have also compared the BGPS sources to criteria for efficient star formation presented independently by Heiderman et al. and Lada et al., and massive star formation presented by Kauffmann et al. 48% of our sample should be forming stars (including massive stars) with high efficiency, and 87% contain subregions that should be efficiently forming stars. Indeed, we find that 67% of the sample exhibit signs of star formation activity based on an association with a mid-IR source.

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The Initial Mass Function and Disk Frequency of the ρ Ophiuchi Cloud: An Extinction-Limited Sample

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We have completed an optical spectroscopic survey of an unbiased, extinction-limited sample of candidate young stars covering 1.3 deg^2 of the ρ Ophiuchi star forming region. While infrared, X-ray, and optical surveys of the cloud have identified many young stellar objects, these surveys are biased towards particular stages of stellar evolution and are not optimal for studies of the disk frequency and initial mass function. We have obtained over 300 optical spectra to help identify 135 association members based on the presence of $H\alpha$ in emission, lithium absorption, X-ray emission, a mid-infrared excess, a common proper motion, reflection nebosity, and/or extinction considerations. Spectral types along with R and I band photometry were used to derive effective temperatures and bolometric luminosities for association members to compare with theoretical tracks and isochrones for pre-main sequence stars. An average age of 3.1 Myr is derived for this population which is intermediate between that of objects embedded in the cloud core of ρ Ophiuchi and low mass stars in the Upper Scorpius subgroup. Consistent with this age we find a circumstellar disk frequency of $27\% \pm 5\%$. We also constructed an Initial Mass Function for an extinction-limited sample of 123 young stellar objects ($A_v \leq 8 \text{ mag}$), which is consistent with the field star Initial Mass Function for YSOs with masses $>0.2 M_\odot$. There may be a deficit of brown dwarfs but this result relies on completeness corrections and requires confirmation.

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A rotating molecular disk toward IRAS 18162-2048, the exciting source of HH 80–81

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We present several molecular line emission arcsec and subarcsec observations obtained with the Submillimeter Array (SMA) in the direction of the massive protostar IRAS 18162-2048, the exciting source of HH 80–81.

The data clearly indicates the presence of a compact (radius $\approx 425\text{--}850 \text{ AU}$) SO_2 structure, enveloping the more compact (radius $<150 \text{ AU}$) 1.4 millimeter dust emission (reported in a previous paper). The emission spatially coincides with the position of the prominent thermal radio jet which terminates at the HH 80–81 and HH 80N Herbig–Haro objects. Furthermore, the molecular emission is elongated in the direction perpendicular to the axis of the thermal radio jet, suggesting a disk-like structure. We derive a total dynamic mass (disk-like structure and protostar) of $11\text{--}15 M_\odot$. The SO_2 spectral line data also allow us to constrain the structure temperature between $120\text{--}160 \text{ K}$ and the volume density $> 2 \times 10^9 \text{ cm}^{-3}$. We also find that such a rotating flattened system could be unstable due to gravitational disturbances.

The data from C^{17}O line emission show a dense core within this star-forming region. Additionally, the H_2CO and the SO emissions appear clumpy and trace the disk-like structure, a possible interaction between a molecular core and the outflows, and in part, the cavity walls excavated by the thermal radio jet.

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Herschel Measurements of Molecular Oxygen in Orion

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We report observations of three rotational transitions of molecular oxygen (O_2) in emission from the H_2 Peak 1 position of vibrationally excited molecular hydrogen in Orion. We observed the 487 GHz, 774 GHz, and 1121 GHz lines using HIFI on the *Herschel Space Observatory*, having velocities of 11 km s⁻¹ to 12 km s⁻¹ and widths of 3 km s⁻¹. The beam-averaged column density is $N(O_2) = 6.5 \times 10^{16}$ cm⁻², and assuming that the source has an equal beam filling factor for all transitions (beam widths 44, 28, and 19"), the relative line intensities imply a kinetic temperature between 65 K and 120 K. The fractional abundance of O_2 relative to H_2 is $0.3 - 7.3 \times 10^{-6}$. The unusual velocity suggests an association with a $\sim 5''$ diameter source, denoted Peak A, the Western Clump, or MF4. The mass of this source is $\sim 10 M_\odot$ and the dust temperature is ≥ 150 K. Our preferred explanation of the enhanced O_2 abundance is that dust grains in this region are sufficiently warm ($T \geq 100$ K) to desorb water ice and thus keep a significant fraction of elemental oxygen in the gas phase, with a significant fraction as O_2 . For this small source, the line ratios require a temperature ≥ 180 K. The inferred O_2 column density $\simeq 5 \times 10^{18}$ cm⁻² can be produced in Peak A, having $N(H_2) \simeq 4 \times 10^{24}$ cm⁻². An alternative mechanism is a low-velocity (10 to 15 km s⁻¹) C-shock, which can produce $N(O_2)$ up to 10^{17} cm⁻².

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Mid-infrared observations of the transitional disks around DH Tau, DM Tau, and GM Aur

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Aims. We present mid-infrared observations and photometry of the transitional disks around the young stellar objects DH Tau, DM Tau, and GM Aur, obtained with VISIR/VLT in N band. Our aim is to resolve the inner region and the large-scale structures of these transitional disks, carrying potential signatures of intermediate or later stages of disk evolution and ongoing planet formation.

Methods. We use the simultaneously observed standard-stars as PSF reference to constrain the radial flux profiles of our target objects. Subtracting the obtained standard-star profile from the corresponding science object profile yields the flux residuals produced by the star-disk system. A detection threshold takes into account the background standard deviation and also the seeing variations during the observations to evaluate the significance of these flux residuals. On the basis of a simple model for the dust re-emission, we derive constraints on the inner radius of the dust disk.

Results. We spatially resolve the transitional disk around GM Aur and determine an inner-disk hole radius of $20.5^{+1.0}_{-0.5}$ AU. The circumstellar disks around DH Tau and DM Tau are not spatially resolved but we are able to constrain the inner-disk hole radius to $< 15.5^{+9.0}_{-2.0}$ and $< 15.5^{+0.5}_{-0.5}$ AU, respectively. The performed photometry yields fluxes of 178 ± 31 mJy for DH Tau, 56 ± 6 mJy for DM Tau, and 229 ± 14 mJy for GM Aur.

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H₂CO in the Horsehead PDR: Photo-desorption of dust grain ice mantles

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Aims. For the first time, we investigate the role of grain surface chemistry in the Horsehead PDR.

Methods. We performed deep observations of several H₂CO rotational lines towards the PDR and its associated dense core in the Horsehead nebula, where the dust is cold ($T_{dust} \simeq 20 - 30$ K). We complemented these observations with a map of the p-H₂CO 3₀₃ – 2₀₂ line at 218.2 GHz (with 12'' angular resolution). We determine the H₂CO abundances using a detailed radiative transfer analysis and compare these results with PDR models including either pure gas-phase chemistry or both gas-phase and grain surface chemistry.

Results. The H₂CO abundances ($\simeq 2 - 3 \times 10^{-10}$) with respect to H nuclei are similar in the PDR and dense core. In the dense core, the pure gas-phase chemistry model reproduces the observed H₂CO abundance. Thus, surface processes do not contribute significantly to the gas-phase H₂CO abundance in the core. In contrast, in the PDR, formation of H₂CO on the surface of dust grains and subsequent photo-desorption into the gas-phase are needed to explain the observed gas-phase H₂CO abundance, as gas-phase chemistry alone does not produce enough H₂CO. The assignments of different formation routes are straightened by the different measured ortho-to-para ratio of H₂CO: the dense core displays the equilibrium value (~ 3) while the PDR displays an out of equilibrium value (~ 2).

Conclusions. Photo-desorption of H₂CO ices is an efficient mechanism to release large amount of gas-phase H₂CO in the Horsehead PDR.

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Disks and Outflows in CO Rovibrational Emission from Embedded, Low-Mass Young Stellar Objects

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Young circumstellar disks that are still embedded in dense molecular envelopes may differ from their older counterparts, but are historically difficult to study because emission from a disk can be confused with envelope or outflow emission. CO fundamental emission is a potentially powerful probe of the disk/wind structure within a few AU of young protostars. In this paper, we present high spectral ($R = 90,000$) and spatial (~ 0.3 arcsec) resolution *VLT*/CRIRES M-band spectra of 18 low-mass young stellar objects (YSOs) with dense envelopes in nearby star-forming regions to explore the utility of CO fundamental ($\Delta v = 1$) $4.6 \mu\text{m}$ emission as a probe of very young disks. CO fundamental emission is detected from 14 of the YSOs in our sample. The emission line profiles show a range of strengths and shapes, but can generally be classified into a broad, warm component and a narrow, cool component. The broad CO emission is detected more frequently from YSOs with bolometric luminosities of $< 15 L_{\odot}$ than those with $> 15 L_{\odot}$. The broad emission shares many of the same properties as CO fundamental emission seen from more mature disks around classical T Tauri stars (CTTSs) and is similarly attributed to the warm (~ 1000 K) inner AU of the disk. CO emission from the inner disk is not detected from most YSOs with a high bolometric luminosity. Instead, the CO emission from those objects is produced in cooler (~ 320 K), narrow lines in ^{12}CO and in rarer isotopologues. From some objects, the narrow lines are blueshifted by up to $\sim 10 \text{ km s}^{-1}$, indicating a slow wind or outflow origin. For other sources the lines are located at the systemic velocity of the star and likely arise in the disk. For a few YSOs, spatially-extended CO and H_2 S(9) emission is detected up to $\sim 2''$ from the central source and is attributed to interactions between the wind and surrounding molecular material. Warm CO absorption is detected in the wind of six objects with velocities up to 100 km s^{-1} , often in discrete velocity components. That the wind is partially molecular where it is launched favors ejection in a disk wind rather than a coronal or chromospheric wind.

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Identification of Bursting Water Maser Features in Orion KL

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In February 2011, a burst event of the H_2O maser in Orion KL (Kleinmann-Low object) has started after 13-year silence. This is the third time to detect such phenomena in Orion KL, followed by those in 1979-1985 and 1998. We have carried out astrometric observations of the bursting H_2O maser features in Orion KL with VERA (VLBI Exploration of Radio Astrometry), a Japanese VLBI network dedicated for astrometry. The total flux of the bursting feature at the LSR velocity of 7.58 km s^{-1} reaches $4.4 \times 10^4 \text{ Jy}$ in March 2011. The intensity of the bursting feature is three orders of magnitudes larger than that of the same velocity feature in the quiescent phase in 2006. Two months later, another new feature appears at the LSR velocity of 6.95 km s^{-1} in May 2011, separated by 12 mas north of the 7.58 km s^{-1} feature. Thus, the current burst occurs at two spatially different features. The bursting masers are elongated along the northwest-southeast direction as reported in the previous burst in 1998. We determine the absolute positions of the bursting features for the first time ever with a submilli-arcsecond (mas) accuracy. Their positions are coincident with the shocked molecular gas called the Orion Compact Ridge. We tentatively detect the

absolute proper motions of the bursting features toward southwest direction. It is most likely that the outflow from the radio source I or another young stellar object interacting with the Compact Ridge is a possible origin of the H₂O maser burst.

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GM 2-4 - a signpost for low and intermediate mass star formation

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We present a multi-wavelength study of the region towards the GM 2-4 nebula and the nearby source IRAS 05373+2340. Our near-infrared H₂ 1-0 S(1) line observations reveal various shock-excited features which are part of several bipolar outflows. We identify candidates for the driving sources of the outflows from a comparison of the multi-waveband archival data-sets and SED modelling. The SED spectral slope (α^{IRAC}) for all the protostars in the field was then compared with the visual extinction map. This comparison suggests that star formation is progressing from NE to SW across this region.

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H₂ flows in the Corona Australis cloud and their driving sources

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Aims: We uncover the H₂ flows in the Corona Australis molecular cloud and in particular identify the flows from the Coronet cluster.

Methods: A deep, near-infrared H₂ v=1-0 S(1), 2.122 μ m-line, narrow-band imaging survey of the R CrA cloud core was carried out. The nature of all candidate-driving sources in the region was evaluated using data available from the literature and also by fitting the spectral energy distributions (SED) of each source either with an extincted photosphere or YSO model. Archival *Spitzer*-IRAC and MIPS data was used to obtain photometry, which was combined with USNO, 2MASS catalogs and millimeter photometry from the literature, to build the SEDs. We identify the best candidate-driving source for each outflow by comparing the flow properties, available proper motions, and the known/estimated properties of the driving sources. We also adopted the thumbrule of outflow power as proportional to source luminosity and inversely proportional to the source age to reach a consensus.

Results: Continuum-subtracted, narrow-band images reveal several new Molecular Hydrogen emission-line Objects (MHOs). Together with previously known MHOs and Herbig-Haro objects we catalog at least 14 individual flow components of which 11 appear to be driven by the R CrA aggregate members. The flows originating in the Coronet cluster have lengths of \sim 0.1-0.2 pc. Eight out of nine submillimeter cores mapped in the Coronet cluster region display embedded stars driving an outflow component. Roughly 80% of the youngest objects in the Coronet are associated with outflows. The MHO flows to the west of the Coronet display lobes moving to the west and vice-versa, resulting in nondetections of the counter lobe in our deep imaging. We speculate that these counterflows may be experiencing

a stunting effect in penetrating the dense central core.

Conclusions: Although this work has reduced the ambiguities for many flows in the Coronet region, one of the brightest H₂ feature (MHO2014) and a few fainter features in the region remain unassociated with a clear driving source. The flows from Coronet, therefore, continue to be interesting targets for future studies.

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Complex Scattered Radiation Fields and Multiple Magnetic Fields in the Protostellar Cluster in NGC 2264

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Near-infrared (IR) imaging polarimetry in the J , H , and K_s bands has been carried out for the protostellar cluster region around NGC 2264 IRS 2 in the Monoceros OB1 molecular cloud. Various infrared reflection nebulae clusters (IRNCs) associated with NGC 2264 IRS 2 and IRAS 12 S1 core were detected as well as local infrared reflection nebulae (IRNe). The illuminating sources of the IRNe were identified with known or new near- and mid-IR sources. In addition, 314 point-like sources were detected in all three bands and their aperture polarimetry was studied. Using a color–color diagram, reddened field stars and diskless pre-main sequence stars were selected to trace the magnetic field (MF) structure of the molecular cloud. The mean polarization position angle of the point-like sources is 81 ± 29 degree in the cluster core, and 58 ± 24 degree in the perimeter of the cluster core, which is interpreted as the projected direction on the sky of the MF in the observed region of the cloud. The Chandrasekhar–Fermi method gives a rough estimate of the MF strength to be about $100 \mu\text{G}$. A comparison with recent numerical simulations of the cluster formation implies that the cloud dynamics is controlled by the relatively strong MF. The local MF direction is well associated with that of CO outflow for IRAS 12 S1 and consistent with that inferred from submillimeter polarimetry. In contrast, the local MF direction runs roughly perpendicular to the Galactic MF direction.

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Resolving the Circumstellar Disk of HL Tauri at Millimeter Wavelengths

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We present results of high-resolution imaging toward HL Tau by the Combined Array for Research in Millimeter-wave Astronomy (CARMA). We have obtained $\lambda = 1.3$ mm and 2.7 mm dust continua with an angular resolution down to $0.13''$. Through model fitting to the two wavelength data simultaneously in Bayesian inference using a flared viscous accretion disk model, we estimate the physical properties of HL Tau, such as density distribution, dust opacity spectral index, disk mass, disk size, inclination angle, position angle, and disk thickness. HL Tau has a circumstellar disk mass of $0.13 M_{\odot}$, a characteristic radius of 79 AU, an inclination of 40° , and a position angle of 136° . Although a thin disk model is preferred by our two wavelength data, a thick disk model is needed to explain the high mid- and far-infrared

emission of the HL Tau spectral energy distribution. This could imply large dust grains settled down on the mid plane with fine dust grains mixed with gas. The HL Tau disk is likely gravitationally unstable and can be fragmented between 50 and 100 AU of radius. However, we did not detect dust thermal continuum supporting the protoplanet candidate claimed by a previous study using observations of the Very Large Array at $\lambda = 1.3$ cm.

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A Rotating Disk in the HH 111 Protostellar System

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The HH 111 protostellar system is a young Class I system with two sources, VLA 1 and VLA 2, at a distance of 400 pc. Previously, a flattened envelope has been seen in C¹⁸O to be in transition to a rotationally supported disk near the VLA 1 source. The follow-up study here is to confirm the rotationally supported disk at 2–3 times higher angular resolutions, at $\sim 0''.3$ (or 120 AU) in 1.33 mm continuum, and $\sim 0''.6$ (or 240 AU) in ¹³CO ($J = 2 - 1$) and ¹²CO ($J = 2 - 1$) emission obtained with the Submillimeter Array. The 1.33 mm continuum emission shows a resolved dusty disk associated with the VLA 1 source perpendicular to the jet axis, with a Gaussian deconvolved size of ~ 240 AU. The ¹³CO and ¹²CO emissions toward the dusty disk show a Keplerian rotation, indicating that the dusty disk is rotationally supported. The density and temperature distributions in the disk derived from a simple disk model are found to be similar to those found in bright T-Tauri disks, suggesting that the disk can evolve into a T-Tauri disk in the late stage of star formation. In addition, a hint of a low-velocity molecular outflow is also seen in ¹³CO and ¹²CO coming out from the disk.

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Overlapping abundance gradients and azimuthal gradients related to the spiral structure of the Galaxy

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The connection between some features of the metallicity gradient in the Galactic disk, best revealed by Open Clusters and Cepheids, and the spiral structure, is explored. The step-like abrupt decrease in metallicity at 8.5 kpc (with $R_0 = 7.5$ kpc, or at 9.5 kpc if $R_0 = 8.5$ kpc is adopted) is well explained by the corotation ring-shaped gap in the density of gas, which isolates the internal and external regions of the disk one from the other. This solves a long standing problem of understanding the different chemical characteristics of the inner and outer parts of the disk. The time required to build up the metallicity difference between the two sides of the step is a measure of the minimal life-time of the present grand-design spiral pattern structure, of the order of 3 Gyr. The plateaux observed on each side of the step are interpreted in terms of the large scale radial motion of the stars and of the gas flow induced by the spiral structure. The star-formation rate revealed by the density of open clusters is maximum in the Galactic radial range from 6 to 12 kpc (with an exception of a narrow gap at corotation), coinciding with the region where the 4-arms

mode is allowed to exist. We argue that most of the old open clusters situated at large galactocentric radii were born in this inner region where conditions more favorable to star-formation are found. The ratio of α -elements to Fe of the sample of Cepheids does not vary appreciably with the Galactic radius, which reveals an homogeneous history of star formation. Different arguments are given showing that usual approximations of chemical evolution models, which assume fast mixing of metallicity in the azimuthal direction and ignore the existence of the spiral arms, are a poor ones.

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Correlation between Interstellar Polarization and Dust Temperature: Alignment of Grains by Radiative Torques is Ubiquitous?

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We investigate the efficiency of interstellar polarization p_λ/A_λ where p_λ is the fractional linear polarization and A_λ is extinction, in 16 lines of sight as a function of wavelength λ . We have used the data obtained with the low-dispersion spectropolarimeter HBS as well as those in literature. It is found that the polarization efficiency p_λ/A_λ is proportional to $\exp(-\beta/\lambda)$ in wavelength $\lambda \approx 0.4 - 0.8 \mu\text{m}$, where β is a parameter which varies from 0.5 to 1.2 μm . We find that β is negatively correlated with the dust temperature deduced from infrared data by Schlegel et al., suggesting that the polarization efficiency is higher in short wavelength for higher temperature. According to the alignment theory by radiative torques (RATs), if the radiation is stronger and bluer, RATs will make small grains align better, and the polarization efficiency will increase in short wavelength. Our finding of the correlation between β and the temperature is consistent with what is expected with the alignment mechanism by RATs.

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The Spitzer ice legacy: Ice evolution from cores to protostars

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Ices regulate much of the chemistry during star formation and account for up to 80% of the available oxygen and carbon. In this paper, we use the *Spitzer c2d* ice survey, complimented with data sets on ices in cloud cores and high-mass protostars, to determine standard ice abundances and to present a coherent picture of the evolution of ices during low- and high-mass star formation. The median ice composition $\text{H}_2\text{O}:\text{CO}:\text{CO}_2:\text{CH}_3\text{OH}:\text{NH}_3:\text{CH}_4:\text{XCN}$ is 100:29:29:3:5:5:0.3 and 100:13:13:4:5:2:0.6 toward low- and high-mass protostars, respectively, and 100:31:38:4:--:--:-- in cloud cores. In the low-mass sample, the ice abundances with respect to H_2O of CH_4 , NH_3 , and the component of CO_2 mixed with H_2O typically vary by $<25\%$, indicative of co-formation with H_2O . In contrast, some CO and CO_2 ice components, XCN and CH_3OH vary by factors 2–10 between the lower and upper quartile. The XCN band

correlates with CO, consistent with its OCN^- identification. The origin(s) of the different levels of ice abundance variations are constrained by comparing ice inventories toward different types of protostars and background stars, through ice mapping, analysis of cloud-to-cloud variations, and ice (anti-)correlations. Based on the analysis, the first ice formation phase is driven by hydrogenation of atoms, which results in a H_2O -dominated ice. At later prestellar times, CO freezes out and variations in CO freeze-out levels and the subsequent CO-based chemistry can explain most of the observed ice abundance variations. The last important ice evolution stage is thermal and UV processing around protostars, resulting in CO desorption, ice segregation and formation of complex organic molecules. The distribution of cometary ice abundances are consistent with the idea that most cometary ices have a protostellar origin.

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Complex molecules toward low-mass protostars: the Serpens core

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Gas-phase complex organic molecules are commonly detected toward high-mass protostellar hot cores. Detections toward low-mass protostars and outflows are comparatively rare, and a larger sample is key to investigate how the chemistry responds to its environment. Guided by the prediction that complex organic molecules form in CH_3OH -rich ices and thermally or non-thermally evaporate with CH_3OH , we have identified three sight-lines in the Serpens core – SMM1, SMM4 and SMM4-W – which are likely to be rich in complex organics. Using the IRAM 30m telescope, narrow lines (FWHM of 1–2 km s^{-1}) of CH_3CHO and CH_3OCH_3 are detected toward all sources, HCOOCH_3 toward SMM1 and SMM4-W, and $\text{C}_2\text{H}_5\text{OH}$ not at all. Beam-averaged abundances of individual complex organics range between 0.6 and 10% with respect to CH_3OH when the CH_3OH rotational temperature is applied. The summed complex organic abundances also vary by an order of magnitude, with the richest chemistry toward the most luminous protostar SMM1. The range of abundances compare well with other beam-averaged observations of low-mass sources. Complex organic abundances are of the same order of magnitude toward low-mass protostars and high-mass hot cores, but HCOOCH_3 is relatively more important toward low-mass protostars. This is consistent with a sequential ice photochemistry, dominated by CHO-containing products at low temperatures and early times.

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A study of methyl formate in astrochemical environments

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Several complex organic molecules are routinely detected in high abundances towards hot cores and hot corinos. For many of them, their paths of formation in space are uncertain, as gas phase reactions alone seem to be insufficient. In this paper, we investigate a possible solid-phase route of formation for methyl formate (HCOOCH_3). We use a chemical model updated with recent results from an experiment where simulated grain surfaces were irradiated with 200 keV protons at 16 K, to simulate the effects of cosmic ray irradiation on grain surfaces. We find that this model may be sufficient to reproduce the observed methyl formate in dark clouds, but not that found in hot cores and corinos.

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Ortho-H₂ and the age of interstellar dark clouds

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Interstellar dark clouds are the sites of star formation. Their main component, dihydrogen exists under two states, ortho and para. H₂ is supposed to form in the ortho:para ratio (OPR) of 3:1 and to subsequently decay to almost pure para-H₂ (OPR \leq 0.001). Only if the H₂ OPR is low enough, will deuteration enrichment, as observed in the cores of these clouds, be efficient. The second condition for strong deuteration enrichment is the local disappearance of CO, which freezes out onto grains in the core formation process. We show that this latter condition does not apply to DCO⁺, which, therefore, should be present all over the cloud. We find that an OPR \geq 0.1 is necessary to prevent DCO⁺ **large-scale apparition**. We conclude that the inevitable decay of ortho-H₂ sets an upper limit of \sim 6 million years to the age of starless molecular clouds under usual conditions.

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http://aramis.obspm.fr/~pagani/biblio_laurent_pagani.php

Accretion powered chromospheres in classical T Tauri stars

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Context. Optical spectra of classical T Tauri stars are rich in emission lines of low excitation species composed of narrow and broad components, thus indicating the existence of two emitting regions with different kinematics, densities and temperatures. The photospheric spectrum is often veiled by an excess continuous emission. This veiling is usually attributed to radiation from a heated region beneath the accretion shock. The broad emission lines of H I, He II, Ca II, Fe II and other species are thought to form in a larger volume of gas.

Aims. The aim of this research is to clarify the nature of the veiling, and whether the narrow chromospheric lines of Fe I and other metals represent a standard chromosphere of a late-type star, or are induced by mass accretion.

Methods. We carried out high-resolution spectroscopy of selected cTTS, with a special focus on DR Tauri, and followed variations of chromospheric features, like narrow Fe I emission lines, and accretion signatures, such as the veiling continuum and the He II line emission.

Results. We found that the amount of veiling in DR Tau varies from practically nothing to factors more than 10 times the stellar continuum intensity, and that the veiling is due both to a non-photospheric continuum and chromospheric line emission filling in the photospheric absorption lines. The latter causes differential veiling in that stronger lines are more veiled. We develop methods to separate the two sources of veiling. Several veiled T Tauri stars show a common effect in that the radial velocities of photospheric and chromospheric lines vary in anti-phase. This is caused by an area with enhanced chromospheric emission, which is offset from the pole of rotation and is associated with the hot spot formed at the footprint of the magnetic funnel of mass accretion.

Conclusions. The enhanced chromospheric emission in cTTS is linked not only to solar-like magnetic activity, but is powered to a larger extent by the accreting gas. We suggest that the area of enhanced chromospheric emission is induced by mass accretion, which modifies the local structure of stellar atmosphere in an area that is more extended than the hot accretion spot. The narrow emission lines from this extended area are responsible for the extra component in the veiling through line-filling of photospheric absorption lines.

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Resolving the CO Snow Line in the Disk around HD 163296

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We report Submillimeter Array (SMA) observations of CO (J=2–1, 3–2 and 6–5) and its isotopologues (¹³CO J=2–1, C¹⁸O J=2–1 and C¹⁷O J=3–2) in the disk around the Herbig Ae star HD 163296 at $\sim 2''$ (250 AU) resolution, and interpret these data in the framework of a model that constrains the radial and vertical location of the line emission regions. First, we develop a physically self-consistent accretion disk model with an exponentially tapered edge that matches the spectral energy distribution and spatially resolved millimeter dust continuum emission. Then, we refine the vertical structure of the model using wide range of excitation conditions sampled by the CO lines, in particular the rarely observed J=6–5 transition. By fitting ¹³CO data in this structure, we further constrain the vertical distribution of CO to lie between a lower boundary below which CO freezes out onto dust grains ($T \sim 19$ K) and an upper boundary above which CO can be photodissociated (the hydrogen column density from the disk surface is $\sim 10^{21}$ cm⁻²). The freeze-out at 19 K leads to a significant drop in the gas-phase CO column density beyond a radius of ~ 155 AU, a “CO snow line” that we directly resolve. By fitting the abundances of all CO isotopologues, we derive isotopic ratios of ¹²C/¹³C, ¹⁶O/¹⁸O and ¹⁸O/¹⁷O that are consistent with quiescent interstellar gas-phase values. This detailed model of the HD 163296 disk demonstrates the potential of a staged, parametric technique for constructing unified gas and dust structure models and constraining the distribution of molecular abundances using resolved multi-transition, multi-isotope observations.

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An overview of the observational and theoretical studies of HH 1 and 2

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We present a description of the bibliography of HH 1 and 2, from the discovery of HH objects (by Herbig and Haro in 1951/2) up to the year 2010. The work on HH 1 and 2 traces the history of the field of Herbig-Haro objects, and includes most of the important developments of our understanding of outflows from young stars.

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<http://www.nucleares.unam.mx/astroplasmas/index.php/recent-papers/refereed-papers-list/127-an-overview-of-the-observational-and-theoretical-studies-of-hh-1-and-2>

Dust Grain Evolution in Spatially Resolved T Tauri Binaries

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Core-accretion planet formation begins in protoplanetary disks with the growth of small, ISM dust grains into larger particles. The progress of grain growth, which can be quantified using 10 μ m silicate spectroscopy, has broad im-

plications for the final products of planet formation. Previous studies have attempted to correlate stellar and disk properties with the $10\mu\text{m}$ silicate feature in an effort to determine which stars are efficient at grain growth. Thus far there does not appear to be a dominant correlated parameter. In this paper, we use spatially resolved adaptive optics spectroscopy of 9 T Tauri binaries as tight as $0.25''$ to determine if basic properties shared between binary stars, such as age, composition, and formation history, have an effect on dust grain evolution. We find with 90-95% confidence that the silicate feature equivalent widths of binaries are more similar than those of randomly paired single stars, implying that shared properties do play an important role in dust grain evolution. At lower statistical significance, we find with 82% confidence that the secondary has a more prominent silicate emission feature (i.e., smaller grains) than the primary. If confirmed by larger surveys, this would imply that spectral type and/or binarity are important factors in dust grain evolution.

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X-ray Production by V1647 Ori During Optical Outbursts

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The pre-main sequence star V1647 Ori has recently undergone two optical/near-infrared (OIR) outbursts that are associated with dramatic enhancements in the stellar accretion rate. Our intensive X-ray monitoring of this object affords the opportunity to investigate whether and how the intense X-ray emission is related to pre-MS accretion activity. Our analysis of all fourteen Chandra X-ray Observatory observations of V1647 Ori demonstrate that variations in the X-ray luminosity of V1647 Ori are correlated with similar changes in the OIR brightness of this source during both (2003–2005 and 2008) eruptions, strongly supporting the hypothesis that accretion is the primary generation mechanism for the X-ray outbursts. Furthermore, the Chandra monitoring demonstrates that the X-ray spectral properties of the second eruption were strikingly similar to those of the 2003 eruption. We find that X-ray spectra obtained immediately following the second outburst — during which V1647 Ori exhibited high X-ray luminosities, high hardness ratios, and strong X-ray variability — are well modeled as a heavily absorbed ($N_H \sim 4 \times 10^{22} \text{ cm}^{-2}$), single-component plasma with characteristic temperatures ($kT_X \sim 2\text{--}6 \text{ keV}$) that are consistently too high to be generated via accretion shocks but are in the range expected for plasma heated by magnetic reconnection events. We also find that the X-ray absorbing column has not changed significantly throughout the observing campaign. Since the OIR and X-ray changes are correlated, we hypothesize that these reconnection events either occur in the accretion stream connecting the circumstellar disk to the star or in accretion-enhanced protostellar coronal activity.

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Complex Structure in Class 0 Protostellar Envelopes II: Kinematic Structure from Single-Dish and Interferometric Molecular Line Mapping

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We present a study of dense molecular gas kinematics in seventeen nearby protostellar systems using single-dish and interferometric molecular line observations. The non-axisymmetric envelopes around a sample of Class 0/I protostars were mapped in the N₂H⁺ (J=1-0) tracer with the IRAM 30m, CARMA and PdBI as well as NH₃ (1,1) with the VLA. The molecular line emission is used to construct line-center velocity and linewidth maps for all sources to examine the kinematic structure in the envelopes on spatial scales from 0.1 pc to 1000 AU. The direction of the large-scale velocity gradients from single-dish mapping is within 45 degrees of normal to the outflow axis in more than half the sample. Furthermore, the velocity gradients are often quite substantial, the average being 2.3 km/s/pc. The interferometric data often reveal small-scale velocity structure, departing from the more gradual large-scale velocity gradients. In some cases, this likely indicates accelerating infall and/or rotational spin-up in the inner envelope; the median velocity gradient from the interferometric data is 10.7 km/s/pc. In two systems, we detect high-velocity HCO⁺ (J=1-0) emission inside the highest-velocity N₂H⁺ emission. This enables us to study the infall and rotation close to the disk and estimate the central object masses. The velocity fields observed on large and small-scales are more complex than would be expected from rotation alone, suggesting that complex envelope structure enables other dynamical processes (i.e. infall) to affect the velocity field.

Accepted by The Astrophysical Journal

<http://arxiv.org/abs/1107.4361>

Searching for the Driving Source of the CO Molecular Outflow in the High-mass Star-Forming Region G240.31+0.07

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We present low and high angular resolution observations at 1.3, 3.6 and 6 cm obtained from the VLA archive toward the high-mass star-formation region G240.31+0.07. We detected, at least, two continuum sources toward G240.31+0.07 at 1.3 cm, which are spatially associated with the millimeter sources MM1 and MM3 reported in the region. Two continuum sources are also detected in the region at 3.6 and 6 cm, spatially coinciding with the millimeter sources MM1 and MM2. We find that the sources MM2 and MM3 seem to be consistent with ultracompact H II regions, harboring B1-0.5 spectral type zero main-sequence stars. Based on the flux density at 1.3, 3.6 and 6 cm, we also find that the spectral index of MM1 is about -0.4, suggesting a combination of thermal and non-thermal emission. In order to search the nature of MM1, we present a detailed comparison of the high angular resolution 6 cm observations of the epochs 1990.3 and 1995.5. The difference image of the two epochs shows variability toward MM1, its flux density and morphology is changing with time. Moreover a condensation, possibly ejected by MM1 and oriented in the same direction of the CO outflow observed in the region, is also detected. We propose that MM1 is a radio jet and the best candidate to be the driving source of the CO outflow observed in the region.

Accepted by The Astronomical Journal

L1157-B1: Water and ammonia as diagnostics of shock temperature

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We investigate the origin and nature of the profiles of water and ammonia observed toward the L1157-B1 clump as part of the HIFI CHESS survey (Ceccarelli et al. 2010) using a new code coupling a gas-grain chemical model with a parametric shock model. First results from the unbiased survey (Lefloch et al. 2010, Codella et al. 2010) reveal different molecular components at different excitation conditions coexisting in the B1 bow shock structure, with NH_3 , H_2CO and CH_3OH emitting only at relatively low outflow velocities whereas H_2O shows bright emission at high velocities. Our model suggests that these differences are purely chemical and can be explained by the presence of a C-type shock whose maximum temperature must be close to 4000 K along the B1 clump.

Accepted by ApJ Letters

The Influence of the Initial Gas Surface Density and Angular Velocity Distributions in Pre-stellar Cores on the Properties of Young Stellar Objects

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Using numerical hydrodynamics modelling, we investigate the dependence of the physical properties of young stellar objects (YSOs) on the initial spatial distribution of gas surface density Σ and angular velocity Ω in natal prestellar cores. In particular, two limiting cases are considered: spatially homogeneous cores with $\Sigma = \text{const}$ and $\Omega = \text{const}$ and also centrally condensed cores with $\Sigma \propto r^{-1}$ and $\Omega \propto r^{-1}$.

We demonstrate that the strength of gravitational instability and fragmentation in protostellar disks is mainly controlled by the initial core mass and the ratio of rotational to gravitational energy and is weakly sensitive to the initial distribution of Σ and Ω in prestellar cores, except for the earliest phases of the evolution when models with spatially uniform cores tend to be more gravitationally unstable. The behavior of the mass accretion rate from the disk onto the star is also weakly sensitive to the initial density and angular velocity profiles, while the rate of mass infall from the core onto the disk is somewhat higher in models with spatially uniform cores.

A substantial dependence of the disk mass, disk radius, and disk-to-star mass ratio on the initial density and angular velocity profiles in the parent core is found only for young class 0 objects and is not systematically detected in the later stages of the evolution. The stellar mass is weakly sensitive to the initial conditions in the core.

Accepted by Astronomy Reports (Astronomicheskii Zhurnal)

Evolution of Super Star Cluster Winds with Strong Cooling

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We study the evolution of Super Star Cluster (SSC) winds driven by stellar winds and supernova (SN) explosions. Time-dependent rates at which mass and energy are deposited into the cluster volume, as well as the time-dependent chemical composition of the re-inserted gas, are obtained from the population synthesis code Starburst99. These results are used as input for a semi-analytic code which determines the hydrodynamic properties of the cluster wind as a function of cluster age. Two types of winds are detected in the calculations. For the quasi-adiabatic solution, all of the inserted gas leaves the cluster in the form of a stationary wind. For the bimodal solution, some of the inserted gas becomes thermally unstable and forms dense warm clumps which accumulate inside the cluster. We calculate the evolution of the wind velocity and energy flux and integrate the amount of accumulated mass for clusters of different mass, radius and initial metallicity. We consider also conditions with low heating efficiency of the re-inserted gas or mass loading of the hot thermalized plasma with the gas left over from star formation. We find that the bimodal regime and the related mass accumulation occur if at least one of the two conditions above is fulfilled.

Accepted by ApJ

<http://arxiv.org/abs/1107.5451>

Sagittarius B2 Main: A Cluster of Ultra-Compact HII Regions & Massive Protostellar Cores

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The ionized core in the Sgr B2 Main star-forming region was imaged using the Submillimeter Array archival data observed for the H26 α line and continuum emission at 0.86 millimeter with an angular resolution 0.3''. Eight hyper-compact H26 α emission sources were detected with a typical size in the range of 1.6–20 \times 10² AU and electron density of 0.3–3 \times 10⁷ cm⁻³, corresponding to the emission measure 0.4–8.4 \times 10¹⁰ cm⁻⁶ pc. The H26 α line fluxes from the eight hyper-compact HII sources imply that the ionization for each of the sources must be powered by a Lyman continuum flux from an O star or a cluster of B stars. The most luminous H26 α source among the eight detected requires an O6 star that appears to be embedded in the ultra-compact HII region F3. In addition, \sim 23 compact continuum emission sources were also detected within the central 5'' \times 3'' (\sim 0.2 pc) region. In the assumption of a power-law distribution for the dust temperature, with the observed brightness temperature of the dust emission we determined the physical properties of the submillimeter emission sources showing that the molecular densities are in the range of 1–10 \times 10⁸ cm⁻³, surface densities between 13 to 150 g cm⁻², and total gas masses in the range from 5 to \gtrsim 200 M_{\odot} which are 1 or 2 orders of magnitude greater than the corresponding values of the Bonnor-Ebert mass. With a mean free-fall time scale of 2 \times 10³ y, each of the massive protostellar cores are undergoing gravitational collapse to form new massive stars in the Sgr B2 Main core.

Accepted by ApJ

<http://arxiv.org/abs/1108.0916>

New Jobs

Postdoctoral Researcher in Theory of Brown Dwarf and Planetary Atmospheres

The School of Physics & Astronomy of the University of St Andrews (www.st-andrews.ac.uk) is seeking an ambitious postdoctoral researcher to work on brown dwarf and planetary atmosphere theory.

Applications are invited for an active postdoctoral researcher in the area of charge separation and discharge processes to be applied to brown dwarfs and planetary atmospheres. The applicant will be part of a newly forming research group LEAP (www.leap-2010.eu) that studies charge processes in planetary atmospheres and is funded by the European Research Council under the FP7 work program Ideas.

The successful candidate is expected to play a leading role in modelling non-equilibrium gas-phase chemistry under the influence of charge processes in a dusty environment.

The School of Physics & Astronomy of the University of St Andrews offers a young, vibrant and modern work environment with 40% of the astronomy staff members and 57% of the postdoctoral researchers being women. The research in St Andrews combines theoretical, numerical and observational research in extra-solar planets, in protoplanetary disk, in star formation, in magnetic activity, and in star-planet interaction as well as in gravitational lensing and galaxy dynamics.

Applicants for this position should have a PhD in astronomy, astrophysics, or a closely related field. The appointment will be for an initial period of two years with a likely extension to a total of three years, and is in collaboration with Dr Christiane Helling funded by an ERC starting grant with funds for computing, publications, travel, etc.

The ideal starting date is 1 March 2012. For further enquiries, please contact Christiane Helling (Christiane.Helling@st-andrews.ac.uk).

Candidates should send a curriculum vitae, publication list, and a brief statement of research interest by Friday, 28 October 2011, and arrange for two letters of reference to be sent by the referees by the same date. Interviews will be held in early December 2011.

We encourage online application <https://www.vacancies.st-andrews.ac.uk/>, however if you are unable to do this, call +44 (0)1334 462571 for an application pack.

PhD position in Theory of Brown Dwarf and Planetary Atmospheres

The School of Physics & Astronomy of the University of St Andrews (www.st-andrews.ac.uk) offers a PhD position on brown dwarf and planetary atmosphere theory.

We are looking for an excellent graduate student. The graduate student will be part of a newly forming research group LEAP (www.leap-2010.eu) that studies charge processes in planetary atmospheres and is funded by the European Research Council under the FP7 work program Ideas. The PhD student will benefit from the SUPA graduate school, the university's GradSkill program as well as from the lively atmosphere in the department.

The School of Physics & Astronomy of the University of St Andrews offers a young, vibrant and modern work environment with 40% of the astronomy staff members being women. The research in St Andrews combines theoretical, numerical and observational research in extra-solar planets, in protoplanetary disk, in star formation, in magnetic activity, and in star-planet interaction as well as in gravitational lensing and galaxy dynamics.

Applicants for this graduate position should have a degree in astronomy, astrophysics, or a closely related field. The graduate student will work under the supervision of Dr Christiane Helling funded by an ERC starting grant with funds for computing, publications, travel, etc.

The ideal starting date is 1 March 2012. For further enquiries, please contact Christiane Helling (Christiane.Helling@st-andrews.ac.uk).

Candidates should send a CV, publication list, and a brief statement of research interest (max. 1 A4 page) to Dr Helling by Tuesday, 1 November 2011, and arrange for two letters of reference to be sent by the referees by the same date. Interviews will be held in early December 2011.

Postdoc Position on Interstellar Polarimetry

The Polarimetry Group at the Astronomy Department, IAG, University of Sao Paulo, Brazil, invites applications for a 2-yr postdoctoral fellowship, renewable for an additional year.

We have been carrying out an Optical/Infrared Survey (O/IR) of Interstellar Polarization of the Galaxy aimed at improving our knowledge of the structure of the interstellar magnetic field. Targets include High Galactic Latitude Clouds, general ISM, Open Clusters and nearby Dark Clouds. Our group also carries out observations and modeling of circumstellar envelopes, as well as MHD modeling of the ISM, with other colleagues in the Astronomy Department. Collaboration with a number of groups around the world on these and other topics is also an on-going activity. Extension of our work towards the sub-mm (Planck, ALMA & APEX) is a recent, exciting scientific pursuit being carried out.

We have developed polarimetric instrumentation and software for the Brazilian National Observatory (LNA) and CTIO (Chile). Currently, a large (2 sq.deg.) area imaging polarimeter is being built and which will carry out SOUTH POL, a survey of the whole Southern sky in polarized light. SOUTH POL will use an 80-cm Robotic Telescope, which will be sited at CTIO in late 2012.

The successful candidate is expected to:

- participate in and support the analysis and publication of our Group's existing O/IR Survey data;
- implement the O/IR Survey data reduction pipeline in IRAF and related database;
- implement SOUTH POL's data reduction pipeline in IRAF and related database, and be involved in all planing aspects of this project, in preparation for its deployment.
- support our Group's observational work at LNA, CTIO and ESO observatories;
- support the preparation and execution of proposals in the sub-mm domain;
- maintain the Group's web pages, including the implementation of a web exposure time calculator.

Close involvement with the other activities of the Group is highly encouraged. A positive attitude towards working collaboratively in a research environment is paramount.

Applicants should have:

- experience in optical and/or NIR imaging or imaging polarimetry; experience with far IR/sub-mm data, in intensity or polarization, would be highly desirable.
- programming skills in IRAF and/or PyRAF scripts; knowledge of IDL would be highly desirable.

Applicants should send a CV, including publication list, statement of interest and two letters of recommendation to:

Prof. Antonio Mario Magalhaes
Departamento de Astronomia
IAG-USP
Rua do Matao, 1226
Sao Paulo - SP 05508-900
Brazil

or, preferably, via email to mario@astro.iag.usp.br. Deadline for applications is September 30, 2011, or until a suitable candidate is found. The successful applicant is expected to take on his position no later than March 2012, although the exact date is negotiable.

The successful candidate will have a fellowship reviewed and awarded by the Sao Paulo state funding agency FAPESP. The fellowship is for two years, renewable for an additional year pending a positive evaluation. The current, tax exempt monthly stipend is R\$ 5,333.40 (about 2,300 EUR or US\$ 3,300, in August 2011). The fellowship additionally provides the fellow with a Research Contingency fund (e.g., for travel, etc.) amounting to 15% of the annual value of the fellowship. FAPESP may also provide for the transportation expenses to Sao Paulo and an extra amount equal to a monthly stipend for installation purposes. For further details, please contact us at mario@astro.iag.usp.br.

Short Announcements

Fizeau exchange visitors program - call for applications

Dear colleagues!

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff).

The deadline for applications is the 15th of September for visits starting 1st of November.

Further informations and application forms can be found at www.european-interferometry.eu

The program is funded by OPTICON/FP7.

Looking forward to your applications,

Josef Hron & Laszlo Mosoni (for the European Interferometry Initiative)

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

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

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

Protoplanetary Dust
Astrophysical and Cosmochemical Perspectives
Edited by Dániel Apai and Dante S. Lauretta

Planet formation studies uniquely benefit from three disciplines: astronomical observations of extrasolar planet-forming disks, analysis of material from the early Solar System, and laboratory astrophysics experiments. Pre-planetary solids, fine dust, and chondritic components are central elements linking these studies. This book offers a comprehensive overview of planet formation, where astronomers, cosmochemists, and laboratory astrophysicists jointly discuss the latest insights from the Spitzer and Hubble space telescopes, new interferometers, space missions including Stardust and Deep Impact, and laboratory techniques. Following the evolution of solids from their genesis through protoplanetary disks to rocky planets, the book discusses in detail how the latest results from these disciplines fit into a coherent picture. The book contains the following chapters:

1. Planet formation and protoplanetary dust

Daniel Apai and Dante Lauretta

- 1.1 Types of extraterrestrial material available
- 1.2 Chronology of planet formation
- 1.3 Protostellar collapse
- 1.4 Structural evolution of protoplanetary disks
- 1.5 Chemical evolution of the gas disks
- 1.6 Laboratory dust analogs
- 1.7 Dust composition in protoplanetary disks
- 1.8 Dust coagulation
- 1.9 Thermal processing of the pre-planetary material
- 1.10 Dispersal of protoplanetary disks
- 1.11 Accretion of planetesimals and rocky planets
- 1.12 Key challenges and perspectives

2. The origins of protoplanetary dust and the formation of accretion disks

Hans-Peter Gail and Peter Hoppe

- 2.1 Dust in the interstellar medium
- 2.2 Presolar grains in primitive Solar System materials
- 2.3 Star formation

3. Evolution of protoplanetary disk structures

Fred Ciesla and Cornelius P. Dullemond

- 3.1 Some properties of protoplanetary disks
- 3.2 Protoplanetary disk structure and evolution
- 3.3 Particle dynamics
- 3.4 Protoplanetary disk dynamics and dust evolution
- 3.5 Summary

4. Chemical and isotopic evolution of the solar nebula and protoplanetary disks

Dmitry Semenov, Subrata Chakraborty and Mark Thiemens

- 4.1 Protoplanetary disks
- 4.2 Chemical constraints from early Solar System materials
- 4.3 Isotopic anomalies and condensation sequence
- 4.4 Oxygen isotopes
- 4.5 Summary

5. Laboratory studies of simple dust analogs in astrophysical environments

John R. Brucato and Joseph A. Nuth III

- 5.1 Dust-analog synthesis
- 5.2 Characterization techniques

- 5.3 Dust processing
- 5.4 Grain-growth studies
- 5.5 Grain-catalysis studies
- 5.6 Conclusion

6. Dust composition in protoplanetary dust

Michiel Min and George Flynn

- 6.1 Modeling the dust composition
- 6.2 Laboratory studies of Solar System dust
- 6.3 Dust composition in Solar System samples
- 6.4 Remote sensing of dust around young stars and in comets
- 6.5 Composition of the dust
- 6.6 Processing history of grains as derived from the dust composition

7. Dust particle size evolution

Klaus M. Pontoppidan and Adrian J. Brearley

- 7.1 Dust coagulation in the Solar System and in extrasolar protoplanetary disks
- 7.2 Nomenclature and definitions
- 7.3 Coagulation basics
- 7.4 Laboratory simulations of dust coagulation
- 7.5 Observational tracers of grain coagulation
- 7.6 Chondritic meteorites
- 7.7 What do chondrite matrices tell us about the grain size of nebular dust?
- 7.8 Dust coagulation: how and when?
- 7.9 Constraints on dust coagulation from amorphous silicates
- 7.10 When did dust coagulation occur?
- 7.11 Astronomical versus meteoritic constraints

8. Thermal processing in protoplanetary nebulae

Daniel Apai, Harold C. Connolly Jr. and Dante S. Lauretta

- 8.1 Thermal processing: annealing and evaporation
- 8.2 Observations of thermal processing in protoplanetary disks
- 8.3 Thermal processing in the Solar System: chondrites
- 8.4 Heating mechanisms
- 8.5 How would Solar System formation look to an outside observer?
- 8.6 Promising future experiments

9. The clearing of protoplanetary disks and of the protosolar nebula

Iaira Pascucci and Shogo Tachibana

- 9.1 The observed lifetime of protoplanetary disks
- 9.2 Disk dispersal processes
- 9.3 Our Solar System
- 9.4 Discussion

10. Accretion of planetesimals and the formation of rocky planets

John E. Chambers, David O'Brien and Andrew M. Davis

- 10.1 Observational constraints on rocky-planet formation
- 10.2 Planetesimal formation
- 10.3 Growth of rocky planets
- 10.4 The effect of the giant planets and the formation of the Asteroid Belt
- 10.5 Summary

Appendix 1: Common minerals in the Solar System

Appendix 2: Mass Spectrometry

Appendix 3: Basics of light absorption and scattering theory

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377 pages, hardcover US\$120.00

Available from <http://www.cambridge.org/us/knowledge/isbn/item2708143/>

Workshop on Cosmic ray induced phenomenology in star-forming environments

April 16-19, 2012, in Sant Cugat, near Barcelona, Spain

Rationale: During the last few years, we witnessed how our newest facilities operating in the regime of gamma-rays of high (more than 100 MeV) and very-high energy (more than 100 GeV), among them the GeV-satellites Fermi and AGILE and the ground-based TeV telescopes MAGIC, VERITAS and HESS, established interesting facts concerning cosmic-ray induced phenomenology in stellar environments. Indeed, observations of nearby normal galaxies like the LMC, have revealed an inner structure that allow spatial investigations with the aim of studying the influence of star forming regions directly. The discoveries of starburst galaxies in gamma-rays were achieved both in GeV and TeV bands, and are anticipated to be complemented by population studies of starburst and luminous infrared galaxies with current and future more-sensitive instruments. Then, discussions of the interplay between central AGNs and starbursts as origins of the high-energy emission are emerging, as well as detailed analysis of the cosmic-ray environments in galaxies other than our own.

The relationship between cosmic-ray acceleration in shells and their interaction in nearby molecular clouds can be studied observationally with an increasing degree of precision, shedding light on the diffusion properties of cosmic-rays in different Galactic environments. Additionally to this traditional focus of astroparticle physics regarding an understanding of the propagation of the highest energy CRs, molecular abundance ratios could turn out to be a new way to trace the presence of cosmic rays and to infer their fluxes, given that observed abundance enhancements could be due to ionization by X-rays and/or interactions of low-energy CRs with gas and dust. Finally, the fluorescent Fe K α line at 6.4 keV from molecular clouds in the Galactic center region has been detected and can be accounted for in terms of the impact of low-energy CRs with neutral gas in clouds.

The aim of this Workshop is to address the current knowledge and challenges on the high-energy emission from stellar environments at all scales; providing a sound review of the state of the field from both observational and theoretical perspectives. The meeting will also analyse the prospects for possible observations with planned instruments across the multi-wavelength spectrum and their anticipated impact on our theoretical understanding of these systems.

The topics that will be discussed in this meeting will include: Cosmic-ray acceleration, propagation, and interaction in star-formation environments – Stellar clusters – The Galactic Center – The Magellanic clouds and Local Group galaxies as gamma-ray emitters – Starbursts, luminous, and ultra-luminous infrared galaxies; their cosmic and gamma-ray states – Diffuse emission processes in galaxies – Low energy cosmic-rays – Mergers and AGN-starburst connection – Current and future low (e.g. with HERSCHEL, ALMA, LOFAR, SKA) and high-energy observations (e.g., HESS, MAGIC, VERITAS, FERMI, CTA, and the forthcoming X-ray satellites).

Registration and abstract submission: The registration and abstract submission is open until 2012 January 15. The fee for the workshop will be 300 Euros (350 Euros if paid after March 15, 2012, or at the registration desk the first day of the Workshop).

Important dates:

January 15, 2012: registration and abstract submission deadline

March 15, 2012: deadline for reduced fee payment & for submitting contributions to opt to the Sant Cugat Forum Award for Young Scientists.

Organizers: Olaf Reimer (Innsbruck University) & Diego F. Torres (ICREA & IEEC-CSIC)

Scientific Organization Committee: Wlodek Bednarek (U. Lodz, Poland), Giuseppe Bono (U. Rome, Italy), Margarita Hernanz (IEEC-CSIC, Spain), Jürgen Knödseder (CESR, France), Yoel Rephaeli (Tel Aviv & UC San Diego), Olaf Reimer (U. Innsbruck, Austria), Todd Thompson (U. Ohio, USA), Diego F. Torres (ICREA & IEEC-CSIC, Spain), Rens Waters (SRON, Netherlands)

E-mail contact: dtorres@ieec.uab.es

<http://www.ice.csic.es/research/forum/2012.html>

NRAO-NAASC 2012 Workshop
Outflows, Winds and Jets:
From Young Stars to Supermassive Black Holes
Mar 3 - 6, 2012
Charlottesville, Virginia, USA

2012 is a special year for radio wavelength science. In addition to the much anticipated operation of ALMA Early Science, newly upgraded NRAO facilities – EVLA, GBT and VLBA – are joining forces to offer the astronomy community unprecedented access to instruments of superb imaging capabilities, highest angular resolution and sensitivity, broad spectral coverage, and highest precision. These telescopes together will transform the science of jets and outflows from young stars to super massive black holes. This workshop is an exciting opportunity to bring together active researchers interested in outflow-bearing systems spanning a wide range of mass and size scales for a refreshing view of the spectacular phenomena.

Key focuses of the workshop will be:

- Probing the driving engines deep with the upgraded facilities
- Emission and absorption properties of outflows, winds, and jets
- Structures and chemistry of the outflow systems on various scales
- Cross-talk among the participating communities
- Synergy programs with the featured facilities and other large telescopes

The approach adopted by this workshop is interdisciplinary. Science from different mass and size scales will be naturally blended. We hope to promote interactions among the various communities from young stars to the active galactic nuclei, and to facilitate mutual exchanges and joint efforts at this unique time.

<https://science.nrao.edu/facilities/alma/naasc-workshops/jets2012>

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the Newsletter bounces back from an address for three consecutive months, the address is deleted from the mailing list.