THE STAR FORMATION NEWSLETTER

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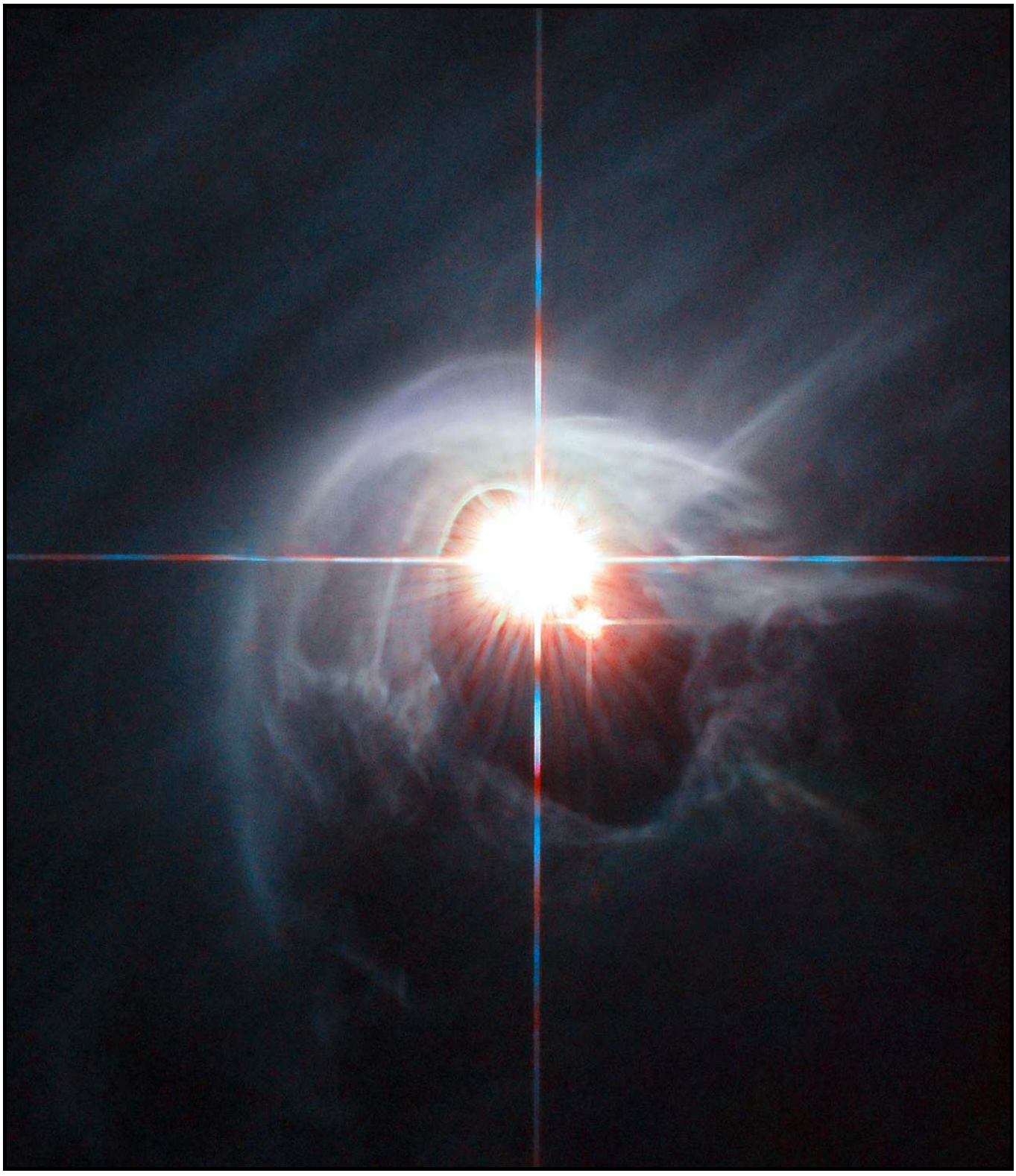

The Star Formation Newsletter

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The Star Formation Newsletter is a vehicle for fast distribution of information of interest for astronomers working on star and planet 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). Additionally, the Newsletter brings short overview articles on objects of special interest, physical processes or theoretical results, the early solar system, as well as occasional interviews.

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Cover Picture

The bright T Tauri star DI Cha, also known as Hen 3-593, is a quadruple system, seen here in a multi-filter HST image. The main component A is a G2 star, which illuminates a prominent reflection nebula. The fainter companion 4.6 arcsec away is itself a M5.5 + M5.5 binary (B,C) with a separation of 0.06 arcsec. The main component A has another M6-type companion D at only 0.2 arcsec separation.

Image credit: NASA / ESA / Hubble / Judy Schmidt.

Submitting your abstracts

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

Abstracts of recently accepted papers

Observability of characteristic binary-induced structures in circumbinary disks

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Context: A substantial fraction of protoplanetary disks forms around stellar binaries. The binary system generates a time-dependent non-axisymmetric gravitational potential, inducing strong tidal forces on the circumbinary disk. This leads to a change in basic physical properties of the circumbinary disk, which should in turn result in unique structures that are potentially observable with the current generation of instruments.
Aims: The goal of this study is to identify these characteristic structures, to constrain the physical conditions that cause them, and to evaluate the feasibility to observe them in circumbinary disks.
Methods: To achieve this, at first two-dimensional hydrodynamic simulations are performed. The resulting density distributions are post-processed with a 3D radiative transfer code to generate re-emission and scattered light maps. Based on these, we study the influence of various parameters, such as the mass of the stellar components, the mass of the disk and the binary separation on observable features in circumbinary disks.
Results: We find that the Atacama Large (sub-)Millimetre Array (ALMA) as well as the European Extremely Large Telescope (E-ELT) are capable of tracing asymmetries in the inner region of circumbinary disks which are affected most by the binary-disk interaction. Observations at submillimetre/millimetre wavelengths will allow the detection of the density waves at the inner rim of the disk and the inner cavity. With the E-ELT one can partially resolve the innermost parts of the disk in the infrared wavelength range, including the disk's rim, accretion arms and potentially the expected circumstellar disks around each of the binary components.

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https://arxiv.org/pdf/1702.02862

The Lifetimes of Phases in High-Mass Star-Forming Regions

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High-mass stars form within star clusters from dense, molecular regions, but is the process of cluster formation slow and hydrostatic or quick and dynamic? We link the physical properties of high-mass star-forming regions with their evolutionary stage in a systematic way, using Herschel and Spitzer data. In order to produce a robust estimate of the relative lifetimes of these regions, we compare the fraction of dense, molecular regions above a column density associated with high-mass star formation, $N(H_2) > 0.4\text{-}2.5 \times 10^{22}$ cm^{-2}, in the 'starless' (no signature of stars > 10 $M_\odot$ forming) and star-forming phases in a $2^\circ \times 2^\circ$ region of the Galactic Plane centered at ℓ=30°. Of regions capable of forming high-mass stars on ∼1 pc scales, the starless (or embedded beyond detection) phase occupies about 60-70% of the dense molecular region lifetime and the star-forming phase occupies about 30-40%. These relative lifetimes are robust over a wide range of thresholds. We outline a method by which relative lifetimes can be anchored to absolute lifetimes from large-scale surveys of methanol masers and UCHII regions. A simplistic application of this method estimates the absolute lifetime of the starless phase to be 0.2-1.7 Myr (about 0.6-4.1 fiducial cloud free-fall times) and the star-forming phase to be 0.1-0.7 Myr (about 0.4-2.4 free-fall times), but these are highly uncertain. This work uniquely investigates the star-forming nature of high-column density gas pixel-by-pixel and our results demonstrate

that the majority of high-column density gas is in a starless or embedded phase.

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http://arxiv.org/pdf/1702.02199

A stellar census of the nearby, young 32 Orionis group

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The 32 Orionis group was discovered almost a decade ago and despite the fact that it represents the first northern, young (age $\sim$25 Myr) stellar aggregate within 100 pc of the Sun ($d \simeq 93$ pc), a comprehensive survey for members and detailed characterisation of the group has yet to be performed. We present the first large-scale spectroscopic survey for new (predominantly M-type) members of the group after combining kinematic and photometric data to select candidates with Galactic space motion and positions in colour-magnitude space consistent with membership. We identify 30 new members, increasing the number of known 32 Ori group members by a factor of three and bringing the total number of identified members to 46, spanning spectral types B5 to L1. We also identify the lithium depletion boundary (LDB) of the group, i.e. the luminosity at which lithium remains unburnt in a coeval population. We estimate the age of the 32 Ori group independently using both isochronal fitting and LDB analyses and find it is essentially coeval with the β Pictoris moving group, with an age of 24 ± 4 Myr. Finally, we have also searched for circumstellar disc hosts utilising the All *WISE* catalogue. Although we find no evidence for warm, dusty discs, we identify several stars with excess emission in the *WISE* $W4$-band at 22 μm. Based on the limited number of $W4$ detections we estimate a debris disc fraction of 32^{+12}_{-8} per cent for the 32 Ori group.

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https://arxiv.org/pdf/1703.00015

Magnetic fields in molecular clouds: Limitations of the analysis of Zeeman observations

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Context. Observations of Zeeman split spectral lines represent an important approach to derive the structure and strength of magnetic fields in molecular clouds. In contrast to the uncertainty of the spectral line observation itself, the uncertainty of the analysis method to derive the magnetic field strength from these observations is not been well characterized so far.
Aims. We investigate the impact of several physical quantities on the uncertainty of the analysis method, which is used to derive the line-of-sight (LOS) magnetic field strength from Zeeman split spectral lines. These quantities are the density, temperature, velocity, and the magnetic field strength.
Methods. We simulate the Zeeman splitting of the 1665 MHz OH line with the 3D radiative transfer (RT) extension ZRAD. This extension is based on the line RT code Mol3D (Ober et al. 2015) and has been developed for the POLArized RadIation Simulator POLARIS (Reissl et al. 2016).
Results. Observations of the OH Zeeman effect in typical molecular clouds are not significantly affected by the uncertainty of the analysis method. However, some observations obtained a magnetic field strength of more than $\sim$300 μG, which may result in an uncertainty of the analysis method of >10%. We derived an approximation to quantify the range of parameters in which the analysis method works sufficiently accurate and provide factors to convert our results to other spectral lines and species as well. We applied these conversion factors to CN and found that

observations of the CN Zeeman effect in typical molecular clouds are neither significantly affected by the uncertainty of the analysis method. In addition, we found that the density has almost no impact on the uncertainty of the analysis method, unless it reaches values higher than those typically found in molecular clouds ($n_{\rm H} \gg 10^7$ cm^{-3}). Furthermore, the uncertainty of the analysis method increases, if both the gas velocity and the magnetic field show significant variations along the line-of-sight. However, this increase should be small in Zeeman observations of most molecular clouds considering typical velocities of $\sim$1 km/s.

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Multi-epoch, high spatial resolution observations of multiple T Tauri systems

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Context. In multiple pre-main-sequence systems the lifetime of circumstellar disks appears to be shorter than around single stars, and the actual dissipation process may depend on the binary parameters of the systems.
Aims. We report high spatial resolution observations of multiple T Tauri systems at optical and infrared wavelengths. We determine if the components are gravitationally bound and orbital motion is visible, derive orbital parameters and investigate possible correlations between the binary parameters and disk states.
Methods. We selected 18 T Tau multiple systems (16 binary and two triple systems, yielding $16 + 2 \times 2 = 20$ binary pairs) in the Taurus-Auriga star forming region from the survey by Leinert et al. (1993), with spectral types from K1 to M5 and separations from 0.22 *arcsec* (31 AU) to 5.8 *arcsec* (814 AU). We analysed data acquired in 2006–07 at Calar Alto using the AstraLux lucky imaging system, along with data from SPHERE and NACO at the VLT, and from the literature.
Results. We found ten pairs to orbit each other, five pairs that may show orbital motion and five likely common proper motion pairs. We found no obvious correlation between the stellar parameters and binary configuration. The 10 μm infra-red excess varies between 0.1 and 7.2 magnitudes (similar to the distribution in single stars, where it is between 1.7 and 9.1), implying that the presence of the binary star does not greatly influence the emission from the inner disk.
Conclusions. We have detected orbital motion in young T Tauri systems over a timescale of $\approx$ 20 years. Further observations with even longer temporal baseline will provide crucial information on the dynamics of these young stellar systems.

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Mid-infrared characterization of the planetary-mass companion ROXs 42B b

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We present new Keck/NIRC2 3–5 μm infrared photometry of the planetary-mass companion to ROXS 42B in L', and for the first time in Brackett-α and in M_s-band. We combine our data with existing near-infrared photometry and K-band (2–2.4 μm) spectroscopy and compare these with models and other directly imaged planetary-mass objects using forward modeling and retrieval methods in order to characterize the atmosphere of ROXS 42B b. ROXS 42B b's 1.25–5 μm spectral energy distribution most closely resembles that of GSC 06214 B and κ And b, although it has a slightly bluer K_s-M_s color than GSC 06214 B and thus so far lacks evidence for a circumplanetary disk. We cannot formally exclude the possibility that any of the tested dust-free/dusty/cloudy forward models describe atmosphere of ROXS 42B b well. However, models with substantial atmospheric dust/clouds yield temperatures and gravities that are consistent when fit to photometry and spectra separately, whereas dust-free model fits to photometry predict temperatures/gravities inconsistent with ROXS 42B b's K-band spectrum and vice-versa. Atmospheric retrieval on the 1–5 μm photometry places a limit on the fractional number density of CO_2 of $\log(n_{CO_2}) < -2.7$ but provides no other constraints so far. We conclude that ROXS 42B b has mid-IR photometric features that are systematically different from other previously observed planetary-mass and field objects of similar temperature. It remains unclear whether this is in the range of the natural diversity of targets at the very young (~2 Myr) age of ROXS 42B b, or unique to its early evolution and environment.

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Gaia-ESO Survey: global properties of clusters Trumpler 14 and 16 in the Carina Nebula

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We present the first extensive spectroscopic study of the global population in star clusters Trumpler 16, Trumpler 14 and Collinder 232 in the Carina Nebula, using data from the Gaia-ESO Survey, down to solar-mass stars. In addition to the standard homogeneous Survey data reduction, a special processing was applied here because of the bright nebulosity surrounding Carina stars. We find about four hundred good candidate members ranging from OB types down to slightly sub-solar masses. About one-hundred heavily-reddened early-type Carina members found here were previously unrecognized or poorly classified, including two candidate O stars and several candidate Herbig Ae/Be stars. Their large brightness makes them useful tracers of the obscured Carina population. The spectroscopically-derived temperatures for nearly 300 low-mass members allows the inference of individual extinction values, and the study of the relative placement of stars along the line of sight. We find a complex spatial structure, with definite clustering of low-mass members around the most massive stars, and spatially-variable extinction. By combining the new data with existing X-ray data we obtain a more complete picture of the three-dimensional spatial structure of the Carina clusters, and of their connection to bright and dark nebulosity, and UV sources. The identification of tens of background giants enables us also to determine the total optical depth of the Carina nebula along many sightlines. We are also able to put constraints on the star-formation history of the region, with Trumpler 14 stars found to be systematically younger than stars in other sub-clusters. We find a large percentage of fast-rotating stars among Carina solar-mass members, which provide new constraints on the rotational evolution of pre-main-sequence stars in this mass range.

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http://arxiv.org/pdf/1702.04776

X-ray survey of the North-America and Pelican star-forming complex (NGC7000/IC5070)

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We present the first extensive X-ray study of the North-America and Pelican star-forming region (NGC7000/IC5070), with the aim of finding and characterizing its young stellar population. X-ray data from Chandra (four pointings) and XMM-Newton (seven pointings) were reduced and source detection was performed on each image. We complement the X-ray data with optical and near-IR data from the IPHAS, UKIDSS, and 2MASS catalogs, and with other published optical and Spitzer IR data. More than 700 X-ray sources are detected, the majority of which have an optical/NIR counterpart. This allows to identify young stars in different stages of formation. Less than 30% of X-ray sources are identified with a previously known young star. We argue that most X-ray sources with an optical/NIR counterpart, except perhaps for a few tens at near-zero reddening, are likely candidate members of the star-forming region, on the basis of both their optical/NIR magnitudes and colors, and of X-ray properties like spectrum hardness or flux variations. They are characterized by a wide range of extinction, and sometimes near-IR excesses, both of which prevent derivation of accurate stellar parameters. The optical color-magnitude diagram suggests ages between 1–10 Myrs. The X-ray members have a very complex spatial distribution with some degree of subclustering, qualitatively similar to that of previously known members. The distribution of X-ray sources relative to IR-excess objects found with Spitzer is sometimes suggestive of sequential star formation, especially near the Gulf of Mexico region, probably triggered by the O5 star illuminating the whole region. Around this latter star no enhancement in the young star density is found, in agreement with previous results. We also determine the local optical/IR reddening law, and compute an updated reddening map of the entire region.

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Star Cluster Formation from Turbulent Clumps. I. The Fast Formation Limit

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We investigate the formation and early evolution of star clusters assuming that they form from a turbulent starless clump of given mass bounded inside a parent self-gravitating molecular cloud characterized by a particular mass surface density. As a first step we assume instantaneous star cluster formation and gas expulsion. We draw our initial conditions from observed properties of starless clumps. We follow the early evolution of the clusters up to 20 Myr, investigating effects of different star formation efficiencies, primordial binary fractions and eccentricities and primordial mass segregation levels. We investigate clumps with initial masses of $M_{\rm cl} = 3000\,{\rm M}_\odot$ embedded in ambient cloud environments with mass surface densities, $\Sigma_{\rm cloud} = 0.1$ and $1\,{\rm g\,cm^{-2}}$. We show that these models of fast star cluster formation result, in the fiducial case, in clusters that expand rapidly, even considering only the bound members. Clusters formed from higher $\Sigma_{\rm cloud}$ environments tend to expand more quickly, so are soon larger than clusters born from lower $\Sigma_{\rm cloud}$ conditions. To form a young cluster of a given age, stellar mass and mass surface density, these models need to assume a parent molecular clump that is many times denser, which is unrealistic compared to observed systems. We also show that in these models the initial binary properties are only slightly modified by interactions, meaning that binary properties, e.g., at 20 Myr, are very similar to those at birth. With this study we set up the basis of future work where we will investigate more realistic models of star formation compared to this instantaneous, baseline case.

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ALMA unveils rings and gaps in the protoplanetary system HD 169142: signatures of two giant protoplanets

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The protoplanetary system HD 169142 is one of the few cases where a potential candidate protoplanet has recently been detected by direct imaging in the near-infrared. To study the interaction between the protoplanet and the disk itself, observations of the gas and dust surface density structure are needed. This paper reports new ALMA observations of the dust continuum at 1.3 mm, ^{12}CO, ^{13}CO, and C^{18}O $J = 2 - 1$ emission from the system HD 169142 (which is observed almost face-on) at an angular resolution of $\sim 0.3'' \times 0.2''$ ($\sim 35 \times 20$ au). The dust continuum emission reveals a double-ring structure with an inner ring between $0.17 - 0.28''$ ($\sim 20 - 35$ au) and an outer ring between $0.48 - 0.64''$ ($\sim 56 - 83$ au). The size and position of the inner ring is in good agreement with previous polarimetric observations in the near-infrared and is consistent with dust trapping by a massive planet. No dust emission is detected inside the inner dust cavity ($R < 20$ au) or within the dust gap ($\sim 35 - 56$ au) down to the noise level. In contrast, the channel maps of the $J = 2 - 1$ line of the three CO isotopologs reveal gas inside the dust cavity and dust gap. The gaseous disk is also much larger than the compact dust emission; it extends to $\sim 1.5''$ (~ 180 au) in radius. This difference and the sharp drop of the continuum emission at large radii point to radial drift of large dust grains (> micron size). Using the thermo-chemical disk code DALI, we modeled the continuum and the CO isotopolog emission to quantitatively measure the gas and dust surface densities. The resulting gas surface density is reduced by a factor of $\sim 30 - 40$ inward of the dust gap. The gas and dust distribution indicate that two giant planets shape the disk

structure through dynamical clearing (dust cavity and gap) and dust trapping (double-ring dust distribution).

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https://arxiv.org/pdf/1702.02844.pdf

X-Shooter spectroscopy of young stellar objects in Lupus. Atmospheric parameters, membership and activity diagnostics

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A homogeneous determination of basic stellar parameters of young stellar object (YSO) candidates is needed to confirm their pre-main sequence evolutionary stage, membership to star forming regions (SFRs), and to get reliable values of the quantities related to chromospheric activity and accretion. We used the code ROTFIT and synthetic BT-Settl spectra for the determination of the atmospheric parameters ($T_{\rm eff}$ and $\log g$), the veiling (r), the radial (RV) and projected rotational velocity ($v \sin i$), from X-Shooter spectra of 102 YSO candidates (95 of infrared Class II and seven Class III) in the Lupus SFR. The spectral subtraction of inactive templates, rotationally broadened to match the $v \sin i$ of the targets, enabled us to measure the line fluxes for several diagnostics of both chromospheric activity and accretion, such as Hα, Hβ, Ca II and Na I lines. We have shown that 13 candidates can be rejected as Lupus members based on their discrepant RV with respect to Lupus and/or the very low $\log g$ values. At least 11 of them are background giants, two of which turned out to be lithium-rich giants. Regarding the members, we found that all Class III sources have Hα fluxes compatible with a pure chromospheric activity, while objects with disks lie mostly above the boundary between chromospheres and accretion. YSOs with transitional disks displays both high and low Hα fluxes. We found that the line fluxes per unit surface are tightly correlated with the accretion luminosity ($L_{\rm acc}$) derived from the Balmer continuum excess. This rules out that the relationships between $L_{\rm acc}$ and line luminosities found in previous works are simply due to calibration effects. We also found that the Ca II-IRT flux ratio, $F_{\rm CaII8542}/F_{\rm CaII8498}$, is always small, indicating an optically thick emission source. The latter can be identified with the accretion shock near the stellar photosphere. The Balmer decrement reaches instead, for several accretors, high values typical of optically thin emission, suggesting that the Balmer emission originates in different parts of the accretion funnels with a smaller optical depth.

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The evolution of protoplanetary disks from their taxonomy in scattered light: Group I vs Group II

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High-resolution imaging reveals a large morphological variety of protoplanetary disks. To date, no constraints on their global evolution have been found from this census. An evolutionary classification of disks was proposed based on their IR spectral energy distribution, with the Group I sources showing a prominent cold component ascribed to an earlier stage of evolution than Group II. Disk evolution can be constrained from the comparison of disks with different properties. A first attempt of disk taxonomy is now possible thanks to the increasing number of high-resolution images of Herbig Ae/Be stars becoming available. Near-IR images of six Group II disks in scattered light were obtained with VLT/NACO in Polarimetric Differential Imaging, which is the most efficient technique to image the light scattered by the disk material close to the stars. We compare the stellar/disk properties of this sample with those of well-studied Group I sources available from the literature. Three Group II disks are detected. The brightness distribution in the disk of HD163296 indicates the presence of a persistent ring-like structure with a possible connection with the CO snowline. A rather compact (less than 100 AU) disk is detected around HD142666 and AK Sco. A taxonomic analysis of 17 Herbig Ae/Be sources reveals that the difference between Group I and Group II is due to the presence or absence of a large disk cavity (larger than 5 AU). There is no evidence supporting the evolution from Group I to Group II. Group II are not evolved version of the Group I. Within the Group II disks, very different geometries (both self-shadowed and compact) exist. HD163296 could be the primordial version of a typical Group I. Other Group II, like AK Sco and HD142666, could be smaller counterpart of Group I unable to open cavities as large as those of Group I.

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Very High Excitation Lines of H_2 in the Orion Molecular Cloud Outflow

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Vibration-rotation lines of H_2 from highly excited levels approaching the dissociation limit have been detected at a number of locations in the shocked gas of the Orion Molecular Cloud (OMC-1), including in a Herbig-Haro object near the tip of one of the OMC-1 "fingers." Population diagrams show that while the excited H_2 is almost entirely at a kinetic temperature of ∼1,800 K, (typical for vibrationally shock-excited H_2), as in the previously reported case of Herbig-Haro object HH 7 up to a few percent of the H_2 is at a kinetic temperature of ∼5,000 K. The location with the largest fraction of hot H_2 is the Herbig-Haro object, where the outflowing material is moving at a higher speed than at the other locations. Although theoretical work is required for a better understanding of the 5,000 K H_2, (including how it cools), its existence and the apparent dependence of its abundance relative to that of the cooler component on the relative velocities of the outflow and the surrounding ambient gas appear broadly consistent with it having recently reformed. The existence of this high temperature H_2 appears to be a common characteristic of shock-excited molecular gas.

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Dissecting the molecular structure of the Orion B cloud: Insight from Principal Component Analysis

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The combination of wideband receivers and spectrometers currently available in (sub-)millimeter observatories deliver wide-field hyperspectral imaging of the interstellar medium. Tens of spectral lines can be observed over degree wide fields in about fifty hours. This wealth of data calls for restating the physical questions about the interstellar medium in statistical terms.
We aim at gaining information on the physical structure of the interstellar medium from a statistical analysis of many lines from different species over a large field of view, without requiring detailed radiative transfer or astrochemical modeling.
We coupled a nonlinear rescaling of the data with one of the simplest multivariate analysis methods, namely the Principal Component Analysis, to decompose the observed signal into components that we interpret first qualitatively and then quantitatively based on our deep knowledge of the observed region and of the astrochemistry at play.
We identify 3 principal components, linear compositions of line brightness temperatures, that are correlated at various levels with the column density, the volume density and the UV radiation field.
When sampling a sufficiently diverse mixture of physical parameters, it is possible to decompose the molecular emission in order to gain physical insight on the observed interstellar medium. This opens a new avenue for future studies of the interstellar medium.

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Thermochemical modelling of brown dwarf discs

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The physical properties of brown dwarf discs, in terms of their shapes and sizes, are still largely unexplored by observations. To what extent brown dwarf discs are similar to scaled-down T Tauri discs is currently unknown, and this work is a step towards establishing a relationship through the eventual modelling of future observations.
We use observations of the brown dwarf disc Oph 102 to infer a fiducial model around which we build a small grid of brown dwarf disc models, in order to model the CO, HCN, and HCO^+ line fluxes and the chemistry which drives their abundances. These are the first brown dwarf models to be published which relate detailed, 2D radiation thermochemical disc models to observational data.
We predict that moderately extended ALMA antenna configurations will spatially resolve CO line emission around brown dwarf discs, and that HCN and HCO^+ will be detectable in integrated flux, following our conclusion that the flux ratios of these molecules to CO emission are comparable to that of T Tauri discs. These molecules have not yet been observed in sub-mm wavelengths in a brown dwarf disc, yet they are crucial tracers of the warm surface-layer gas and of ionization in the outer parts of the disc.
We present the prediction that if the physical and chemical processes in brown dwarf discs are similar to those that occur in T Tauri discs – as our models suggest – then the same diagnostics that are used for T Tauri discs can be used for brown dwarf discs (such as HCN and HCO^+ lines that have not yet been observed in the sub-mm), and that these lines should be observable with ALMA. Through future observations, either confirmation (or refutation) of these ideas about brown dwarf disc chemistry will have strong implications for our understanding of disc chemistry, structure, and subsequent planet formation in brown dwarf discs.

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Photodissociation and photoionisation of atoms and molecules of astrophysical interest

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A new collection of photodissociation and photoionisation cross sections for 102 atoms and molecules of astrochemical interest has been assembled, along with a brief review of the basic physical processes involved. These have been used to calculate dissociation and ionisation rates, with uncertainties, in a standard ultraviolet interstellar radiation field (ISRF) and for other wavelength-dependent radiation fields, including cool stellar and solar radiation, Lyman-? dominated radiation, and a cosmic-ray induced ultraviolet flux. The new ISRF rates generally agree within 30compilations, with a few notable exceptions. Comparison with other databases such as PHIDRATES is made. The reduction of rates in shielded regions was calculated as a function of dust, molecular and atomic hydrogen, atomic C, and self-shielding column densities. The relative importance of these shielding types depends on the atom or molecule in question and the assumed dust optical properties. All of the new data are publicly available from the Leiden photodissociation and ionisation database.
Sensitivity of the calculated rates to variation of temperature and isotope, and uncertainties in measured or calculated cross sections, are tested and discussed. Tests were conducted on the new rates with an interstellar-cloud chemical model, and find general agreement (within a factor of two) in abundances obtained with the previous iteration of the Leiden database assuming an ISRF, and order-of-magnitude variations assuming various kinds of stellar radiation. The newly parameterised dust-shielding factors makes a factor-of-two difference to many atomic and molecular abundances relative to parameters currently in the UDfA and KIDA astrochemical reaction databases. The newly-calculated cosmic-ray induced photodissociation and ionisation rates differ from current standard values up to a factor of 5. Under high temperature and cosmic-ray-flux conditions the new rates alter the equilibrium abundances of abundant dark cloud abundances by up to a factor of two. The partial cross sections for H2O and NH3 photodissociation forming OH, O, NH2 and NH are also evaluated and lead to radiation-field-dependent branching ratios.

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Tracing the Magnetic Field of IRDC G028.23–00.19 Using NIR Polarimetry

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The importance of the magnetic (B) field in the formation of infrared dark clouds (IRDCs) and massive stars is an ongoing topic of investigation. We studied the plane-of-sky B field for one IRDC, G028.23-00.19, to understand the interaction between the field and the cloud. We used near-IR background starlight polarimetry to probe the B field and performed several observational tests to assess the field importance. The polarimetric data, taken with the Mimir instrument, consisted of H-band and K-band observations, totaling 17,160 stellar measurements. We traced the plane-of-sky B-field morphology with respect to the sky-projected cloud elongation. We also found the relationship between the estimated B-field strength and gas volume density, and we computed estimates of the normalized mass-to-magnetic flux ratio. The B-field orientation with respect to the cloud did not show a preferred alignment, but it did exhibit a large-scale pattern. The plane-of-sky B-field strengths ranged from 10 to 165 μG, and the B-field strength dependence on density followed a power law with an index consistent with 2/3. The mass-to-magnetic flux ratio also increased as a function of density. The relative orientations and relationship between the B field and density imply that the B field was not dynamically important in the formation of the IRDC. The increase in mass-to-flux ratio as a function of density, though, indicates a dynamically important B field. Therefore, it is unclear whether the B field influenced the formation of G28.23. However, it is likely that the presence of the IRDC changed the local B-field morphology.

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Widening of Protostellar Outflows: an Infrared Outflow Survey in Low Luminosity Objects

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We present an outflow survey toward 20 Low Luminosity Objects (LLOs), namely protostars with an internal luminosity lower than 0.2 $L_{\odot}$. Although a number of studies have reported the properties of individual LLOs, the reasons for their low luminosity remain uncertain. To answer this question, we need to know the evolutionary status of LLOs. Protostellar outflows are found to widen as their parent cores evolve, and therefore, the outflow opening angle could be used as an evolutionary indicator. The infrared scattered light escapes out through the outflow cavity and highlights the cavity wall, giving us the opportunity to measure the outflow opening angle. Using the Canada-France-Hawaii Telescope, we detected outflows toward eight LLOs out of 20 at Ks band, and based on archival Spitzer IRAC1 images, we added four outflow-driving sources from the remaining 12 sources. By fitting these images with radiative transfer models, we derive the outflow opening angles and inclination angles. To study the widening of outflow cavities, we compare our sample with the young stellar objects from Arce & Sargent (2006) and Velusamy et al. (2014) in the plot of opening angle versus bolometric temperature taken as an evolutionary indicator.Our LLO targets match well the trend of increasing opening angle with bolometric temperature reported by Arce & Sargent and are broadly consistent with that reported by Velusamy et al., suggesting that the opening angle could be a good evolutionary indicator for LLOs. Accordingly, we conclude that at least 40% of the outflow-driving LLOs in our sample are young Class 0 objects.

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The JCMT Gould Belt Survey: A First Look at IC 5146

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We present 450 μm and 850 μm submillimetre continuum observations of the IC 5146 star-forming region taken as part of the JCMT Gould Belt Survey. We investigate the location of bright submillimetre (clumped) emission with the larger-scale molecular cloud through comparison with extinction maps, and find that these denser structures correlate with higher cloud column density. Ninety-six individual submillimetre clumps are identified using FellWalker and their physical properties are examined. These clumps are found to be relatively massive, ranging from 0.5 $M_\odot$ to 116 $M_\odot$ with a mean mass of 8 $M_\odot$ and a median mass of 3.7 $M_\odot$. A stability analysis for the clumps suggest that the

majority are (thermally) Jeans stable, with $M/M_J < 1$. We further compare the locations of known protostars with the observed submillimetre emission, finding that younger protostars, i.e., Class 0 and I sources, are strongly correlated with submillimetre peaks and that the clumps with protostars are among the most Jeans unstable. Finally, we contrast the evolutionary conditions in the two major star-forming regions within IC 5146: the young cluster associated with the Cocoon Nebula and the more distributed star formation associated with the Northern Streamer filaments. The Cocoon Nebula appears to have converted a higher fraction of its mass into dense clumps and protostars, the clumps are more likely to be Jeans unstable, and a larger fraction of these remaining clumps contain embedded protostars. The Northern Streamer, however, has a larger number of clumps in total and a larger fraction of the known protostars are still embedded within these clumps.

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Investigating the past history of EXors: the cases of V1118 Ori, V1143 Ori, and NY Ori

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EXor objects are young variables that show episodic variations of brightness commonly associated to enhanced accretion outbursts. With the aim of investigating the long-term photometric behaviour of a few EXor sources, we present here data from the archival plates of the Asiago Observatory, showing the Orion field where the three EXors V1118, V1143, and NY are located. A total of 484 plates were investigated, providing a total of more than 1000 magnitudes for the three stars, which cover a period of about 35 yrs between 1959 to 1993. We then compared our data with literature data. Apart from a newly discovered flare-up of V1118, we identify the same outbursts already known, but we provide two added values: (i) a long-term sampling of the quiescence phase; and (ii) repeated multi-colour observations (BVRI bands). The former allows us to give a reliable characterisation of the quiescence, which represents a unique reference for studies that will analyze future outbursts and the physical changes induced by these events. The latter is useful for confirming whether the intermittent increases of brightness are accretion-driven (as in the case of V1118), or extinction-driven (as in the case of V1143). Accordingly, doubts arise about the V1143 classification as a pure EXor object. Finally, although our plates do not separate NY Ori and the star very close to it, they indicate that this EXor did not undergo any major outbursts during our 40 yrs of monitoring.

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Uncrowding R 136 from VLT/SPHERE extreme adaptive optics

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This paper presents the sharpest near-IR images of the massive cluster R 136 to date, based on the extreme adaptive optics of the SPHERE focal instrument implemented on the ESO Very Large Telescope and operated in its IRDIS imaging mode.
The crowded stellar population in the core of the R 136 starburst compact cluster remains still to be characterized in terms of individual luminosities, age, mass and multiplicity. SPHERE/VLT and its high contrast imaging possibilities open new windows to make progress on these questions.
Stacking-up a few hundreds of short exposures in J and Ks spectral bands over a Field of View (FoV) of 10.9"×12.3" centered on the R136a1 stellar component, enabled us to carry a refined photometric analysis of the core of R 136. We detected 1110 and 1059 sources in J and Ks images respectively with 818 common sources.
Thanks to better angular resolution and dynamic range, we found that more than 62.6% (16.5%) of the stars, detected both in J and Ks data, have neighbours closer than 0.2" (0.1").
The closest stars are resolved down to the full width at half maximum (FWHM) of the point spread function (PSF) measured by *Starfinder*. Among newly resolved and detected sources R136a1 and R136c are found to have optical companions and R136a3 is resolved as two stars (PSF fitting) separated by 59 ± 2 mas. This new companion of R136a3 presents a correlation coefficient of 86% in J and 75% in Ks. The new set of detected sources were used to re-assess the age and extinction of R 136 based on 54 spectroscopically stars that have been recently studied with HST slit-spectroscopy (Crowther et al. 2016) of the core of this cluster.
Over 90% of these 54 sources identified visual companions (closer than 0.2"). We found the most probable age and extinction for these sources are $1.8^{+1.2}_{-0.8}$ Myr, $A_J = (0.45 \pm 0.5)$ *mag* and $A_K = (0.2 \pm 0.5)$ *mag* within the photometric and spectroscopic error-bars. Additionally, using PARSEC evolutionary isochrones and tracks, we estimated the stellar mass range for each detected source (common in J and K data) and plotted the generalized histogram of mass (MF with error-bars).
Using SPHERE data, we have gone one step further and partially resolved and studied the IMF covering mass range of (3 - 300) $M_\odot$ at the age of 1 and 1.5 Myr. The density in the core of R 136 (0.1 - 1.4 pc) is estimated and extrapolated in 3D and larger radii (up to 6pc). We show that the stars in the core are still unresolved due to crowding, and the results we obtained are upper limits. Higher angular resolution is mandatory to overcome these difficulties.

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ALMA Observations of Starless Core Substructure in Ophiuchus

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Compact substructure is expected to arise in a starless core as mass becomes concentrated in the central region likely to form a protostar. Additionally, multiple peaks may form if fragmentation occurs. We present ALMA Cycle 2 observations of 60 starless and protostellar cores in the Ophiuchus molecular cloud. We detect eight compact

substructures which are > 15 arcsec from the nearest *Spitzer* YSO. Only one of these has strong evidence for being truly starless after considering ancillary data, e.g., from *Herschel* and X-ray telescopes. An additional extended emission structure has tentative evidence for starlessness. The number of our detections is consistent with estimates from a combination of synthetic observations of numerical simulations and analytical arguments. This result suggests that a similar ALMA study in the Chamaeleon I cloud, which detected no compact substructure in starless cores, may be due to the peculiar evolutionary state of cores in that cloud.

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The Greater Taurus-Auriga Ecosystem I: There Is A Distributed Older Population

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The Taurus-Auriga association and its associated molecular cloud are a benchmark population for studies of star and planet formation. The census of Taurus-Auriga has been assembled over seven decades and has inherited the biases, incompleteness, and systematic uncertainties of the input studies. The notably unusual shape of the inferred IMF and the existence of several isolated disk-bearing stars suggest that additional (likely disk-free) members might remain to be discovered. We therefore have begun a global reassessment of the membership of Taurus-Auriga that exploits new data and better definitions of youth and kinematic membership. As a first step, we reconsider the membership of all disk-free candidate members from the literature with spectral type $\geq$F0, $3^h50^m < \alpha < 5^h40^m$, and $14^\circ < \delta < 34^\circ$. We combine data from the literature with Keck/HIRES and UH88/SNIFS spectra to test the membership of these candidates using HR diagram positions, proper motions, RVs, Hα, lithium, and surface gravity. We find 218 confirmed or likely Taurus members, 160 confirmed or likely interlopers, and only 18 that still lack sufficient evidence to draw firm conclusions. A significant fraction of these stars (81/218=37%) are not included in the most recent canonical member lists. Intriguingly, there are few additional members in the immediate vicinity of the molecular clouds, preserving the IMFs that have been deemed anomalous in past work. Many of the likely Taurus members are distributed broadly across the search area. When combined with known disk hosts, our updated census reveals two regimes: a high-density population with a high disk fraction (indicative of youth) that broadly traces the molecular clouds, and a low-density population with low disk fraction (hence likely older) that most likely represents previous generations of star formation.

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Gravitational Focusing and the Star Cluster Initial Mass Function

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We discuss the possibility that gravitational focusing, is responsible for the power-law mass function of star clusters $N(\log M) \propto M^{-1}$. This power law can be produced asymptotically when the mass accretion rate of an object depends

upon the mass of the accreting body as $\dot{M} \propto M^2$. While Bondi-Hoyle-Littleton accretion formally produces this dependence on mass in a uniform medium, realistic environments are much more complicated. However, numerical simulations in SPH allowing for sink formation yield such an asymptotic power-law mass function. We perform pure N-body simulations to isolate the effects of gravity from those of gas physics and to show that clusters naturally result with the power-law mass distribution. We also consider the physical conditions necessary to produce clusters on appropriate timescales. Our results help support the idea that gravitationally-dominated accretion is the most likely mechanism for producing the cluster mass function.

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Structure of Herbig AeBe disks at the milliarcsecond scale: A statistical survey in the H band using PIONIER-VLTI

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Context. It is now generally accepted that the near-infrared excess of Herbig AeBe stars originates in the dust of a circumstellar disk.
Aims. The aims of this article are to infer the radial and vertical structure of these disks at scales of order 1 au, and the properties of the dust grains.
Methods. The program objects (51 in total) were observed with the H-band (1.6 μm) PIONIER/VLTI interferometer. The largest baselines allowed us to resolve (at least partially) structures of a few tenths of an au at typical distances of a few hundred parsecs. Dedicated UBVRIJHK photometric measurements were also obtained. Spectral and 2D geometrical parameters are extracted via fits of a few simple models: ellipsoids and broadened rings with azimuthal modulation. Model bias is mitigated by parallel fits of physical disk models. Sample statistics were evaluated against similar statistics for the physical disk models to infer properties of the sample objects as a group.
Results. We find that dust at the inner rim of the disk has a sublimation temperature $T_{sub} \sim 1800$ K. A ring

morphology is confirmed for approximately half the resolved objects; these rings are wide $\delta r/r \gtrsim 0.5$. A wide ring favors a rim that, on the star-facing side, looks more like a knife edge than a doughnut. The data are also compatible with the combination of a narrow ring and an inner disk of unspecified nature inside the dust sublimation radius. The disk inner part has a thickness $z/r \sim 0.2$, flaring to $z/r \sim 0.5$ in the outer part. We confirm the known luminosity-radius relation; a simple physical model is consistent with both the mean luminosity-radius relation and the ring relative width; however, a significant spread around the mean relation is present. In some of the objects we find a halo component, fully resolved at the shortest interferometer spacing, that is related to the HAeBe class.

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Herschel observations of the Galactic HII region RCW 79

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Triggered star formation around HII regions could be an important process. The Galactic HII region RCW 79 is a prototypical object for triggered high-mass star formation. We take advantage of Herschel data from the surveys HOBYS, "Evolution of Interstellar Dust", and Hi-Gal to extract compact sources in this region, complemented with archival 2MASS, Spitzer, and WISE data to determine the physical parameters of the sources (e.g., envelope mass, dust temperature, and luminosity) by fitting the spectral energy distribution. We obtained a sample of 50 compact sources, 96% of which are situated in the ionization-compressed layer of cold and dense gas that is characterized by the column density PDF with a double-peaked lognormal distribution. The 50 sources have sizes of 0.1-0.4 pc with a typical value of 0.2 pc, temperatures of 11-26 K, envelope masses of 6-760 $M_{\odot}$, densities of 0.1-44 $\times 10^5$ cm^{-3}, and luminosities of 19-12712 $L_{\odot}$. The sources are classified into 16 class 0, 19 intermediate, and 15 class I objects. Their distribution follows the evolutionary tracks in the diagram of bolometric luminosity versus envelope mass (Lbol-Menv) well. A mass threshold of 140 $M_{\odot}$, determined from the Lbol-Menv diagram, yields 12 candidate massive dense cores that may form high-mass stars. The core formation efficiency (CFE) for the 8 massive condensations shows an increasing trend of the CFE with density. This suggests that the denser the condensation, the higher the fraction of its mass transformation into dense cores, as previously observed in other high-mass star-forming regions.

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Imaging a Central Ionized Component, a Narrow Ring, and the CO Snowline in the Multi-Gapped Disk of HD 169142

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We report Very Large Array observations at 7 mm, 9 mm, and 3 cm toward the pre-transitional disk of the Herbig Ae star HD 169142. These observations have allowed us to study the mm emission of this disk with the highest angular resolution so far ($0\farcs12 \times 0\farcs09$, or 14 au×11 au, at 7 mm). Our 7 and 9 mm images show a narrow ring of emission at a radius of ~ 25 au tracing the outer edge of the inner gap. This ring presents an asymmetric morphology that could be produced by dynamical interactions between the disk and forming planets. Additionally, the azimuthally averaged radial intensity profiles of the 7 and 9 mm images confirm the presence of the previously reported gap at ~ 45 au, and reveal a new gap at ~ 85 au. We analyzed archival DCO^+(3-2) and $C^{18}O$(2-1) ALMA observations, showing that the CO snowline is located very close to this third outer gap. This suggests that growth and accumulation of large dust grains close to the CO snowline could be the mechanism responsible for this proposed outer gap. Finally, a compact source of emission is detected at 7 mm, 9 mm, and 3 cm toward the center of the disk. Its flux density and spectral index indicate that it is dominated by free-free emission from ionized gas, which could be associated with either the photoionization of the inner disk, an independent object, or an ionized jet.

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Searching for chemical signatures of brown dwarf formation

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Recent studies have shown that close-in brown dwarfs in the mass range 35–55 $M_{\rm Jup}$ are almost depleted as companions to stars, suggesting that objects with masses above and below this gap might have different formation mechanisms. We determine the fundamental stellar parameters, as well as individual abundances for a large sample of stars known to have a substellar companion in the brown dwarf regime. The sample is divided into stars hosting "massive" and "low-mass" brown dwarfs. Following previous works a threshold of 42.5 $M_{\rm Jup}$ was considered. Our results confirm that stars with brown dwarf companions do not follow the well-established gas-giant planet metallicity correlation seen in main-sequence planet hosts. Stars harbouring "massive" brown dwarfs show similar metallicity and abundance distribution as stars without known planets or with low-mass planets. We find a tendency of stars harbouring "less-massive" brown dwarfs of having slightly larger metallicity, $[X_{\rm Fe}/{\rm Fe}]$ values, and abundances of Sc II, Mn I, and Ni I in comparison with the stars having the massive brown dwarfs. The data suggest, as previously reported, that massive and low-mass brown dwarfs might present differences in period and eccentricity. We find evidence of a non-metallicity dependent mechanism for the formation of massive brown dwarfs. Our results agree with a scenario in which massive brown dwarfs are formed as stars. At high-metallicities, the core-accretion mechanism might become efficient in the formation of low-mass brown dwarfs while at lower metallicities low-mass brown dwarfs could form by gravitational instability in turbulent protostellar discs.

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Rotation in young massive star clusters

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Hydrodynamical simulations of turbulent molecular clouds show that star clusters form from the hierarchical merger of several sub-clumps. We run smoothed-particle hydrodynamics simulations of turbulence-supported molecular clouds with mass ranging from 1700 to 43000 $M\odot$. We study the kinematic evolution of the main cluster that forms in each cloud. We find that the parent gas acquires significant rotation, because of large-scale torques during the process of hierarchical assembly. The stellar component of the embedded star cluster inherits the rotation signature from the parent gas. Only star clusters with final mass $<$ few $\times$ 100 $M\odot$ do not show any clear indication of rotation. Our simulated star clusters have high ellipticity ($\sim$0.4–0.5 at $t = 4$ Myr) and are subvirial ($Q_{\rm vir} \lesssim 0.4$). The signature of rotation is stronger than radial motions due to subvirial collapse. Our results suggest that rotation is common in embedded massive ($\gtrsim$1000 $M\odot$) star clusters. This might provide a key observational test for the hierarchical assembly scenario.

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Chondrule Accretion with a Growing Protoplanet

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Chondrules are primitive materials in the Solar System. They are formed in the first about 3 Myr of the Solar System's history. This timescale is longer than that of Mars formation, and it is conceivable that protoplanets, planetesimals and chondrules might have existed simultaneously in the solar nebula. Due to protoplanets perturbation on the planetesimal dynamics and chondrule accretion on them, all the formed chondrules are unlikely to be accreted by planetesimals. We investigate the amount of chondrules accreted by planetesimals in such a condition. We assume that a protoplanet is in oligarchic growth, and we perform analytical calculations of chondrule accretion both by a protoplanet and by planetesimals. Through the oligarchic growth stage, planetesimals accrete about half of the formed chondrules. The smallest planetesimals get the largest amount of the chondrules, compared with the amount accreted by more massive planetesimals. We perform a parameter study and find that this fraction is not largely changed for a wide range of parameter sets.

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Estimating extinction using unsupervised machine learning

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Dust extinction is the most robust tracer of the gas distribution in the interstellar medium, but measuring extinction is limited by the systematic uncertainties involved in estimating the intrinsic colors to background stars. In this paper we present a new technique, Pnicer, that estimates intrinsic colors and extinction for individual stars using unsupervised machine learning algorithms. This new method aims to be free from any priors with respect to the column density and intrinsic color distribution. It is applicable to any combination of parameters and works in arbitrary numbers

of dimensions. Furthermore, it is not restricted to color space. Extinction toward single sources is determined by fitting Gaussian mixture models along the extinction vector to (extinction-free) control field observations. In this way it becomes possible to describe the extinction for observed sources with probability densities, rather than a single value. PNICER effectively eliminates known biases found in similar methods and outperforms them in cases of deep observational data where the number of background galaxies is significant, or when a large number of parameters is used to break degeneracies in the intrinsic color distributions. This new method remains computationally competitive, making it possible to correctly de-redden millions of sources within a matter of seconds. With the ever-increasing number of large-scale high-sensitivity imaging surveys, PNICER offers a fast and reliable way to efficiently calculate extinction for arbitrary parameter combinations without prior information on source characteristics. The PNICER software package also offers access to the well-established NICER technique in a simple unified interface and is capable of building extinction maps including the NICEST correction for cloud substructure. PNICER is offered to the community as an open-source software solution and is entirely written in Python.

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Impact of photometric variability on age and mass determination of Young Stellar Objects: A case study on Orion Nebula Cluster

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In case of pre-main sequence objects, the only way to determine age and mass is by fitting theoretical isochrones on color-magnitude (alternatively luminosity-temperature) diagrams. Since young stellar objects exhibit photometric variability over wide range in magnitude and colors, the age and mass determined by fitting isochrones is expected to be inaccurate, if not erroneous. These in turn will badly affect any study carried out on age spread and process of star formation. Since we have carried out very extensive photometric observations of the Orion Nebula Cluster (ONC), we decided to use our multi-band data to explore the influence of variability in determining mass and age of cluster members. In this study, we get the amplitudes of the photometric variability in V, R, and I optical bands of a sample of 346 ONC members and use it to investigate how the variability affects the inferred masses and ages and if it alone can take account for the age spread among the ONC members reported by earlier studies. We find that members that show periodic and smooth photometric rotational modulation have their masses and ages unaffected by variability. On other hand, we found that members with periodic but very scattered photometric rotational modulation and members with irregular variability have their masses and ages significantly affected. Moreover, using Hertzsprung-Russell (HR) diagrams we find that the observed I band photometric variability can take account of only a fraction (about 50%) of the inferred age spread, whereas the V band photometric variability is large enough to mask any age spread.

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Polarized disk emission from Herbig Ae/Be stars observed using Gemini Planet Imager: HD 144432, HD 150193, HD 163296, and HD 169142

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In order to look for signs of on-going planet formation in young disks, we carried out the first J-band polarized emission imaging of the Herbig Ae/Be stars HD 150193, HD 163296, and HD 169142 using the Gemini Planet Imager (GPI), along with new H band observations of HD 144432. We confirm the complex "double ring" structure for the nearly face-on system HD 169142 first seen in H-band, finding the outer ring to be substantially redder than the inner one in polarized intensity. Using radiative transfer modeling, we developed a physical model that explains the full spectral energy distribution (SED) and J- and H-band surface brightness profiles, suggesting that the differential color of the two rings could come from reddened starlight traversing the inner wall and may not require differences in grain properties. In addition, we clearly detect an elongated, off-center ring in HD 163296 (MWC 275), locating the scattering surface to be 18 AU above the midplane at a radial distance of 77 AU, co-spatial with a ring seen at 1.3mm by ALMA linked to the CO snow line. Lastly, we report a weak tentative detection of scattered light for HD 150193 (MWC 863) and a non-detection for HD 144432; the stellar companion known for each of these targets has likely disrupted the material in the outer disk of the primary star. For HD 163296 and HD 169142, the prominent outer rings we detect could be evidence for giant planet formation in the outer disk or a manifestation of large-scale dust growth processes possibly related to snow-line chemistry.

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Star-forming filament models

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New models of star-forming filamentary clouds are presented, to quantify their properties and to predict their evolution. These 2D axisymmetric models describe filaments having no core, one low-mass core, and one cluster-forming core. They are based on Plummer-like cylinders and spheroids, bounded by a constant-density surface of finite extent. In contrast to 1D Plummer-like models, they have specific values of length and mass, they approximate observed column density maps, and their distributions of column density (N-pdfs) are pole-free. Each model can estimate the star-forming potential of a core-filament system, by identifying the zone of gas dense enough to form low-mass stars, and by counting the number of enclosed thermal Jeans masses. This analysis suggests that the Musca Center filament may be near the start of its star-forming life, with enough dense gas to make its first 3 protostars, while the Coronet filament is near the midpoint of its star formation, with enough dense gas to add 8 protostars to its 20 known stars. In contrast L43 appears near the end of its star-forming life, since it lacks enough dense gas to add any new protostars to the 2 YSOs already known.

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Wide-Field ^{12}CO ($J = 2 - 1$) and ^{13}CO ($J = 2 - 1$) Observations toward the Aquila Rift and Serpens Molecular Cloud Complexes

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We present results of wide-field ^{12}CO ($J = 2 - 1$) and ^{13}CO ($J = 2 - 1$) observations toward the Aquila Rift and

Serpens molecular cloud complexes ($25^\circ < l < 33^\circ$ and $1^\circ < b < 6^\circ$) at an angular resolution of $3'.4$ (≈ 0.25 pc) and at a velocity resolution of 0.079 km s^{-1} with the velocity coverage of -5 km s^{-1} $< V_{\rm LSR} <$ 35 km s^{-1}. We found that the ^{13}CO emission better traces the structures seen in the extinction map and derived the $X_{^{13}{\rm CO}}$-factor of this region. Applying `SCIMES` to the ^{13}CO data cube, we identified 61 clouds and derived their masses, radii, and line widths. The line-width-radius relation of the identified clouds basically follows those of nearby molecular clouds. Majority of the identified clouds are close to virial equilibrium although the dispersion is large. By inspecting the ^{12}CO channel maps by eye, we found several arcs which are spatially extended to $0.2 - 3$ degree in length. In the longitude-velocity diagrams of ^{12}CO, we also found the two spatially-extended components which appear to converge toward Serpens South and W40 region. The existence of two components with different velocities and arcs suggests that large-scale expanding bubbles and/or flows play a role in the formation and evolution of the Serpens South and W40 cloud.

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Two dimensional ice mapping of molecular cores

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We present maps of the column densities of H_2O, CO_2, and CO ices towards the molecular cores B 35A, DC 274.2-00.4, BHR 59, and DC 300.7-01.0. These ice maps, probing spatial distances in molecular cores as low as 2200 AU, challenge the traditional hypothesis that the denser the region observed, the more ice is present, providing evidence that the relationships between solid molecular species are more varied than the generic picture we often adopt to model gas-grain chemical processes and explain feedback between solid phase processes and gas phase abundances. We present the first combined solid-gas maps of a single molecular species, based upon observations of both CO ice and gas phase C^{18}O towards B 35A, a star-forming dense core in Orion. We conclude that molecular species in the solid phase are powerful tracers of "small scale" chemical diversity, prior to the onset of star formation. With a component analysis approach, we can probe the solid phase chemistry of a region at a level of detail greater than that provided by statistical analyses or generic conclusions drawn from single pointing line-of-sight observations alone.

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Large-Scale Spectroscopic Mapping of the ρ Ophiuchi Molecular Cloud Complex I. The C_2H to N_2H^+ Ratio as a Signpost of Cloud Characteristics

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We present 2.5-square-degree C_2H N=1–0 and N_2H^+ J=1–0 maps of the ρ Ophiuchi molecular cloud complex. These are the first large-scale maps of the ρ Ophiuchi molecular cloud complex with these two tracers. The C_2H emission is spatially more extended than the N_2H^+ emission. One faint N_2H^+ clump Oph-M and one C_2H ring Oph-RingSW are

identified for the first time. The observed C_2H to N_2H^+ abundance ratio ($[C_2H]/[N_2H^+]$) varies between 5 and 110. We modeled the C_2H and N_2H^+ abundances with 1-D chemical models which show a clear decline of $[C_2H]/[N_2H^+]$ with chemical age. Such an evolutionary trend is little affected by temperatures when they are below 40 K. At high density ($n_H > 10^5$ cm^{-3}), however, the time it takes for the abundance ratio to drop at least one order of magnitude becomes less than the dynamical time (e.g., turbulence crossing time $\sim 10^5$ years). The observed $[C_2H]/[N_2H^+]$ difference between L1688 and L1689 can be explained by L1688 having chemically younger gas in relatively less dense regions. The observed $[C_2H]/[N_2H^+]$ values are the results of time evolution, accelerated at higher densities. For the relative low density regions in L1688 where only C_2H emission was detected, the gas should be chemically younger.

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ALMA Observations of Vibrationally Excited HC_3N Lines Toward Orion KL

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We present high spatial resolution ALMA observations of vibrational transitions of HC_3N toward Orion KL in the 214247 GHz frequency band. 41 transitions of HC_3N in 7 vibrationally excited states, and 23 transitions of ^{1}3C isotopologues of HC_3N in 2 vibrational states are detected. The line images show that vibrationally excited HC_3N lines originate mainly from the hot core of Orion and IRc7. The images of HC3N vibrationally excited lines show that the line emission peaks associated with the hot core move from south to northeast as E_u increases. Based on multiple transitions of each vibrationally excited state, we performed local thermodynamic equilibrium calculations in the XCLASS suite toward the hot core and IRc7 positions. Generally, transitions in highly excited states have higher rotational temperatures and lower column densities. The rotational temperatures and column densities of the hot core range from 93 to 321 K, and from 1.0×10^{14} to 4.9×10^{16} cm$^{?2}$, respectively. Lower rotational temperatures ranging from 88 to 186 K and column densities from 1.0×10^{14} to 3.2×10^{16} cm$^{?2}$ are obtained toward IRc7. The facts that the hot core emission peaks of vibrationally excited HC_3N lines move from south to northeast with increasing E_u, and that higher-energy HC_3N lines have higher rotational temperatures and lower column densities, appear to support that the hot core is externally heated. The emission peaks are moving along the major axis of the SiO outflow, which may indicate that higher-energy HC_3N transitions are excited by interaction between pre-existing dense medium and shocks generated by SiO outflows.

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The turbulent life of dust grains in the supernova-driven, multi-phase interstellar medium

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Dust grains are an important component of the interstellar medium (ISM) of galaxies. We present the first direct measurement of the residence times of interstellar dust in the different ISM phases, and of the transition rates between these phases, in realistic hydrodynamical simulations of the multi-phase ISM. Our simulations include a time-dependent chemical network that follows the abundances of H^+, H, H_2, C^+ and CO and take into account self-shielding by gas and dust using a tree-based radiation transfer method. Supernova explosions are injected either at random locations, at density peaks, or as a mixture of the two. For each simulation, we investigate how matter circulates between the ISM phases and find more sizeable transitions than considered in simple mass exchange schemes in the literature. The derived residence times in the ISM phases are characterised by broad distributions, in particular for the molecular, warm and hot medium. The most realistic simulations with random and mixed driving have median residence times in the molecular, cold, warm and hot phase around 17, 7, 44 and 1 Myr, respectively. The transition rates measured in the random driving run are in good agreement with observations of Ti gas-phase depletion in the warm and cold phases in a simple depletion model. ISM phase definitions based on chemical abundance rather than temperature cuts are physically more meaningful, but lead to significantly different transition rates and residence times because there is no direct correspondence between the two definitions.

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The anatomy of the Orion B Giant Molecular Cloud: A local template for studies of nearby galaxies

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Molecular lines and line ratios are commonly used to infer properties of extra-galactic star forming regions. The new generation of millimeter receivers almost turns every observation into a line survey. Full exploitation of this technical advancement in extra-galactic study requires detailed bench-marking of available line diagnostics.
We aim to develop the Orion B Giant Molecular Cloud (GMC) as a local template for interpreting extra-galactic molecular line observations.
We use the wide-band receiver at the IRAM-30m to spatially and spectrally resolve the Orion B GMC. The observations cover almost 1 square degree at $26''$ resolution with a bandwidth of 32 GHz from 84 to 116 GHz in only two tunings. Among the mapped spectral lines are the ^{12}CO, ^{13}CO, C^{18}O, C^{17}O, HCN, HNC, ^{12}CN, C_2H, HCO^+, N_2H^+ $(1-0)$, and ^{12}CS, ^{32}SO, SiO, $c-C_3H_2$, CH_3OH $(2-1)$ transitions.
We introduce the molecular anatomy of the Orion B GMC, including relationships between line intensities and gas column density or far-UV radiation fields, and correlations between selected line and line ratios. We also obtain

a dust-traced gas mass that is less than approximately one third the CO-traced mass, using the standard $X_{\rm CO}$ conversion factor. The presence of over-luminous CO can be traced back to the dependence of the CO intensity on UV illumination. As a matter of fact, while most lines show some dependence on the UV radiation field, CN and C_2H are the most sensitive. Moreover, dense cloud cores are almost exclusively traced by N_2H^+. Other traditional high-density tracers, such as HCN$(1-0)$, are also easily detected in extended translucent regions at a typical density of $\sim 500\,{\rm H_2\,cm^{-3}}$. In general, we find no straightforward relationship between line critical density and the fraction of the line luminosity coming from dense gas regions.
Our initial findings demonstrate that the relationships between line (ratio) intensities and environment in GMCs are more complicated than often assumed. Sensitivity (i.e., the molecular column density), excitation, and, above all, chemistry contribute to the observed line intensity distributions, and they must be considered together when developing the next generation of extra-galactic molecular line diagnostics of mass, density, temperature, and radiation field.

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Stellar energetic particle ionization in protoplanetary disks around T Tauri stars

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Anomalies in the abundance measurements of short lived radionuclides in meteorites indicate that the protosolar nebulae was irradiated by a high amount of energetic particles ($E \gtrsim 10$ MeV). The particle flux of the contemporary Sun cannot explain these anomalies. However, similar to T Tauri stars the young Sun was more active and probably produced enough high energy particles to explain those anomalies. We want to study the interaction of stellar energetic particles with the gas component of the disk and identify possible observational tracers of this interaction. We use a 2D radiation thermo-chemical protoplanetary disk code to model a disk representative for T Tauri stars. We use a particle energy distribution derived from solar flare observations and an enhanced stellar particle flux proposed for T Tauri stars. For this particle spectrum we calculate the stellar particle ionization rate throughout the disk with an accurate particle transport model. We study the impact of stellar particles for models with varying X-ray and cosmic-ray ionization rates. We find that stellar particle ionization has a significant impact on the abundances of the common disk ionization tracers HCO^+ and N_2H^+, especially in models with low cosmic-ray ionization rates. In contrast to cosmic rays and X-rays, stellar particles cannot reach the midplane of the disk. Therefore molecular ions residing in the disk surface layers are more affected by stellar particle ionization than molecular ions tracing the cold layers/midplane of the disk. Spatially resolved observations of molecular ions tracing different vertical layers of the disk allow to disentangle the contribution of stellar particle ionization from other competing ionization sources. Modeling such observations with a model like the one presented here allows to constrain the stellar particle flux in disks around T Tauri stars.

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The Dusty Silhouette Jet HH 1019 in the Carina Nebula

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We report the discovery in *Hubble Space Telescope (HST)* images of the new Herbig-Haro jet, HH 1019, located near the Tr 14 cluster in the Carina Nebula. Like other HH jets in the region, this bipolar collimated flow emerges from the head of a dark dust pillar. However, HH 1019 is unique because – unlike all other HH jets known to date – it is identified by a linear chain of dark, dusty knots that are seen primarily in silhouette against the background screen of the H II region. Proper motions confirm that these dark condensations move along the jet axis at high speed. [S II] emission traces a highly collimated jet that is spatially coincident with these dust knots. The high extinction in the body of the jet suggests that this outflow has lifted a large amount of dust directly from the disc, although it is possible that it has entrained dust from its surrounding protostellar envelope before exiting the dust pillar. If dust in HH 1019 originates from the circumstellar disc, this provides further evidence for a jet launched from a range of radii in the disc, including those outside the dust sublimation radius. HH 1019 may be the prototype for a new subclass of dusty HH objects seen primarily in extinction against the background screen of a bright H II region. Such jets may be common, but difficult to observe because they require the special condition of a very bright background in order to be seen in silhouette.

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Vertical structure of the transition zone from infalling rotating envelope to disc in the Class 0 protostar, IRAS 04368+2557

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We have resolved for the first time the radial and vertical structures of the almost edge-on envelope/disc system of the low-mass Class 0 protostar L1527. For that,we have usedAtacama Large Millimetre/submillimetre Array (ALMA) observations with a spatial resolution of 0.25" x 0.13" and 0.37" x 0.23" at 0.8 and 1.2 mm, respectively. The L1527 dust continuum emission has a deconvolved size of 78 au x 21 au, and shows a flared disc-like structure. A thin infalling-rotating envelope is seen in the CCH emission outward of about 150 au, and its thickness is increased by a factor of 2 inward of it. This radius lies between the centrifugal radius (200 au) and the centrifugal barrier of the infalling-rotating envelope (100 au). The gas stagnates in front of the centrifugal barrier and moves towards vertical directions. SO emission is concentrated around and inside the centrifugal barrier. The rotation speed of the SO emitting gas is found to be decelerated around the centrifugal barrier. A part of the angular momentum could be extracted by the gas that moves away from the mid-plane around the centrifugal barrier. If this is the case, the centrifugal barrier would be related to the launching mechanism of low-velocity outflows, such as disc winds.

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A dearth of short-period massive binaries in the young massive star forming region M17: Evidence for a large orbital separation at birth?

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The formation of massive stars remains poorly understood and little is known about their birth multiplicity properties. Here, we investigate the strikingly low radial-velocity dispersion measured for a sample of 11 massive pre- and near-main-sequence stars ($\sigma_{\rm rv} = 5.6 \pm 0.2$ km s^{-1}) in the young massive star forming region M17 to obtain first constraints on the multiplicity properties of young massive stellar objects.
Methods: We compute the RV dispersion of synthetic populations of massive stars for various multiplicity properties and we compare the simulated $\sigma_{\rm rv}$ distributions to the observed value. We specifically investigate two scenarios: a low binary fraction and a dearth of short-period binary systems.
Results: Simulated populations with low binary fractions ($f_{\rm bin} = 0.12^{+0.16}_{-0.09}$) or with truncated period distributions ($P_{\rm cutoff} > 9$ months) are able to reproduce the low $\sigma_{\rm rv}$ observed within their 68%-confidence intervals. Parent populations with $f_{\rm bin} > 0.42$ or $P_{\rm cutoff} < 47$ d can however be rejected at the 5%-significance level. Both constraints are contrast with the high binary fraction and plethora of short-period systems found in few Myr-old, OB-type populations. To explain the difference, the first scenario requires a variation of the outcome of the massive star formation process. In the the second scenario, compact binaries must form later on, and the cut-off period may be related to physical length-scales representative of the bloated pre-main-sequence stellar radii or of their accretion disks.
Conclusions: If the obtained constraints are representative of the overall properties of massive young stellar objects, our results may provide support to a formation process in which binaries are initially formed at larger separations, then harden or migrate to produce the typical (untruncated) power-law period distribution observed in few Myr-old OB binaries.

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Young Stellar Objects in the Massive Star-Forming Regions W51 and W43

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We present the results of our investigation of the star-forming complexes W51 and W43, two of the brightest in the first Galactic quadrant. In order to determine the young stellar object (YSO) populations in W51 and W43 we used

color-magnitude relations based on Spitzer mid-infrared and 2MASS/UKIDSS near-infrared data. We identified 302 Class I YSOs and 1178 Class II/transition disk candidates in W51, and 917 Class I YSOs and 5187 Class II/transition disk candidates in W43. We also identified tens of groups of YSOs in both regions using the Minimal Spanning Tree (MST) method. We found similar cluster densities in both regions even though Spitzer was not able to probe the densest part of W43. By using the Class II/I ratios, we traced the relative ages within the regions and based on the morphology of the clusters we argue that several sites of star formation are independent of one another in terms of their ages and physical conditions. We used spectral energy distribution (SED)-fitting to identify the massive YSO (MYSO) candidates since they play a vital role in the star formation process and then examined them to see if they are related to any massive star formation tracers such as UCH II regions, masers and dense fragments. We identified 17 MYSO candidates in W51, and 14 in W43, respectively and found that groups of YSOs hosting MYSO candidates are positionally associated with H II regions in W51, though we do not see any MYSO candidates associated with previously identified massive dense fragments in W43.

Accepted by ApJ

http://arxiv.org/pdf/1703.02771

Planetesimal formation near the snowline: in or out?

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The formation of planetesimals in protoplanetary disks is not well-understood. Streaming instability is a promising mechanism to directly form planetesimals from pebble-sized particles, provided a high enough solids-to-gas ratio. However, local enhancements of the solids-to-gas ratio are difficult to realize in a smooth disk, which motivates the consideration of special disk locations such as the snowline. In this article we investigate the viability of planetesimal formation by streaming instability near the snowline due to water diffusion and condensation. We adopt a viscous disk model, and numerically solve the transport equations for vapor and solids on a cylindrical, 1D grid. We take into account radial drift of solids, gas accretion on to the central star, and turbulent diffusion. We study the importance of the back-reaction of solids on the gas and of the radial variation of the mean molecular weight of the gas. We find that water diffusion and condensation can locally enhance the ice surface density by a factor 3–5 outside the snowline. Assuming that icy pebbles contain many micron-sized silicate grains that are released during evaporation, the enhancement is increased by another factor $\sim$2. In this 'many-seeds' model, the solids-to-gas ratio interior to the snowline is enhanced as well, but not as much as just outside the snowline. In the context of a viscous disk, the diffusion-condensation mechanism is most effective for high values of the turbulence parameter α (10^{-3}–10^{-2}). Therefore, assuming young disks are more vigorously turbulent than older disks, planetesimals near the snowline can form in an early stage of the disk. In highly turbulent disks, tens of Earth masses can be stored in an annulus outside the snowline, which can be identified with recent ALMA observations.

Accepted by A&A

http://arxiv.org/pdf/1702.02151

Orbiting Clouds of Material at the Keplerian Co-Rotation Radius of Rapidly Rotating Low Mass WTTs in Upper Sco

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Using *K2* data, we have identified 23 very low mass members of the ρ Oph and Upper Scorpius star-forming region as having periodic photometric variability not easily explained by well-established physical mechanisms such as star spots, eclipsing binaries, or pulsation. All of these unusual stars are mid-to-late M dwarfs without evidence of active accretion, and with photometric periods generally <1 day. Often the unusual light curve signature takes the form of narrow flux dips; when we also have rotation periods from star spots, the two periods agree, suggesting that the flux dips are due to material orbiting the star at the Keplerian co-rotation radius. We sometimes see "state-changes" in the phased light curve morphologies where ∼25% of the waveform changes shape on timescales less than a day; often, the "state-change" takes place immediately after a strong flare. For the group of stars with these sudden light curve morphology shifts, we attribute their flux dips as most probably arising from eclipses of warm coronal gas clouds, analagous to the sling-shot prominences postulated to explain transient Hα absorption features in AB Doradus itself and other rapidly rotating late type stars. For another group of stars with somewhat longer periods, we find the short duration flux dips to be highly variable on both short and long timescales, with generally asymmetric flux dip profiles. We believe that these flux dips are due to particulate clouds possibly associated with a close-in planet or resulting from a recent collisional event.

Accepted by AJ

https://arxiv.org/pdf/1702.01797

Spiral Arms, Infall, and Misalignment of the Circumbinary Disk from the Circumstellar Disks in the Protostellar Binary System L1551 NE

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We report the ALMA Cycle 2 observations of the Class I binary protostellar system L1551 NE in the 0.9-mm continuum, $C^{18}O$ (3-2), ^{13}CO (3–2), SO (7_8-6_7), and the CS (7–6) emission. At $0farcs18$ (= 25 AU) resolution, $sim4$-times higher than that of our Cycle 0 observations, the circumbinary disk as seen in the 0.9-mm emission is shown to be comprised of a northern and a southern spiral arm, with the southern arm connecting to the circumstellar disk around Source B. The western parts of the spiral arms are brighter than the eastern parts, suggesting the presence of an $m = 1$ spiral mode. In the $C^{18}O$ emission, the infall gas motions in the inter-arm regions and the outward gas motions in the arms are identified. These observed features are well reproduced with our numerical simulations, where gravitational torques from the binary system impart angular momenta to the spiral-arm regions and extract angular momenta from the inter-arm regions. Chemical differentiation of the circumbinary disk is seen in the four molecular species. Our Cycle 2 observations have also resolved the circumstellar disks around the individual protostars, and the beam-deconvolved sizes are $0farcs29\ times\ 0farcs19$ (= 40 $times$ 26 AU) (P.A. = $144degr$) and $0farcs26\ times\ 0farcs20$ (= 36 $times$ 27 AU) (P.A. = $147degr$) for Sources A and B, respectively. The position and inclination angles of these circumstellar

disks are misaligned with that of the circumbinary disk. The $C^{18}O$ emission traces the Keplerian rotation of the misaligned disk around Source A.

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http://arxiv.org/pdf/1702.05562

Secular evolution of eccentricity in protoplanetary discs with gap-opening planets

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We explore the evolution of the eccentricity of an accretion disc perturbed by an embedded planet whose mass is sufficient to open a large gap in the disc. Various methods for representing the orbit-averaged motion of an eccentric disc are discussed. We characterize the linear instability which leads to the growth of eccentricity by means of hydrodynamical simulations. We numerically recover the known result that eccentricity growth in the disc is possible when the planet-to-star mass ratio exceeds 0.003. For mass ratios larger than this threshold, the precession rates and growth rates derived from simulations, as well as the shape of the eccentric mode, compare well with the predictions of a linear theory of eccentric discs. We study mechanisms by which the eccentricity growth eventually saturates into a non-linear regime.

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http://arxiv.org/pdf/1702.04543

Characterising face-on accretion onto and the subsequent contraction of protoplanetary discs

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Observations indicate that stars generally lose their protoplanetary discs on a timescale of about 5 Myr. Which mechanisms are responsible for the disc dissipation is still debated. Here we investigate the movement through an ambient medium as a possible cause of disc dispersal. The ram pressure exerted by the flow can truncate the disc and the accretion of material with no azimuthal angular momentum leads to further disc contraction. We derive a theoretical model from accretion disc theory that describes the evolution of the disc radius, mass, and surface density profile as a function of the density and velocity of the ambient medium. We test our model by performing hydrodynamical simulations of a protoplanetary disc embedded in a flow with different velocities and densities. We find that our model gives an adequate description of the evolution of the disc radius and accretion rate onto the disc. The total disc mass in the simulations follows the theoretically expected trend, except at the lowest density where our simulated discs lose mass owing to continuous stripping. This stripping may be a numerical rather than a physical effect. Some quantitative differences exist between the model predictions and the simulations. These are at least partly caused by numerical viscous effects in the disc and depend on the resolution of the simulation. Our model can be used as a conservative estimate for the process of face-on accretion onto protoplanetary discs, as long as viscous processes in the disc can be neglected. The model predicts that in dense gaseous environments, discs can shrink substantially in size and can, in theory, sweep up an amount of gas of the order of their initial mass. This process could be relevant for planet formation in dense environments.

Accepted by A&A

http://arxiv.org/pdf/1702.04383

ALMA and VLA Observations: Evidence for Ongoing Low-mass Star Formation near Sgr A*

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Using the VLA, we recently detected a large number of protoplanetary disk (proplyd) candidates lying within a couple of light years of the massive black hole Sgr A*. The bow-shock appearance of proplyd candidates point toward the young massive stars located near Sgr A*. Similar to Orion proplyds, the strong UV radiation from the cluster of massive stars at the Galactic center is expected to photoevaporate and photoionize the circumstellar disks around young, low mass stars, thus allowing detection of the ionized outflows from the photoionized layer surrounding cool and dense gaseous disks. To confirm this picture, ALMA observations detect millimeter emission at 226 GHz from five proplyd candidates that had been detected at 44 and 34 GHz with the VLA. We present the derived disk masses for four sources as a function of the assumed dust temperature. The mass of protoplanetary disks from cool dust emission ranges between 0.03 – 0.05 solar mass. These estimates are consistent with the disk masses found in star forming sites in the Galaxy. These measurements show the presence of on-going star formation with the implication that gas clouds can survive near Sgr A* and the relative importance of high vs low-mass star formation in the strong tidal and radiation fields of the Galactic center

Accepted by MNRAS

http://arxiv.org/pdf/1701.05939

Moving ... ??

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

New Jobs

Post-doctoral research fellow in Star Formation

The School of Physics and Astronomy at the University of Leeds invites applications for a 3-year fixed term research postdoctoral fellow in Star Formation.

You will work on an STFC-funded project with Prof Oudmaijer, Dr Lumsden and Prof Hoare to investigate high spatial and spectral resolution near- and mid-infrared observations of intermediate mass and massive young stellar objects.

You will carry out a programme to study the sub-au to 100 au scale structures due to accretion and outflows. The observations include high resolution spectroscopy and IR interferometry of accretion disks, jets and winds. The programme will exploit the large sample of MYSOs discovered by the Red MSX Source survey led by the Leeds group to study the massive star formation processes as a function of mass and evolutionary stage.

With a PhD (or you will have submitted your thesis prior to taking up the appointment) in Astrophysics or a closely allied discipline, you will have experience in infrared/optical observational astronomy and a developing track record of peer reviewed publications in international journals.

The application deadline is Monday the 3rd of April 2017, and the starting date will be by arrangement but will be 1st of May 2017 at the earliest.

For more information on the application and more particulars see the link http://jobs.leeds.ac.uk (reference MAPPA1039), for more information on the project, you can also contact Prof Rene Oudmaijer at r.d.oudmaijer@leeds.ac.uk

Specially Appointed Research Staff at the NAOJ Chile Observatory (Stationed at the Kagoshima University)

The NAOJ Chile Observatory invites applications for a Specially Appointed Research Staff to conduct the research project 'ALMA Study of Disk Formation around Protostars' using ALMA data (including archival data). The selected applicant will spend 100 % of the time for this project under the supervision of Professor Takakuwa at the Kagoshima University (1-21-35 Korimoto, Kagoshima, Kagoshima Prefecture, Japan). The selected applicant is required (1) to publish one paper using ALMA per year, and (2) to submit one ALMA proposal per year. The selected applicant may supervise students for the purpose of carrying out this project. See

http://alma.mtk.nao.ac.jp/j/forresearchers/almagrant/images/almagrant_h29_takakuwa_en.pdf

for further information.

The candidate must have a Doctoral degree (PhD) or equivalent in a relevant field. The selected applicant will be employed by the NAOJ, and will be stationed at the Kagoshima University. In case the PI of the project (Prof.

Takakuwa) moves to another university or institute, the selected candidate is expected to accompany the PI. However, if such an arrangement is deemed difficult by the new university/institute, the selected candidate will be relocated to NAOJ in Mitaka and continue the proposed research project.

In principle, the term is for two years from the starting date. NAOJ will conduct a review based on the mid-term performance report submitted by the PI and may extend the term for an additional year. For a researcher who has been employed by NINS (National Institutes of Natural Sciences) after April 1, 2013, his/her term will be set so that the total employment period from April 1, 2013 will be less than 10 years.

The starting date is negotiable, but must be between April 1st 2017 and March 31st 2018.

Interested candidates should prepare the documents in English, convert them to PDF (max 10MB per email) and send them to the e-mail address with a subject line 'Application for 'ALMA Study of Disk Formation around Protostars". Please contact us if you do not receive a reply within two working days.

(1) Cover letter with the title of the research project.
(2) Curriculum vitae
(3) Publication list (Separate refereed papers from others. State your role for co-authored papers.)
(4) PDF of three relevant papers
(5) Statement describing your commitment and plans for the job
(6) Two or more reference letters (must be sent directly to the e-mail address, before the deadline.)
(7) Your e-mail address and phone number

The application deadline is March 31, 2017, 15:00 (JST)

Inquiry about research project: takakuwa_atmark_sci.kagoshima-u.ac.jp

Submission and general inquiries: alma-grant-application_atmark_nao.ac.jp (replace _atmark_ with)

The fellow will receive a monthly salary of 350,000 JPY plus compensation for commuting expenses. Social insurance will be applied. Bonus and retirement allowances are not provided.

Please note that once you are employed as a Specially Appointed Research Staff by NAOJ, you will not be eligible anymore for a NAOJ Project Research Fellow.

Meetings

Star formation in Different Environments: From Local Clouds to Galaxies

ICISE, Quy Nhon, 6-12 August, 2017

Building upon the success of the SFDE16 conference held in ICISE, Quy Nhon, Vietnam, we will get together again in 2017 to discuss about the recent progress in star formation from local clouds to distant galaxies. The conference will highlight the recent advances in wide-field and high resolution surveys and detail numerical simulations of star formation in different environments, from individual star to galaxy systems. The idea is to search for a universal picture of star formation across all scales and also identify the characteristics of each individual scale.

The goal of the conference is to share the different views from different research communities by balancing contributions from different categories and to encourage collaborations between researchers across the Globe. Depending on the demand, we might continue as SFDExSeries in the next years. Focus group meetings also allow more specific topic discussion. Ample time is set aside to encourage discussions and collaboration.

Topics

Local star formation, SF in the Milky Way molecular clouds, ISM, stellar feedback, cluster formation, massive SF, galactic center, Nearby galaxies, Environmental effect, interacting galaxies, High-z (including primordial star formation), Connecting all scales of SF and the universal processes of star formation

Deadlines

Oral abstract submission deadline: 30 March, 2017
Poster abstract submission deadline: 30 April, 2017
Early registration deadline: 06 Jun, 2017
Final registration deadline: 16 July, 2017

The number of participants will be limited to around 80 so that all participants will be accommodated in the same hotel Seagull. Priority will be given to speakers and poster presenters and early registration participants.

Registration fee is 350 USD (early bird) or 420 USD (normal)

Accommodation + meal (breakfast, lunch, dinner) fee for the entire conference duration (6 nights) is 450 USD for a single room and 315 USD per person for a double room.

INVITED SPEAKERS

Neal Evans (UTexas, US), Yu Gao (Purple Mountain Observatory, CN), Bunyo Hatsukade (NAOJ, JP), Jacqueline Hodge (Leiden, NL), Tomoharu Oka (Keio Univ., JP), Chelsea Sharon (McMaster, CA), (to be updated)

SCIENTIFIC ORGANIZING COMMITTEE

Francoise Combes (Observatoire de Paris, FR), Daisuke Iono (NAOJ, JP), Bruce Elmegreen (IBM, US), Daniel Espada (NAOJ, JP), Jens Kauffmann (MpifR, DE), Guinevere Kauffmann (MPIA, DE), Woong-Tae Kim (SNU, KR), Mark Krumholz (ANU, AU), Adam Leroy (Ohio State University, US), Satoki Matsushita (ASIAA, TW), Frdrique Motte (Grenoble university, FR), Fumitaka Nakamura (NAOJ, JP), Quang Nguyen-Luong (KASI, KR), Christine Wilson (McMaster University, CA)

LOCAL ORGANIZING COMMITTEE

Fumitaka Nakamura (NAOJ, Japan), Quang Nguyen-Luong (KASI, Korea), Jean Tran Thanh Van (ICISE, Vietnam), Tran Thanh Son (ICISE, Vietnam)

WEBSITE:

http://rencontresduvietnam.org/conferences/2017/sfde2017/

The Guillermo Haro advanced school on modelling the ionized universe

The Guillermo Haro advanced school on modelling the ionized universe will be held at INAOE (Instituto Nacional de Astrofisica, Optica y Electronica, Tonantzintla, Puebla, Mexico) from July 3rd to 14th, 2017. The school will provide a comprehensive, state-of-the-art, hands-on approach to the modelling of ionized gas in different environments, from AGB stars to active galactic nuclei, to an audience of up to 40 young researchers, mainly PhD students and postdocs.

The first week will consist of a Cloudy workshop led by Gary Ferland. Cloudy is a general-use spectral synthesis code designed to simulate conditions in interstellar matter under a broad range of conditions. The workshop will cover both observations and theory, showing how to apply Cloudy to a wide variety of astronomical environments, including the interstellar medium, AGB stars, active galactic nuclei, starburst galaxies, and the intergalactic medium. The sessions will combine textbook study, using Osterbrock & Ferland's Astrophysics of Gaseous Nebulae and Active Galactic Nuclei, with the application of Cloudy to research problems chosen by the participants. No prior experience with Cloudy is assumed. The participants will break up into small teams and organize research projects of mutual interest. The workshop will also include a practical introduction by Christophe Morisset to the use of PyNeb, a code for the analysis of emission lines in ionized gas, and pyCloudy, a package that facilitates the interaction with Cloudy and that allows the construction of pseudo-3D models.

The second week will delve further into the topics introduced during the first week, with lectures by Gloria Delgado-Inglada (IA-UNAM), Gary Ferland (University of Kentucky), Christophe Morisset (IA-UNAM), Hagai Netzer (Tel Aviv University), Manuel Peimbert (IA-UNAM), and Mnica Rodrguez (INAOE). The lectures will explore the problems encountered when applying ionization models to real objects, such as those involving uncertainties in atomic data, dust structure and composition, or the spectral energy distribution of the ionizing source, as well as the effects of shocks and possible departures from the Maxwellian velocity distribution. The lecturers will present different strategies that can be used to approach specific problems, and will discuss future developments in the field. During this second week, the participants will also have time to build on the projects developed in the first week or to start afresh with new projects that explore the capabilities of Cloudy.

Web site for more information: http://www.inaoep.mx/~progharo/gh2017/index.php

Second announcement

Planet Formation and Evolution 2017

Jena, Germany, 25 - 27 September 2017

RATIONALE:

The German community of researchers working in the fields of planet formation, exoplanets and planetary systems, protoplanetary and debris disks, astrobiology, and planetary research in general organizes the workshops "Planet Formation and Evolution" since 2001. The meetings in the series are typically held every 1,5 years at different German universities that host research groups actively working on these topics. This workshop is the 11th in the series. PFE meetings are usually attended by scientists from all parts of Germany with a broad international participation. Following the spirit of the previous very stimulating meetings, the goal of this workshop is to provide a common platform for scientists working in the fields listed above. Most importantly, this workshop is aimed at stimulating and intensifying the dialogue between researchers using various approaches - observations, theory, and laboratory studies. In particular, students and postdocs are encouraged to present their results and to use the opportunity to learn more about the main questions and most recent results in adjacent fields.

TOPICS:

Dust, Pebbles, Planetesimals; Protoplanetary and Transitional Disks; Exoplanet Observations; Exoplanet Interiors, Atmospheres, and Habitability; Planetary System Dynamics; Debris Disks; Solar System

CONFIRMED INVITED SPEAKERS:

Anthony Boccaletti (Paris), Carsten Guettler (Goettingen), Grant Kennedy (Cambridge), Zoe Leinhardt (Bristol), Nadine Nettelmann (Rostock), Ilaria Pascucci (Arizona), Sean Raymond (Bordeaux), Ignas Snellen (Leiden)

SCIENTIFIC ORGANIZING COMMITTEE:

Juergen Blum (Braunschweig), Stefan Dreizler (Goettingen), Cornelis Dullemond (Heidelberg), Barbara Ercolano (Muenchen), Artie Hatzes (Tautenburg), Hubert Klahr (Heidelberg), Willy Kley (Tuebingen), Alexander Krivov (Jena, chair), Ralph Neuhaeuser (Jena), Susanne Pfalzner (Bonn), Heike Rauer (Berlin), Mario Trieloff (Heidelberg), Sebastian Wolf (Kiel), Gerhard Wurm (Duisburg)

LOCAL ORGANIZING COMMITTEE:

Mark Booth, Alexander Krivov, Torsten Loehne, Markus Mugrauer, Harald Mutschke, Annett Weise

VENUE:

Friedrich-Schiller University Jena, Faculty of Physics and Astronomy, Lecture Hall 1, Max-Wien-Platz 1, 07743 Jena, Germany

REGISTRATION AND ABSTRACT SUBMISSION:

Registration and abstract submission through the workshop website are now open. Make sure to register early, as the number of participants is limited to 150.

IMPORTANT DATES:

Registration deadline: June 1, 2017
Abstract submission deadline: June 1, 2017
Talk/poster selection: August, 2017
Hotel booking: see website
Final announcement: early September, 2017
Workshop: September 25-27, 2017

TRAVEL AND ACCOMMODATION:

See website for detailed travel information and hotel booking instructions.

FEES AND TRAVEL SUPPORT:

The workshops in the series are traditionally neutral in terms of funding. This implies that no registration fee is charged and that no financial support is offered to the participants. In exceptional cases, the organisers will try to arrange some support from the funds provided to us by the German Research Foundation (DFG) for the meeting organization.

WEBSITE:

http://www.astro.uni-jena.de/~pfe2017

CONTACT:

If you have any questions or requests, please contact us at pfe2017@uni-jena.de.

Summary of Upcoming Meetings

Astrochemistry VII - Through the Cosmos from Galaxies to Planets
20 - 24 March 2017, Puerto Varas, Chile
http://newt.phys.unsw.edu.au/IAUS332/

Formation and Dynamical Evolution of Exoplanets
26 - 31 March 2017, Aspen, USA
http://ciera.northwestern.edu/Aspen2017.php

Multi-Scale Star Formation
3 - 7 April 2017, Morelia, Mexico
http://www.irya.unam.mx/multi-scaleSF17/

The migration issue: from protoplanets to supermassive black holes
22 - 24 May 2017, Cambridge, UK
http://www.ast.cam.ac.uk/meetings/2017/migration.issue.protoplanets.supermassive.black.holes

Protoplanetary Disks and Planet Formation and Evolution
29 May - 23 June 2017, Garching bei München, Germany
http://www.munich-iapp.de/scientific-programme/programmes-2017/protoplanetary-disks/

Accretion, Differentiation and Early Evolution of Terrestrial Planets
29 May - 3 June 2017, Nice, France
https://www-n.oca.eu/morby/Accrete.html

Francesco's Legacy: Star Formation in Space and Time
6 - 9 June 2017, Firenze, Italy
http://www.arcetri.astro.it/sfst2017/

Gordon Research Seminar Origins of Solar Systems
17 - 18 June 2017, South Hadley, USA
https://www.grc.org/programs.aspx?id=17506

Gordon Research Conference Origins of Solar Systems: Making a Habitable Planet
18 - 23 June 2017, South Hadley, USA
https://www.grc.org/programs.aspx?id=12346

Comparing simulations and observations of the varying scales of star formation
26-27 June 2017, Prague, Czech Republic
http://eas.unige.ch/EWASS2017/session.jsp?id=S3

Current and Future Perspectives of Chemical Modelling in Astrophysics
17 - 19 July 2017, Hamburg, Germany
http://www.hs.uni-hamburg.de/astromodel2017

Star Formation in Different Environments: From Local Clouds to Galaxies
6 - 12 August 2017, Quy Nhon, Vietnam
http://rencontresduvietnam.org/conferences/2017/sfde2017/

Ages^2: Taking stellar ages to the next power
18 - 22 September 2017, Elba, Italy
http://www.stsci.edu/institute/conference/ages2017

Planet Formation and Evolution 2017
25 - 27 September 2017, Jena, Germany
http://www.astro.uni-jena.de/~pfe2017