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Abstracts of recently accepted papers

The Dependence of the Initial Mass Function on Metallicity, and the Opacity Limit for Fragmentation

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We investigate the dependence of stellar properties on the opacity limit for fragmentation which is set by the metallicity of a molecular cloud. We compare the results from two large-scale hydrodynamical simulations of star cluster formation that resolve the fragmentation process down to the opacity limit, the first of which was reported by Bate, Bonnell & Bromm. The initial conditions of the two calculations are identical, but in the new simulation the onset of the opacity limit occurs at a lower gas density, and this is expected to increase the minimum mass of a brown dwarf by a factor of three (to ≈ 9 Jupiter masses).

We find that the lowest mass object is a factor of three higher in the low-metallicity calculation, as expected. However, apart from this shift of the low-mass cut-off, the initial mass functions (IMFs) produced by the two calculations are indistinguishable. In particular, the median (characteristic) mass is unchanged. These results add support to the accretion-ejection model proposed by Bate & Bonnell for the origin of the IMF, which predicts that the characteristic mass should vary in proportion to the mean thermal Jeans mass in the cloud. They also indicate that the form of the IMF above the low-mass cut-off should not display a strong metallicity dependence, assuming that the cooling is dominated by dust and that the overall mean thermal Jeans mass of a molecular cloud does not depend on its metallicity. However, if the mean thermal Jeans mass of a molecular cloud is set by the thermal behaviour of gas during the *formation of the cloud*, this should lead to an *indirect* dependence of the characteristic mass of the IMF on metallicity because of the link between the characteristic mass and the mean thermal Jeans mass of the cloud.

Accepted by MNRAS

Paper and animations available at http://www.astro.ex.ac.uk/people/mbate

The Circumstellar Environment of High Mass Protostellar Objects. III Evidence of Infall?

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The results are presented of a molecular line survey to search for the spectral signature of infall towards 77 850μm continuum sources believed to be candidate high mass protostellar objects. Up to six different transitions, HCO^+ J= 1 $\rightarrow$ 0, J= 3 $\rightarrow$ 2 and J= 4 $\rightarrow$ 3, H_2CO $2_{12} - 1_{11}$, N_2H^+ J= 1 $\rightarrow$ 0 and $H^{13}CO^+$ J= 3 $\rightarrow$ 2, were observed towards each source. Towards the peak of the 850μm emission, N_2H^+ was typically strong, with a peak antenna temperature of $\sim$ 1.5K, with a typical linewidth of $\sim$ 2 $\mathrm{km\,s^{-1}}$. The good agreement between the velocity and velocity width of the N_2H^+ and $H^{13}CO^+$ emission suggests that both species are tracing similar material in the sources. With

respect to the velocity of the N_2H^+, there is a statistically significant excess of blue asymmetric line profiles in both the HCO^+ J= $1 \rightarrow 0$ and H_2CO transitions. This excess reaches levels similar to that seen towards samples of low mass protostars, and suggests that the material around these high mass sources is infalling. We identify 22 promising candidate infall sources which show at least one blue asymmetric line profile and no red asymmetric profiles. The infall velocity is estimated to be in the range of 0.1 $\mathrm{km\,s^{-1}}$ to 1 $\mathrm{km\,s^{-1}}$ with an implied mass accretion rate of between 2×10^{-4} $M_\odot$ /yr and 10^{-3} $M_\odot$ /yr.

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http://www.jb.man.ac.uk/∼gaf/Papers.html

Proper Motions of the HH 47 Jet Observed with the Hubble Space Telescope

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We present a proper motion study of the shock waves within the classic stellar jet HH 47 based on Hubble Space Telescope Hα and [S II] images of the region taken over two epochs. Individual knots within the jet and in the bow shock/Mach disk working surface of HH 47A move significantly in the five years that separate the images, and the excellent spatial resolution of HST makes it possible to measure the proper motions with enough precision to easily observe differential motions throughout the flow. The bright portion of the jet emerges at 37.5 +/- 2.5 degrees from the plane of the sky with an average velocity of 300 km/s. Dynamical ages of the shock waves in the jet range from a few decades for knots recently ejected by the source to $\sim$ 1300 years for the faint extended bow shock HH 47D. The jet curves, but motions of knots in the jet are directed radially away from the exciting source, and velocity variability in the flow drives the shock waves that heat the jet internally. The jet orientation angle varies with time by about 15 degrees, and currently points to the northwestern portion of a cavity outlined by a reflection nebula, where a quasi-stationary shock deflects the jet. The major working surface HH 47A is more complex than a simple bow shock/Mach disk, and contains numerous clumps that move relative to one another with velocities of $\sim$ +/- 40 km/s. Small clumps or instabilities affect the Mach disk, and dense clumps may move all the way through the working surface to cause the bumpy morphology seen at the bow shock. A localized area between the bow shock and Mach disk varies significantly between the two sets of images.

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http://sparky.rice.edu/∼hartigan/pub.html

Self-Sustained Ionization and Vanishing Dead Zones in Protoplanetary Disks

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We analyze the ionization state of the magnetohydrodynamically turbulent protoplanetary disks and propose a new mechanism of sustaining ionization. First, we show that in the quasi-steady state of turbulence driven by magnetorotational instability in a typical protoplanetary disk with dust grains, the amount of energy dissipation should be sufficient for providing the ionization energy that is required for activating magnetorotational instability. Second, we show that in the disk with dust grains the energetic electrons that compose electric currents in weakly ionized gas can provide collisional ionization, depending on the actual saturation state of magnetorotational turbulence. On the other hand, we show that in the protoplanetary disks with the reduced effect of dust grains, the turbulent motion can homogenize the ionization degree, leading to the activation of magnetorotational instability even in the absence of other ionization processes. The results in this Letter indicate that most of the regions in protoplanetary disks remain

magnetically active, and we thus require a change in the theoretical modeling of planet formation.

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http://arxiv.org/abs/astro-ph/0506131

HST/ACS Images of the GG Tauri Circumbinary Disk

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Hubble Space Telescope Advanced Camera for Surveys images of the young binary GG Tauri and its circumbinary disk in V and I bandpasses were obtained in 2002 and are the most detailed of this system to date . They confirm features previously seen in the disk including: a "gap" apparently caused by shadowing from circumstellar material; an asymmetrical distribution of light about the line of sight on the near edge of the disk; enhanced brightness along the near edge of the disk due to forward scattering; and a compact reflection nebula near the secondary star. New features are seen in the ACS images: two short filaments along the disk; localized but strong variations in the disk intensity ("gaplets"); and a "spur" or filament extending from the reflection nebulosity near the secondary. The back side of the disk is detected in the V band for the first time. The disk appears redder than the combined light from the stars, which may be explained by a varied distribution of grain sizes. The brightness asymmetries along the disk suggest that it is asymmetrically illuminated by the stars due to extinction by nonuniform circumstellar material or the illuminated surface of the disk is warped by tidal effects (or perhaps both). Localized, time-dependent brightness variations in the disk are also seen.

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Preprint available at `http://arxiv.org/abs/astro-ph/0508222`

The dynamical influence of cooling in the envelope of prestellar and protostellar cores

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We compute numerical simulations of spherical collapse triggered by a slow increase in external pressure. We compare isothermal models to models including cooling with a simple but self-consistent treatment of the coupling between gas, grains and radiation field temperatures. The hydrostatic equilibrium appears to hold past the marginally stable state, until the collapse proceeds. The last hydrostatic state before collapse has a lower central gas temperature in the centre due to the enhanced coupling between gas, grains and radiation field. This results in slightly lower pressure gradients in the bulk of the envelope which is hence slightly more extended than in the isothermal case. Due to the sensitivity of the collapse on these initial conditions, protostellar infall velocities in the envelope turn out to be much slower in the case with cooling.

Our models also compute the radiative transfer and a rather large chemical network coupled to gas dynamics. However, we note that the steady-state chemisorption of CO is sufficient to provide an accurate cooling function of the gas. This justifies the use of post-processing techniques to account for the abundance of observed molecules.

Existing observations of infall signatures put very stringent constraints on the kinematics and temperature profile of

the class 0 protostar IRAM 04191+1522. We show that isothermal models fail to account for the innermost slow infall motions observed, even with the most hydrostatic initial conditions. In contrast, models with cooling reproduce the general shape of the temperature profile inferred from observations and are in much better agreement with the infall signatures in the inner 3000 AU.

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Constraining the IMF in Extreme Environments: Detecting Young Low Mass Stars in Unresolved Starbursts

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We demonstrate the feasibility of detecting directly low mass stars in unresolved super–star clusters with ages < 10 Myr using near–infrared spectroscopy at modest resolution (R $\sim$ 1000). Such measurements could constrain the ratio of high to low mass stars in these extreme star–forming events, providing a direct test on the universal nature of the initial mass function (IMF) compared to the disk of the Milky Way (Chabrier, 2003). We compute the integrated light of super–star clusters with masses of 10^6 $M_\odot$ drawn from the Salpeter (1955) and Chabrier (2003) IMFs for clusters aged 1, 3, and 10 Myr. We combine, for the first time, results from Starburst99 (Leitherer et al. 1999) for the main sequence and post–main sequence population (including nebular emission) with pre–main sequence (PMS) evolutionary models (Siess et al. 2000) for the low mass stars as a function of age. We show that $\sim$ 4–12 % of the integrated light observed at 2.2 μm comes from low mass PMS stars with late–type stellar absorption features at ages < 3 Myr. This light is discernable using high signal–to–noise spectra (> 100) at R=1000 placing constraints on the ratio of high to low mass stars contributing to the integrated light of the cluster.

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http://xxx.lanl.gov/abs/astro-ph/0507646

FUSE observations of molecular hydrogen on the line of sight towards HD 141569A

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We present an analysis of the Far Ultraviolet Spectroscopic Explorer (*FUSE*) spectrum of HD 141569A, a transitional object known to possess a circumstellar disk. We observe two components of gas at widely different temperatures along the line of sight. We detect cold H_2, which is thermalized up to $J = 2$ at a kinetic temperature of $\sim$ 51 K. Such low temperatures are typical of the diffuse interstellar medium. Since the line of sight to HD 141569A does not pass through its disk, it appears that we are observing the cold H_2 in a low extinction envelope associated with the high Galactic latitude dark cloud complex L134N, which is in the same direction and at nearly the same distance as HD 141569A. The column densities of the higher J-levels of H_2 suggest the presence of warm gas along the line of sight. The excitation conditions do not seem to be consistent with what is generally observed in diffuse interstellar clouds. The observed radial velocity of the gas implies that the UV spectral lines we observe are likely interstellar in origin rather than circumstellar, although our absorption line study does not definitely rule out the possibility that the warm gas is close to the star. The discovery of such warm gas along the line of sight may provide evidence for turbulent phenomena in the dark cloud L134N.

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A stability analysis of radiative shocks in the presence of a transverse magnetic field

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Radiative shock waves may be subject to a global thermal instability in which the cooling layer and shock front undergo growing resonant oscillations. For strong hydrodynamic shocks, the presence of the overstability depends on the temperature and density indices of power-law cooling functions and the specific heat ratio, α, β and γ, respectively. Here, we investigate the stabilising influence of a transverse magnetic field by introducing the shock Alfvén number, M_a as a fourth parameter. We thus investigate the stability criteria for both molecular and atomic shocks under a wide range of conditions. In particular, we find that all molecular shocks in which the cooling increases with the temperature ($\alpha > 0$) are stabilised to the first four modes if $M_a < 20$ ($\beta = 2$). For $\alpha = -0.5$, the first overtone remains stable only for $M_a < 8$. We conclude that molecular shocks in the interstellar medium are probably stabilised by a transverse magnetic field unless exceptional circumstances arise in which the cooling strongly increases as the gas cools.

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Preprints: astro-ph/0505061, or at http://star.arm.ac.uk/∼mds/Linear/linear.html

A One-AU Expanding Water Maser Circular Ring in the W75N(B)-VLA 2 Shell

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We have identified and modeled a remarkable water maser "microstructure" of $\simeq 1.1$ mas size within the expanding shell of $\simeq 0\farcs16$ size associated with the young stellar object W75N(B)-VLA 2. The water maser spots of this microstructure present a spatial distribution and line-of-sight velocity components that fit extremely well a circular ring of $\simeq 1$ AU radius expanding at $\simeq 2.5$ km s^{-1}. In particular, we have studied the spatio-kinematics and intensity distribution of the maser emission of an expanding ring observed at arbitrary angles. We construct position-velocity diagrams for the maser spots, calculating the maximum intensity as a function of the impact parameter and then comparing the results with the observation. This is the first time that such well-ordered spatio-kinematical behavior of the water masers is observed and modeled at the very small scale of $\simeq 1$ AU. The VLA 2 maser shell is probably produced by an energetic stellar wind that compresses the ambient medium and drives a shock into it. Water maser emission is excited in flattened structures behind the shocks. We speculate that either this kind of spatio-kinematical microstructures are produced by fluid instabilities within the shocked material or that they correspond to nearly round cloudlets (turbulent eddies?) in the ambient medium that were flattened by the expanding shock.

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http://www.astroscu.unam.mx/∼lucero/preprints

Star Formation Efficiency in Driven, Supercritical, Turbulent Clouds

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We present measurements of the star formation efficiency (SFE) in 3D numerical simulations of driven turbulence in supercritical, ideal-MHD, and non-magnetic regimes, characterized by their mean normalized mass-to-flux ratio μ, all with 64 Jeans masses and similar rms Mach numbers (~ 10). In most cases, the moderately supercritical runs with $\mu = 2.8$ have significantly lower SFEs than the non-magnetic cases, being comparable to observational estimates for whole molecular clouds ($\leq 5\%$ over 4 Myr). Also, as the mean field is increased, the number of collapsed objects decreases, and the median mass of the collapsed objects increases. However, the largest collapsed-object masses systematically occur in the weak-field case $\mu = 8.8$. The high-density tails of the density histograms in the simulations are depressed as the mean magnetic field strength is increased. This suggests that the smaller numbers and larger masses of the collapsed objects in the magnetic cases may be due to a greater scarcity and lower mean densities (implying larger Jeans masses) of the collapse candidates. In this scenario, the effect of a weak field is to reduce the probability of a core reaching its thermal Jeans mass, even if it is supercritical. We thus suggest that the SFE may be monotonically reduced as the field strength increases from zero to subcritical values, rather than there being a discontinuous transition between the sub- and supercritical regimes, and that a crucial question to address is whether the turbulence in molecular clouds is driven or decaying, with current observational and theoretical evidence favoring (albeit inconclusively) the driven regime.

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2-D models of layered protoplanetary discs: I. The ring instability

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In this work we use the radiation hydrodynamic code TRAMP to perform a two-dimensional axially symmetric model of the layered disc. Using this model we follow the accumulation of mass in the dead zone due to the radially varying accretion rate. We found a new type of instability which causes the dead zone to split into rings. This "ring instability" works due to the positive feedback between the thickness of the dead zone and the mass accumulation rate.

We give an analytical description of this instability, taking into account non-zero thickness of the dead zone and deviations from the Keplerian rotational velocity. The analytical model agrees reasonably well with results of numerical simulations. Finally, we speculate about the possible role of the ring instability in protoplanetary discs and in the formation of planets.

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High-Mass Cloud Cores in the η Carinae Giant Molecular Cloud

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We carried out an unbiased survey for massive dense cores in the giant molecular cloud associated with η Carinae with the NANTEN telescope in ^{12}CO, ^{13}CO, and C^{18}O $J = 1$–0 emission lines. We identified 15 C^{18}O cores, whose typical line width $\Delta V_{\rm comp}$, radius r, mass M, column density $N(\rm H_2)$, and average number density $n(\rm H_2)$ were 3.3 km s^{-1}, 2.2 pc, 2.6×10^3 $M_\odot$, 1.3×10^{22} cm^{-2}, and 1.2×10^3 cm^{-3}, respectively. Two of the 15 cores are associated with IRAS point sources whose luminosities are larger than 10^4 $L_\odot$, which indicates that massive star formation is occuring within these cores. Five cores including the two with IRAS sources are associated with MSX point sources. We detected H^{13}CO$^+$ ($J = 1$–0) emission toward 4 C^{18}O cores, two of which are associated with IRAS and MSX point sources, another one

is associated only with an MSX point source, and the other is associated with neither IRAS nor MSX point sources. The core with neither IRAS nor MSX point sources shows the presence of a bipolar molecular outflow in ^{12}CO (J = 2–1), which indicates that star formation is also occuring in the core, and the other three of the four H^{13}CO$^+$ detections show wing-like emission. In total, six C^{18}O cores out of 15 (= 40%) are experienced star formation, and at least 2 of 15 (= 13 %) are massive-star forming cores in the η Car GMC. We found that massive star formation occurs preferentially in cores with larger $N(H_2)$, M, $n(H_2)$, and smaller ratio of M_{vir}/M. We also found that the cores in the η Car GMC are characterized by large ΔV and M_{vir}/M on average compared to the cores in other GMCs observed with the same telescope. These properties of the cores may account for the fact that as much as 60–87 % of the cores do not show any signs of massive star formation. We investigated the origin of a large amount of turbulence in the η Car GMC. We found that turbulence injection from stellar winds, molecular outflows, and supernova remnants which originated from stars formed within the GMC, are not enough to explain the existing turbulence. We propose the possibility that the large turbulence was pre-existing when the GMC was formed, and is now dissipating. Mechanisms such as multiple supernova explosions in the Carina flare supershell may have contributed to form a GMC with a large amount of turbulence.

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A Highly Collimated, Young and Fast CO Outflow in OMC1 South

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We present high angular resolution ($\sim 1''$), sensitive CO(2-1) line observations of the region OMC1 South in the Orion Nebula made using the Submillimeter Array (SMA). We detect the CO(2-1) high velocity outflow that was first found by Rodríguez-Franco et al. (1999a) with the IRAM 30 m. Our observations resolve the outflow, whose velocity-integrated emission has a deconvolved width of $0\farcs89 \pm 0\farcs06$ (390 AU) and a projected length of $\sim 48''$ (21,000 AU) with very high redshifted and blueshifted gas with velocities of about $\pm$80 km s^{-1}. This outflow is among the most collimated ($\sim 3^\circ$) and youngest outflows (600 yr) that have been reported. The data show that this collimated outflow has been blowing in the same direction during the last 600 yr. At high velocities, the CO(2-1) outflow traces an extremely collimated jet, while at lower velocities the CO emission traces an envelope possibly produced by entrainment of ambient gas. Furthermore, we also detect for the first time a millimeter wavelength continuum source associated with a class I protostar that we suggest could be the possible exciting source for this collimated outflow. However, the bolometric luminosity of this source appears to be far too low to account for the powerful molecular outflow.

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Abstracts of papers in Nature and Science

Because of embargoes on preprints for Nature and Science, abstracts for these two journals will be accepted for papers that have already been published

Extreme collisions between planetesimals as the origin of warm dust around a Sun-like star

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The slow but persistent collisions between asteroids in our Solar System generate a tenuous cloud of dust known as the zodiacal light (because of the light the dust reflects). In the young Solar System, such collisions were more common and the dust production rate should have been many times larger. Yet copious dust in the zodiacal region around stars much younger than the Sun has rarely been found. Dust is known to orbit around several hundred main-sequence stars, but this dust is cold and comes from a Kuiper-belt analogous region out beyond the orbit of Neptune. Despite many searches, only a few main-sequence stars reveal warm (> 120 K) dust analogous to zodiacal dust near the Earth. Signs of planet formation (in the form of collisions between bodies) in the regions of stars corresponding to the orbits of the terrestrial planets in our Solar System have therefore been elusive. Here we report an exceptionally large amount of warm, small, silicate dust particles around the solar-type star BD+20 307 (HIP 8920, SAO 75016). The composition and quantity of dust could be explained by recent frequent or huge collisions between asteroids or other 'planetesimals' whose orbits are being perturbed by a nearby planet.

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An extrasolar giant planet in a close triple-star system

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Hot Jupiters are gas-giant planets orbiting with periods of 3?9 days around Sun-like stars. They are believed to form in a disk of gas and condensed matter at or beyond 2.7 astronomical units from their parent star. At such distances, there exists a sufficient amount of solid material to produce a core capable of capturing enough gas to form a giant planet. Subsequently, they migrate inward to their present close orbits. Here I report the detection of an unusual hot Jupiter orbiting the primary star of a triple stellar system, HD 188753. The planet has an orbital period of 3.35 days and a minimum mass of 1.14 times that of Jupiter. The primary star's mass is 1.06 times that of the Sun, 1.06 $M_{\odot}$. The secondary star, itself a binary stellar system, orbits the primary at an average distance of 12.3 AU with an eccentricity of 0.50. The mass of the secondary pair is 1.63 $M_{\odot}$. Such a close and massive secondary would have truncated a disk around the primary to a radius of only 1.3 AU and might have heated it up to temperatures high enough to prohibit giant-planet formation, leaving the origin of this planet unclear.

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A planetary system as the origin of structure in Fomalhaut's dust belt

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The Sun and >15 per cent of nearby stars are surrounded by dusty disks that must be collisionally replenished by asteroids and comets, as the dust would otherwise be depleted on timescales $<10^7$ years. Theoretical studies show that the structure of a dusty disk can be modified by the gravitational influence of planets, but the observational evidence is incomplete, at least in part because maps of the thermal infrared emission from the disks have low linear resolution (35 AU in the best case). Optical images provide higher resolution, but the closest examples (AU Mic and Pic) are edge-on, preventing the direct measurement of the azimuthal and radial disk structure that is required for fitting theoretical models of planetary perturbations. Here we report the detection of optical light reflected from the dust grains orbiting Fomalhaut (HD 216956). The system is inclined 24^o away from edge-on, enabling the measurement of disk structure around its entire circumference, at a linear resolution of 0.5 AU. The dust is distributed in a belt 25 AU wide, with a very sharp inner edge at a radial distance of 133 AU, and we measure an offset of 15 AU between the belt's geometric centre and Fomalhaut. Taken together, the sharp inner edge and offset demonstrate the presence of planetary-mass objects orbiting Fomalhaut.

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Timescales of shock processes in chondritic and martian meteorites

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The accretion of the terrestrial planets from asteroid collisions and the delivery to the Earth of martian and lunar meteorites has been modelled extensively. Meteorites that have experienced shock waves from such collisions can potentially be used to reveal the accretion process at different stages of evolution within the Solar System. Here we have determined the peak pressure experienced and the duration of impact in a chondrite and a martian meteorite, and have combined the data with impact scaling laws to infer the sizes of the impactors and the associated craters on the meteorite parent bodies. The duration of shock events is inferred from trace element distributions between coexisting high-pressure minerals in the shear melt veins of the meteorites. The shock duration and the associated sizes of the impactor are found to be much greater in the chondrite (1 s and 5 km, respectively) than in the martian meteorite (10 ms and 100 m). The latter result compares well with numerical modelling studies of cratering on Mars, and we suggest that martian meteorites with similar, recent ejection ages (10^5 to 10^7 years ago) may have originated from the same few square kilometres on Mars.

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Widespread magma oceans on asteroidal bodies in the early Solar System

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Immediately following the formation of the Solar System, small planetary bodies accreted1, some of which melted to produce igneous rocks. Over a longer timescale (15-33 Myr), the inner planets grew by incorporation of these smaller objects through collisions. Processes operating on such asteroids strongly influenced the final composition of these

planets, including Earth. Currently there is little agreement about the nature of asteroidal igneous activity: proposals range from small-scale melting, to near total fusion and the formation of deep magma oceans. Here we report a study of oxygen isotopes in two basaltic meteorite suites, the HEDs (howardites, eucrites and diogenites, which are thought to sample the asteroid 4 Vesta) and the angrites (from an unidentified asteroidal source). Our results demonstrate that these meteorite suites formed during early, global-scale melting ($\geq$50 per cent) events. We show that magma oceans were present on all the differentiated Solar System bodies so far sampled. Magma oceans produced compositionally layered planetesimals; the modification of such bodies before incorporation into larger objects can explain some anomalous planetary features, such as Earth's high Mg/Si ratio.

Published by Nature 435, 916, 2005 (16 June issue)

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

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

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

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.

Dissertation Abstracts

The Impact of Protostellar Jets on their Environment

Barry O'Connell

Thesis work conducted at: Armagh Observatory, College Hill, Armagh BT61 9DG, Northern Ireland

Current address: Cedrus, Parteen, Co.Clare, Ireland

Electronic mail: boc@arm.ac.uk

Ph.D dissertation directed by: Michael Smith

Ph.D degree awarded: July 2005

The nature of the accelerated and heated gas along collimated outflows emanating from deeply embedded protostars is investigated. By analysing the shock structures and excitation conditions it is possible to deduce information concerning the flow dynamics and environmental structure governing the morphology of outflows. Narrow-band imaging at near-infrared wavelengths and various spectroscopic techniques are employed in conjunction with bow shock modeling to uncover the underlying gas dynamics and excitation structure.

The L 1634 globule contains two series of aligned molecular shock waves associated with the Herbig-Haro flows HH 240 and HH 241. Near-infrared spectroscopy and narrow-band imaging in the (1,0) S(1) and (2,1) S(1) emission lines of molecular hydrogen yield the spatial distributions of both the molecular excitation and velocity, which demonstrate distinct properties for the individual bow shocks. Bow shock models are applied to infer the shock physics, geometry, speed, density and magnetic field properties. The advancing compact bow HH 240C is interpreted as a J-type bow (frozen-in magnetic field) with the flanks in transition to C-type (field diffusion). It is a paraboloidal bow of speed ~ 42 km s^{-1} entering a medium of density $\sim 2 \times 10^4$ cm^{-3}. The following bow HH 240A can be fit by a C-type model. It has a higher bow speed in spite of a lower excitation, and is propagating through a lower density medium. It is concluded that, while the CO emission originates from cloud gas directly set in motion, the H_2 emission is generated from shocks sweeping through an outflow.

The HH 211 outflow is of considerable interest because of its ascribed youth. The outflow is explored through imaging and spectroscopy in the near-infrared. The detection of a near-infrared continuum of unknown origin is confirmed. It is proposed that the continuum is emitted by the driving protostellar source, escapes the core through the jet-excavated cavity, and illuminates the features aligning the outflow. In addition, [Fe II] emission at 1.644 μm has been detected but is restricted to isolated condensations. The ordered structure of the western outflow is modeled as a series of C-type shocks with J-type dissociative apices. Essentially the same conditions are predicted for each bow except for a systematic reduction in speed and density with distance from the driving source. Increased K-band extinctions are found in the bright regions, as high as 2.9 magnitudes, and suggest that the bow shocks become visible where the outflow impacts on dense clumps of cloud material.

Integral field spectroscopy was performed on the highly symmetric HH 212 outflow. Narrow-band images and spectra were simultaneously obtained between 1.5 to 2.5 μm. Images in H_2 and [Fe II] transition lines were compared in order to extract the excitation and extinction conditions. Collisional excitation was confirmed as the process leading to the radiation from the inner knots and bows. Lower excitation and extinction are found for the bows which appear to have exited from the dense inner gas. The peak flux positions are compared for all the transition lines detected. For the knots, a trend is found between the measured offsets and the upper level temperatures both along the outflow direction and transverse to the jet axis. An underlying shock structure is implied.

A timescale for the Class O evolutionary stage is suggested which relates the envelope mass to the mass accretion rate as inferred from the outflow luminosity. The deduced timescales are in general agreement with the Class O lifetimes estimated from statistical surveys. It is proposed that in order to investigate the relationship between outflows and protostellar evolution, the individual environmental factors for each outflow need to be examined. Only then can the intrinsic luminosities be revealed and related to the evolution which may be different for each source.

http://star.arm.ac.uk/∼boc/

New Jobs

Professor in Astronomy Unit of Queen Mary, University of London

Applications are invited for a permanent post as a Professor in the Astronomy Unit of the School of Mathematical Sciences at Queen Mary, University of London, with an associated lectureship available in due course.

Applicants should have an outstanding record of research achievement and leadership preferably in either Planet Formation or Cosmology, although strong candidates in other areas may be considered if they focus, complement, and enhance the existing programmes of the Unit. Appointees will also be expected to teach in the School of Mathematical Sciences, which has buoyant student numbers.

The Professorial salary (minimum £45,647 per annum inclusive of London allowance) depends on qualifications and experience. The post is available from 1 January 2006 or as soon as possible thereafter.

For any further details on the Astronomy unit which has a current faculty of 14 and computing facilities including a 156 CPU high performance cluster please visit the website:
http://www.maths.qmul.ac.uk/Astronomy,
and for an application form:
http://www.maths.qmul.ac.uk/Astronomy/jobs/
or alternatively visit the Human Resources website on
http://www.admin.qmul.ac.uk/humanresources/vacancies/.

Informal enquiries to:
Professor Jim Emerson, Astronomy Unit Director.
Tel: +44 (0) 20 7882 5040; Fax +44 (0) 20 8981 9587;
Email: j.p.emerson@qmul.ac.uk,
or to Professor David Arrowsmith, Head of School
(+44 (0) 20 7882 5464) Email: d.k.arrowsmith@qmul.ac.uk

Completed application forms and CVs should be returned quoting reference number 05260/FD to Ms Mariana Carter, School of Mathematical Sciences, Queen Mary, University of London, Mile End Road, London E1 4NS (Email m.carter@qmul.ac.uk).

Applications will be considered until the post is filled, with the first review covering applications received by 01 October 2005.

Postdoctoral or Ph.D. position in Infrared Astronomy/Interferometry

Applications are invited for a postdoctoral or Ph.D. position in the Infrared Interferometry Group of the Max-Planck Institute for Radio Astronomy in Bonn (see http://www.mpifr-bonn.mpg.de/div/ir-interferometry). Preference will be given to applicants with experience in one of the following areas: star formation, active galactic nuclei, or radiative transfer modeling.

The successful applicants will be expected to participate in the development of interferometric methods, interferometric observations, and their interpretation. The positions offer excellent opportunities for high-resolution studies using the VLT Interferometer (in particular, its AMBER phase closure instrument) and speckle interferometry. As our group is a member of the international VLTI AMBER and the LBT LINC-NIRVANA consortia, we own a large amount of both VLTI and LBT Guaranteed Observing Time.

Applications should be emailed to: Prof. Gerd Weigelt, MPI for Radioastronomy, Bonn, weigelt@mpifr-bonn.mpg.de

Applicants should submit a curriculum vitae, list of publications, and brief description of research interests, and arrange for one letter of recommendation to be emailed to weigelt@mpifr-bonn.mpg.de. The appointments are initially for one year and are renewable for up to six years. Review of applications will begin on 5 Sep 2005 and continue until the position is filled.

The Max Planck Society is an equal opportunity employer and aims to employ more disabled people. Applications from disabled persons are therefore particularly welcome.

New Books

From Dust to Stars

Norbert S. Schulz

This new book will be a welcome addition on the book shelves for many of the readers of this Newsletter. Written as a textbook for graduate students and researchers, *From Dust to Stars* discusses topics ranging from the properties of the interstellar medium, the dynamics and structure of molecular clouds, concepts of stellar collapse and the evolution of young stellar objects. It also includes a treatment of accretion phenomena, magnetic activity, and high energy processes in YSOs as well as a discussion of stellar cluster properties, a desciption of various star forming regions and a view on proto-solar systems. The relevant physics is outlined in a number of appendices ranging from gas dynamics, magnetohydrodynamics, opacities and various aspects of modern topics in spectroscopy. It features over 900 references mostly from research performed within the last ten years.

1. About the Book

2. Historical Background
2.1 And There Was Light? - 2.2 The Quest to Understand the Formation of Stars - 2.3 Observing Stellar Formation

3. Studies of Interstellar Matter
3.1 The Interstellar Medium - 3.2 Interstellar Gas - 3.3 Column Densities in the ISM - 3.4 Interstellar Dust - 3.5 The ISM in other Galaxies

4. Molecular Clouds and Cores
4.1 Global Cloud Properties - 4.2 Cloud Dynamics - 4.3 Dynamic Properties of Cores

5. Concepts of Stellar Collapse
5.1 Classical Collapse Concepts - 5.2 Stability Considerations - 5.3 Collapse of Rotating and Magnetized Clouds - 5.4 Cores, Disks and Outflows: the Full Solution

6. Evolution of Young Stellar Objects
6.1 Protostellar Evolution - 6.2 Evolution in the HR-Diagram - 6.3 PMS Classification - 6.4 Binaries

7. Accretion Phenomena and Magnetic Activity in YSOs
7.1 Accretion Disks - 7.2 Stellar Rotation in YSOs - 7.3 Magnetic Activity in PMS Stars

8. High-energy Signatures in YSOs
8.1 The X-ray Account of YSOs - 8.2 X-rays from Protostars - 8.3 X-ray Spectra of PMS Stars - 8.4 γ-Radiation from YSOs

9. Star-forming Regions
9.1 Embedded Stellar Clusters - 9.2 General Cluster Properties - 9.3 Well-studied Star-forming Regions - 9.4 Formation in Large Scales

10. Proto-solar Systems and the Sun
10.1 Protoplanetary Disks - 10.2 The Makiing of the Sun

A. Gas Dynamics

B. Magnetic Fields and Plasmas

C. Radiative Interactions with Matter

D. Spectroscopy

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Meetings

Mini-Workshop on Nearby Resolved Debris Disks

October 19-20
Space Telescope Science Institute
Baltimore, USA

http://www.stsci.edu/institute/conference/nrdd

The goal of the workshop is to discuss new space and ground based data for nearby resolved debris disks as a whole set and to compare the data with models of their dynamics, radiative transfer and chemical/dust processed evolution. The targeted objects include the Fabulous Four - Vega, Fomalhaut, Beta Pictoris and Epsilon Eridani - as well as more recently discovered sources like HR4796A, AU Mic, HD 141569 and HD107146.

Topics we plan to address in this forum are:

- The complete inventory of currently known nearby, resolved debris disk systems
- The structure of these disks and their implied dynamical history
- The composition of the dust and its associated radiative transfer
- The role of the central star in shaping debris disks
- Evidence for the presence of planets in these systems
- The nature and origin of these systems: left over debris or failed planetary systems?

Invited Speakers are:

- Pawel Artymowicz
- Jane Greaves
- Paul Kalas
- David Koerner
- Kate Su
- Taku Takeuchi
- Alycia Weinberger
- Mark Wyatt

For additional information and pre-registration, please visit our website at http://www.stsci.edu/institute/conference/nrdd.

On behalf of the SOC,

Inga Kamp (kamp@stsci.edu)