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Abstracts of recently accepted papers

Migration and Dynamical Relaxation in Crowded Systems of Giant Planets

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This paper explores the intermediate-time dynamics of newly formed solar systems with a focus on possible mechanisms for planetary migration. We consider two limiting corners of the available parameter space – crowded systems containing $N = 10$ giant planets in the outer solar system, and solar systems with $N = 2$ planets that are tidally interacting with a circumstellar disk. Crowded planetary systems can be formed in accumulation scenarios – if the disk is metal rich and has large mass – and through gravitational instabilities. The planetary system adjusts itself toward stability by spreading out, ejecting planets, and sending bodies into the central star. For a given set of initial conditions, dynamical relaxation leads to a well-defined distribution of possible solar systems. For each class of initial conditions, we perform large numbers of N-body simulations to obtain a statistical description of the possible outcomes. For $N = 10$ planet systems, we consider several different planetary mass distributions; we also perform secondary sets of simulations to explore chaotic behavior and longer term dynamical evolution. For systems with 10 planets initially populating the radial range 5 AU $\leq a \leq$ 30 AU, these scattering processes naturally produce planetary orbits with $a \sim 1$ AU and the full range of possible eccentricity ($0 \leq \epsilon \leq 1$). Shorter period orbits (smaller a) are difficult to achieve. To account for the observed eccentric giant planets, we also explore a mechanism that combines dynamical scattering and tidal interactions with a circumstellar disk. This combined model naturally produces the observed range of semi-major axis a and eccentricity ϵ. We discuss the relative merits of the different migration mechanisms for producing the observed eccentric giant planets.

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On the web at: astro-ph/0301561

CO Depletion and Deuterium Fractionation in Prestellar Cores

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We report the detection of D_2CO in a sample of starless dense cores, in which we previously measured the degree of CO depletion. The deuterium fractionation is found extremely high, $[D_2CO]/[H_2CO] \sim 1 - 10\%$, similar to that reported in low-mass protostars. This provides convincing evidence that D_2CO is formed in the cold pre-stellar cores, and later desorbed when the gas warms up in protostars. We find that the cores with the highest CO depletions have

also the largest $[D_2CO]/[H_2CO]$ ratios, supporting the theoretical prediction that deuteration increases with increasing CO depletion.

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http://arXiv.org/abs/astro-ph/0301651

Dust emissivity in the Submm/Mm: SCUBA and SIMBA observations of Barnard 68

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We have observed the dark cloud Barnard 68 with SCUBA at 850 μm and with SIMBA at 1.2 mm. The submillimetre and millimetre dust emission correlate well with the extinction map of Alves, Lada & Lada (2001). The $A_V/850$ μm correlation is clearly not linear and suggests lower temperatures for the dust in the inner core of the cloud. Assuming a model for the temperature gradient, we derive the cloud-averaged dust emissivities (normalised to the V-Band extinction efficiency) at 850 μm and 1.2 mm. We find $\kappa_{850\mu m}/\kappa_V = 4.0 \pm 1.0 \cdot 10^{-5}$ and $\kappa_{1.2mm}/\kappa_V = 9.0 \pm 3.0 \cdot 10^{-6}$. These values are compared with other determinations in this wavelength regime and with expectations for models of diffuse dust and grain growth in dense clouds.

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Gas-phase CO_2 toward massive protostars

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We present infrared spectra of gas-phase CO_2 around 15 μm toward 14 deeply embedded massive protostars obtained with the Short Wavelength Spectrometer on board the Infrared Space Observatory. Gas-phase CO_2 has been detected toward 8 of the sources. The excitation temperature and the gas/solid ratio increase with the temperature of the warm gas. Detailed radiative transfer models show that a jump in the abundance of two orders of magnitude is present in the envelope of AFGL 2591 at T >300 K. No such jump is seen toward the colder source NGC 7538 IRS9. Together, these data indicate that gas-phase CO_2 shows the same evolutionary trends as CO_2 ice and other species, such as HCN, C_2H_2, H_2O, and CH_3OH. The gas-phase CO_2 abundance toward cold sources can be explained by gas-phase chemistry and possible freeze-out in the outer envelope. Different chemical scenarios are proposed to explain the gas-phase CO_2 abundance of 1–2$\times10^{-6}$ for T >300 K and of $\sim10^{-8}$ for T <300 K toward AFGL 2591. The best explanation for the low abundance in the warm exterior is provided by destruction of CO_2 caused by the passage of a shock in the past, combined with freeze-out in the coldest part at T <100 K. The high abundance in the interior at temperatures where all oxygen should be driven into H_2O is unexpected, but may be explained either by production of OH through X-ray ionization leading to the formation of abundant gas-phase CO_2, or by incomplete destruction of evaporated CO_2 for T >300 K.

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http://www.strw.leidenuniv.nl/∼boonman/papers/co2.pdf

Gas-phase CO_2, C_2H_2, and HCN toward Orion-KL

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The infrared spectra toward Orion-IRc2, Peak 1 and Peak 2 in the 13.5-15.5 μm wavelength range are presented, obtained with the Short Wavelength Spectrometer on board the Infrared Space Observatory. The spectra show absorption and emission features of the vibration-rotation bands of gas-phase CO_2, HCN, and C_2H_2, respectively. Toward the deeply embedded massive young stellar object IRc2 all three bands appear in absorption, while toward the shocked region Peak 2 CO_2, HCN, and C_2H_2 are seen in emission. Toward Peak 1 only CO_2 has been detected in emission. Analysis of these bands shows that the absorption features toward IRc2 are characterized by excitation temperatures of ∼175–275 K, which can be explained by an origin in the shocked plateau gas. HCN and C_2H_2 are only seen in absorption in the direction of IRc2, whereas the CO_2 absorption is probably more widespread. The CO_2 emission toward Peak 1 and 2 is best explained with excitation by infrared radiation from dust mixed with the gas in the warm component of the shock. The similarity of the CO_2 emission and absorption line shapes toward IRc2, Peak 1 and Peak 2 suggests that the CO_2 is located in the warm component of the shock (T ∼200 K) toward all three positions. The CO_2 abundances of $\sim10^{-8}$ for Peak 1 and 2, and of a few times 10^{-7} toward IRc2 can be explained by grain mantle evaporation and/or reformation in the gas-phase after destruction by the shock. The HCN and C_2H_2 emission detected toward Peak 2 is narrower (T ∼50–150 K) and originates either in the warm component of the shock or in the extended ridge. In the case of an origin in the warm component of the shock, the low HCN and C_2H_2 abundances of $\sim10^{-9}$ suggest that they are destroyed by the shock or have only been in the warm gas for a short time ($t \lesssim 10^4$ yr). In the case of an origin in the extended ridge, the inferred abundances are much higher and do not agree with predictions from current chemical models at low temperatures.

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http://www.strw.leidenuniv.nl/∼boonman/papers/orion.pdf

Anatomy of a high-mass star forming cloud: the G24.78+0.08 (proto)stellar cluster

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We present the results of an interferometric and single-dish study of G24.78+0.08, a region associated with high-mass star formation. Observations have been carried out in several molecular species, which are suitable to trace environments with different densities and temperatures. Evidence for this region to contain a cluster of very young massive stellar objects has been presented in a previous paper (Furuya et al. 2002). We suggest that the embedded stars might be too young to have affected the surrounding molecular cloud significantly on a large scale. This gives us the opportunity to investigate the configuration of the cloud as it was prior to the star formation episode. We assess that the (proto)stellar cluster lies at the center of a molecular clump with diameter of ∼2 pc: to a good approximation this may be described as a spherically symmetric clump with density profile of the type $n_{H_2} \propto R^{-1.8}$. Inside 0.5 pc from the center, instead, the gas is much more inhomogeneous and concentrated in a few high-density cores surrounding the (proto)stars. Our findings indicate that a self-regulating formation mechanism for the high-mass stars in G24.78 is plausible: in the proposed scenario star formation would occur from inside-out collapse of the parsec-scale clump, followed by infall reversal due to outflows powered by the newly formed massive stars. We also find that one of the two bipolar outflows powered by the embedded YSOs is more extended and hence older than the other, thus confirming the evolutionary sequence proposed in our previous article.

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http://www.arcetri.astro.it/∼starform/publ2003.htm

Shocked gas around CepA: evidence for multiple outflows from H_2S and SO_2 observations

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The Cepheus A star forming region has been investigated through a multiline H_2S and SO_2 survey at mm-wavelengths. Large scale maps and high-resolution line profiles reveal the occurrence of several outflows. CepA-East is associated with multiple mass loss processes: in particular, we detect a 0.6 pc jet-like structure which shows for the first time that the CepA-East YSOs are driving a collimated outflow moving towards the south.

The observed outflows show different clumps associated with definitely different H_2S/SO_2 integrated emission ratios indicating that the gas chemistry in Cepheus A has been altered by the passage of shocks. H_2S appears to be more abundant than SO_2 in high velocity clumps, in agreement with chemical models. However, we also find quite narrow H_2S linewidths, suggesting of regions where the evaporated H_2S molecules had enough time to slow down but not to freeze out onto dust grains. Finally, the comparison between the line profiles indicates that the excitation conditions increase with the velocity, as expected for a propagation of collimated bow shocks.

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Structure of the DM Tau Outer Disk: probing the vertical kinetic temperature gradient

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We use high angular and spectral resolution ($\sim 1''$ & 0.1 km/s) images in ^{12}CO, ^{13}CO J=2→1, J=1→0 and C^{18}O J=2→1 coming from the IRAM interferometer to probe the vertical temperature distribution in the disk of DM Tau. We investigate here a new method based on the different opacities of the CO isotopomers to sample the temperature disk structure at various vertical scales inside the disk. Typically, the ^{12}CO transitions are sampling at 2-4 scale heights, while the ^{13}CO data are more likely tracing 1 scale height for the J=2-1, and the disk mid-plane for the J=1-0 line. At the disk scale at which the IRAM observations are sensitive ($R \geq 50-60$ AU), the analysis reveals a vertical temperature gradient. The outer layers where $\tau(^{12}\mathrm{CO\ J=2\rightarrow1}) \simeq 1$ are warmer (~ 30 K) than the inner layers probed by ^{13}CO and C^{18}O data ($\sim 13-20$ K). These findings are consistent with the structure expected for flared irradiated disks around TTauri stars. We also observe that the outer radius of the disk is smaller in ^{13}CO and C^{18}O than in ^{12}CO. These differences in truncation radius are in agreement with photodissociation effects. We also note that the dynamical mass determination from CO is weakly affected by the temperature gradient.

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Near-Infrared Interferometric Measurements of Herbig Ae/Be Stars

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We have observed the Herbig Ae/Be sources AB Aur, VV Ser, V1685 Cyg (BD+40°4124), AS 442, and MWC 1080

with the Palomar Testbed Interferometer, obtaining the longest baseline near-IR interferometric observations of this class of objects. All of the sources are resolved at 2.2 μm with angular size scales generally ≤ 5 mas, consistent with the only previous near-IR interferometric measurements of Herbig Ae/Be stars by Millan-Gabet and collaborators. We determine the angular size scales and orientations predicted by uniform disk, Gaussian, ring, and accretion disk models. Although it is difficult to distinguish different radial distributions, we are able to place firm constraints on the inclinations of these models, and our measurements are the first that show evidence for significantly inclined morphologies. In addition, the derived angular sizes for the early type Herbig Be stars in our sample, V1685 Cyg and MWC 1080, agree reasonably well with those predicted by the face-on accretion disk models used by Hillenbrand and collaborators to explain observed spectral energy distributions. In contrast, our data for the later-type sources AB Aur, VV Ser, and AS 442 are somewhat inconsistent with these models, and may be explained better through the puffed-up inner disk models of Dullemond and collaborators.

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A triple radio continuum source associated with IRAS 16547-4247: a collimated stellar wind emanating from a massive protostar

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We report the discovery, made using the Australia Telescope Compact Array, of a triple radio source toward IRAS 16547−4247, a luminous infrared source with a bolometric luminosity of $6.2 \times 10^4 L_\odot$. The radio source shows a near linear structure, consisting of a compact central object and two outer lobes, separated by about $20''$, symmetrically located from the central source. The radio emission from the lobes has spectral indices of -0.61 and -0.33, characteristic of non-thermal emission. The emission from the central object has a spectral index of 0.49, consistent with free-free emission from a thermal jet. Also reported are 1.2 millimeter continuum and molecular line observations made with the Swedish ESO Submillimeter Telescope. The 1.2 mm observations show that the dust emission arises from a region of $33'' \times 25''$ (FWHM) with a total flux of 16.4 Jy, implying a mass of 1.3×10^3 $M_\odot$. The line observations indicate that IRAS 16547−4247 is associated with a molecular core with a FWHM deconvolved angular size of $27''$ (diameter of 0.38 pc at the distance of 2.9 kpc), a molecular hydrogen density of 5.2×10^5 cm^{-3}, and a mass of 9.0×10^2 $M_\odot$. We propose that this dense massive core hosts a high-mass star in an early stage of evolution in which it is undergoing the ejection of a collimated stellar wind. The radio emission from the lobes arises in shocks resulting from the interaction of this collimated wind with the surrounding medium. Our observations indicate that the jets found in the formation of low-mass stars are also produced in high-mass stars, with IRAS 16547−4247 being the most luminous YSO object presently known to host a jet.

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http://www.journals.uchicago.edu/ApJ/future.html

Estimating the Interstellar Extinction and the Contribution from an Accretion Shock to the Emission-Continuum Formation for DS Tau and DG Tau.

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UV spectra of DG Tau and DS Tau, observed with the HST/STIS Spectrograph were analyzed. Upper limits of interstellar extinction A_V for these stars were derived and it appeared that they are smaller than ones found by different authors from optical band observations.

The ratio of the flux in the C IV 1550 doublet lines to the excess-continuum flux was determined for DS Tau, DG Tau and TW Hya. This ratio proved to be one order of magnitude lower than its values predicted by the accretion-shock

(AS) models developed by Lamzin (1998) and by Calvet and Gullbring (1998). This result lead us to believe that for these stars, the emission continuum originates in the accretion disk and/or in the boundary layer rather in the AS as assumed up to now. Similar results were derived earlier for DR Tau, T Tau and RY Tau, so it well can be that for most CTTSs accretion disk reaches the surface of the central star, and accretion occurs predominantly throught boundary layer.

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The vertical structure of T Tauri accretion discs. III. Consistent interpretation of spectra and visibilities with a two-layer model.

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We present a two-layer accretion disc model developed to simultaneously fit optical long baseline visibilities and spectral energy distributions of T Tauri accretion discs. This model allows us to access easily the physical conditions in the disc as the mid-plane or the surface temperature.

Our model includes viscous heating, absorption of stellar irradiation, and thermalisation with the surrounding medium. The disc is modelled with concentric cylinders for which the vertical radiation transfer is computed using two layers with vertically averaged temperatures: the outer layer is heated by the stellar irradiation and by the inner layer, and the inner layer by viscous dissipation and by the outer layer. We investigate three prescriptions for the geometrical thickness of the disc: it is either proportional the scale height (model 1), given ad hoc (model 2), or zero (model 3). We then derive the disc structure in the case of the α and β viscosity prescriptions, as well as for various optical thickness regimes of the disc.

This analytical model allows us to disentangle regions where the mid-plane temperature and the effective temperature are dominated by accretion from regions dominated by reprocessing of stellar light. In the case of α-prescription, we find that the structure of model 2 gives predictions very close to those of numerical simulations from previous authors.

From the disc structure, we derive the spectral energy distributions, images and interferometric visibilities. We analyse the influence of the disc parameters on the resulting structure and on the observable outputs. We apply our model to interpret consistently the spectral energy distributions and visibilities of SU Aur and FU Ori for which interferometric data are available, and that are not known to be part of a multiple system. We were not able to derive a consistent fit for T Tau North, which might come from caveats in the flux correction from its South component, but were able to separately derive fits for its spectrum and its visibilities.

We find that even a single interferometric measurement at one infrared wavelength can bring a very strong constraint on disc models. We predict that future massive interferometric observations of accretion discs will provide a breakthrough in the understanding of accretion disc physics.

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On marginally resolved objects in optical interferometry

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With the present and soon-to-be breakthrough of optical interferometry, countless objects shall be within reach of interferometers; yet, most of them are expected to remain only marginally resolved with hectometric baselines.

In this paper, we tackle the problem of deriving the properties of a marginally resolved object from its optical visibilities. We show that they depend on the moments of flux distribution of the object: centre, mean angular size, asymmetry, and curtosis. We also point out that the visibility amplitude is a second-order phenomenon, whereas the phase is a combination of a first-order term, giving the location of the photocentre, and a third-order term, more difficult to detect than the visibility amplitude, giving an asymmetry coefficient of the object. We then demonstrate that optical visibilities are not a good model constraint while the object stays marginally resolved, unless observations are carried

out at different wavelengths. Finally, we show an application of this formalism to circumstellar discs.

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Calculations of the profiles of C IV 1550, N V 1240, O VI 1035 and Si IV 1400 doublet lines originated in the accretion shock of CTTSs. Plane-parallel slab.

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It was calculated how profiles of C IV 1550, N V 1240, O VI 1035 and Si IV 1400 doublet lines look like if to observe plane-parallel accretion shock at different inclination angles. The calculations were done for the range of precursor gas velocities V_0 and densities ρ_0, expected in the case of accretion onto CTTSs. It appeared that comparison of the calculated profiles and relative intensities of the doublet lines with observations could be used to derive 1D shock's parameters, but to derive the parameters of CTTS's accretion shock it is necessary to know the geometry of the accretion zone.

One can use my 1D limb darkening function $I_\nu(\mu, V_0, \rho_0)$ to derive parameters of the accretion process either by preliminary choice of the accretion shock geometry or in the frame of modified Doppler imaging approach. At the same time it follows from my calculations that (contrary to the current viewpoint) the innermost regions of the accretion disks of DR Tau, T Tau and RY Tau are not disrupted by stellar magnetic field and reach the surfaces of these stars. As a result only small portion of accretion disk's matter falls to these stars passing throught the accretion shock.

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Calculations of the profiles of C IV 1550 doublet lines originated in the accretion shock of CTTSs: the case of axially symmetric radial accretion.

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Profiles of C IV 1550 doublet lines originated in the CTTS's accretion shock were calculated under the following assumptions: 1) the form of the accretion zone is axially symmetric – the circular spot or spherical belt; 2) precursor's gas velocity and density are constant, i.e. do not depend on θ, φ coordinates; 3) stream lines of the infall gas are radial. It was found that calculated profiles of C IV 1550 doublet lines differ from the observed ones in a qualitative way. Presumbly it means that infall gas velocity vector has tangential component of order of some tenths km/s due to non-radial character of the magnetic field near the surfaces of CTTSs.

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Halting planet migration by photoevaporation from the central source

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The recent discovery of Jupiter-mass planets orbiting at a few AU from their stars compliments earlier detections of massive planets on very small orbits. The short period orbits strongly suggest that planet migration has occurred, with the likely mechanism being tidal interactions between the planets and the gas disks out of which they formed. The newly discovered long period planets, together with the gas giant planets in our solar system, show that migration

is either absent or rapidly halted in at least some systems. We propose a mechanism for halting type-II migration at several AU in a gas disk. Photoevaporation of the disk by irradiation from the central star can produce a gap in the disk at a few AU, preventing planets outside the gap from migrating down to the star. This would result in an excess of systems with planets at or just outside the photoevaporation radius

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A Study of the Luminosity and Mass Functions of the Young IC 348 Cluster using FLAMINGOS Wide-Field Near-Infrared Images

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We present wide-field near-infrared (JHK) images of the young, $\tau = 2\,$Myr IC 348 cluster taken with FLAMINGOS. We use these new data to construct an infrared census of sources, which is sensitive enough to detect a $10\,M_{Jup}$ brown dwarf seen through an extinction of $A_V \sim 7$. We examine the cluster's structure and relationship to the molecular cloud and construct the cluster's K band luminosity function. Using our model luminosity function algorithm we derive the cluster's initial mass function throughout the stellar and substellar regimes and find that the IC 348 IMF is very similar to that found for the Trapezium Cluster with both cluster IMFs having a mode between $0.2 - 0.08\,M_\odot$. In particular we find that, similar to our results for the Trapezium, brown dwarfs constitute only 1 in 4 of the sources in the IC 348 cluster. We show that a modest secondary peak forms in the substellar IC 348 KLF, corresponding to the same mass range responsible for a similar KLF peak found in the Trapezium. We interpret this KLF peak as either evidence for a corresponding secondary IMF peak at the deuterium burning limit, or as arising from a feature in the substellar mass-luminosity relation that is not predicted by current theoretical models. Lastly, we find that IC 348 displays radial variations of its sub-solar ($0.5 - 0.08 M_\odot$) IMF on a parsec scale. Whatever mechanism that is breaking the universality of the IMF on small spatial scales in IC 348 does not appear to be acting upon the brown dwarf population, whose relative size does not vary with distance from the cluster center.

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On the Early Evolution of Forming Jovian Planets I: Initial Conditions, Systematics and Qualitative Comparisons to Theory

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We analyze the formation and migration of an already formed proto-Jovian companion embedded in a circumstellar disk. We use two dimensional (r, θ)[1] hydrodynamic simulations using a 'Piecewise Parabolic Method' (PPM) code to model the evolutionary period in which the companion makes its transition from 'Type I' migration to 'Type II' migration.

The results of our simulations show that spiral waves extending several wavelengths inward and outward from the planet are generated by the gravitational torque of the planet on the disk. Their effect on the planet cause it to

[1] Throughout this paper and its companion, Paper II, we use 'θ' to denote the azimuth coordinate rather than the more usual variable 'ϕ' in order to avoid confusion between references to the coordinate and to components of the planet's gravitational potential, ϕ_m, common throughout Paper II.

migrate inward towards the star, and their effect on the disk cause it to form a deep (low surface density) gap near the planet. We study the sensitivity of the planet's migration rate to the planet's mass and to the disk's mass. Until a transition to slower Type II migration, the migration rate of the planet is of order 1 AU/10^3 yr, and varies by less than a factor of two with a factor twenty change in planet mass, but depends near linearly on the disk mass. Although the disk is stable to self gravitating disk perturbations (Toomre $Q > 5$ everywhere), implying the effects of gravity should be insignificant, migration is faster by a factor of two or more when disk self gravity is suppressed. Migration is equally sensitive to the disk's mass distribution within 1–2 Hill radii of the planet, as demonstrated by our simulations' sensitivity to the planet's assumed gravitational softening parameter, and which also crudely models the effect of the disk's extent into the third (z) dimension.

Deep gaps form within ~ 500 yr after the beginning of the simulations, but migration can continue much longer: the formation of a deep gap and the onset of Type II migration are not equivalent. The gap is several AU in width and displays very nearly the ${M_{\rm pl}}^{2/3}$ proportionality predicted by theory. Beginning from an initially unperturbed $0.05 M_\odot$ disk, planets of mass $M_{\rm pl} > 0.3 M_{\rm J}$ can open a gap which is deep and wide enough to complete the transition to slower Type II migration. Lower mass objects continue to migrate rapidly for the duration of the simulation, eventually impacting the inner boundary of our grid. This transition mass is much larger than that predicted as the 'Shiva mass' discussed in Ward and Hahn (2000), making the survival of forming planets even more precarious than they would predict.

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Preprints available at: http://www.maths.ed.ac.uk/∼andy/publications.html

On the Early Evolution of Forming Jovian Planets II: Analysis of Accretion and Gravitational Torques

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We continue our numerical study of the migration of an already formed proto-Jovian companion embedded in a circumstellar disk. We first study the sensitivity of the planet's migration to its mass accretion rate, and find that the disk can supply a forming planet with mass at an essentially infinite rate ($\sim 1 M_{\rm J}/25$ yr) so that a gap could form very quickly via further dynamical interactions between the planet and remaining disk matter. The accreted matter has less orbital angular momentum than the planet and exerts an effective inward torque, so that inward migration is slightly accelerated. However, if a partial gap is formed prior to rapid accretion, the effective torque is small and its contribution to the migration is negligible. Although the disk can supply mass at a high rate, we show that mass accretion rates faster than $\sim 10^{-4} M_{\rm J}$/yr are not physically reasonable in the limit of either a thin, circumplanetary disk or of a spherical envelope. Planet growth and ultimately survival are therefore limited to the planet's ability to accept additional matter, not by the disk in which it resides.

Large gravitational torques are produced both at Lindblad resonances and at corotation resonances. We compare the torques in our simulations to analytic theories at Lindblad resonances and find that common approximations to the theories predict torques that are a factor ~ 10 or more larger than those obtained from the simulations. Accounting for the disk's vertical structure (crudely modeled in our simulations and the theory with a gravitational softening parameter) and small shifts in resonance positions due to pressure gradients, to disk self gravity and to inclusion of non-WKB terms in the analysis Artymowicz 1993 can reduce the difference to a factor $\sim 3 - 6$, but do not account for the full discrepancy. Torques from the corotation resonances that are positive in sign, slowing the migration, contribute 20-30% or more of the net torque on the planet, but are not well resolved and vary from simulation to simulation. A more precise accounting of the three dimensional mass distribution and flow pattern near the planet will be required to accurately specify the torques from both types of resonances in the simulations.

We show that the assumption of linearity underlying theoretical analyses of the interactions at Lindblad resonances is recovered in the simulations with planets with masses below $0.5 M_{\rm J}$, but the assumption that interactions occur only at the resonances may be more difficult to support. Angular momentum transfer occurs over a region of finite width

near both Lindblad and corotation resonances. The shape of the disk's response there (due e.g. to local variations in epicyclic frequency) varies from pattern to pattern, making the true position of the resonance less clear. We speculate that the finite width allows for overlap and mixing between resonances and may be responsible for the remainder of the differences between torques from theory and simulation, but whether accounting for such overlap in a theory will improve the agreement with the simulations is not clear.

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XMM-Newton study of the star forming region NGC 1333

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We analyze the data of a deep *XMM-Newton* X-ray imaging observation of the NGC 1333 star forming region. The observation covered a period of about 14 hours and has a total MOS-equivalent exposure time of 235 ksec. In addition to 46 bright X-ray sources revealed by source detection routines, we find weak X-ray emission at the positions of 40 X-ray sources detected originally in a recent *Chandra* observation of NGC 1333. The *XMM-Newton* countrates of most sources agree well with their countrates in the *Chandra* data; about 80% of the sources vary by a factor of less than 3 between the two X-ray observations which are separated by 18 month. The X-ray lightcurves of several sources reveal large flares with parameters typical for X-ray active young stellar objects. We also construct and analyze the X-ray spectra of the stronger sources and derive plasma temperatures between ~ 0.7 keV and ~ 3 keV for the T Tauri stars in NGC 1333, and higher temperatures up to ~ 12 keV for flaring sources and deeply embedded young stellar objects. We consider in detail the X-ray properties of the optically invisible infrared source SVS 16, which showed a large X-ray flare during our observation. Its X-ray spectrum confirms that the hydrogen column density towards SVS 16 is much lower than expected from the extinction determined from near-IR spectroscopy and photometry. The reason for this inconsistency remains unclear. Finally, we search for, but do not detect any X-ray emission from HH 7-11 or one of the other Herbig-Haro objects in NGC 1333. Also, none of the class 0 protostars in the region is detected in X-rays.

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Preprints are available at http://www.mpifr-bonn.mpg.de/staff/tpreibis/publications.html (paper # 33)

High-Resolution Mid-Infrared Observations of Very Young Stellar Objects in NGC 1333

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We observed 22 young stellar objects in the region of NGC 1333 using the mid-infrared camera MIRLIN. NGC 1333 (in the Perseus OB2 molecular cloud complex) is a relatively well-studied region, but not at high spatial resolution in the mid-infrared. MIRLIN's $0.''5$ spatial resolution allows us to look for source extension and multiplicity, and to place new constraints on spectral energy distributions. We report here new detections of 8 objects at mid-IR wavelengths. We find one object, SVS 12, that may be extended or multiple, and we confirm multiplicity in SVS 16. We find a new companion to ASR 107. We are able to classify 6 objects as Class I, flat spectrum, or II, place strong classification constraints on 2 objects, and more loosely restrict the classification of 8 more objects. These observations will aid in interpretation of planned SIRTF observations of this cluster.

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The transverse velocity and excitation structure of the HH 110 jet

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We present long-slit spectroscopic observations of the HH 110 jet obtained with the 4.2 m William Herschel Telescope. We have obtained for the first time, spectra for slit positions along and across the jet axis (at the position of knots B, C, I, J and P) to search for the observational signatures of entrainment and turbulence by studying the kinematics and the excitation structure. We find that the HH 110 flow accelerates from a velocity of 35 km s^{-1} in knot A up to 110 km s^{-1} in knot P. We find some systematic trends for the variation of the emission line ratios along the jet. No clear trends for the variation of the radial velocity are seen across the width of the jet beam. The cross sections of the jet show complex radial velocity and line emission structures which differ quite strongly from each other.

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A Coupled Dynamical and Chemical Model of Starless Cores of Magnetized Molecular Clouds. II. Chemical Differentiation

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Dense cores of molecular clouds are the basic units of isolated low-mass star formation. They have been observed extensively in various molecule lines and dust continuum aimed at revealing their chemical and dynamical state. In a previous paper, we have formulated a coupled dynamical and chemical model for data interpretation, and carried out an initial investigation focusing on the effects of magnetic field on the core dynamics and chemistry. Here, we update our chemical network and the treatment of magnetic field-matter coupling, and explore the effects of changing various parameters, including the initial gas-phase metal abundances, adsorption energies, cosmic ray ionization rate, sticking probability onto dust grains, cloud mass, as well as magnetic field strength. The model results are compared to the velocity field and column density distributions of CO, CS, CCS, NH_3, N_2H^+ and HCO^+ inferred observationally for the well-studied starless core L1544. We find that, in agreement with previous work, models with the so-called "high metal" abundances produce excessive CS and CCS by more than two orders of magnitude. Models of magnetized clouds with "low metal" and "mixed metal" (with a strong initial depletion of sulphur) abundances can fit the data available on L1544 reasonably well, with the low metal model fitting somewhat better the chemical data (except for CS) and the mixed metal model the velocity field. Taking into account of a newly recalculated rate for the neutral-neutral reaction S+CCH→CCS+H increases the abundance of CCS substantially, leading to a better agreement with observation for the mixed metal model. We considered two sets of adsorption energies, compiled respectively by Aikawa et al. and Hasegawa & Herbst. Our results favor the former over the latter. For our standard models, we adopted a cosmic ionization rate of 1.3×10^{-17} s^{-1} and a sticking probability of 0.3. Increasing their values does not improve the model fits. Somewhat surprisingly, removing the magnetic support of the cloud leads to relatively modest changes in the peak column densities of the species except for CS. However, the spatial distributions of CS and CCS become more centrally concentrated than observed in L1544, and the infall speed is too large to be acceptable. This illustrates the need for both chemical and dynamical data to provide the tightest possible model constraints.

A generic feature of our coupled dynamical and chemical model is that NH_3 and, to a lesser extent, N_2H^+ are concentrated in the slowly contracting, central plateau region of the growing core, whereas CS and CCS are most abundant in the lower-density envelope surrounding the plateau, which has a faster infall motion. The chemical differentiation offers an exciting possibility of directly probing the velocity field of core evolution leading to star formation.

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Possible detection of a magnetic field in T Tauri

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Medium-resolution ($R \simeq 15000$) circular spectropolarimetry of T Tauri is presented. The star was observed twice: on November 11, 1996 and January 22, 2002. Weak circular polarization was found in photospheric absorption lines, indicating a mean surface longitudinal magnetic field $B_{\|}$ of 160 ± 40 G and 140 ± 50 G at the epoch of the first and second observations respectively. While these values are near the detection limit of our apparatus, we believe that they are real. One can conclude from our data that $B_{\|}$ of T Tau does not significantly exceed 200 G, which is much less than surface magnetic field strength of the star (> 2.3 kG) found by Guenther et al. (1999) and Johns-Krull et al. (2000). We discuss possible reasons for this difference.

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Hubble Space Telescope WFPC2 Imaging of the Disk and Jet of HV Tauri C

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We have obtained Hubble Space Telescope WFPC2 images of the HV Tauri young triple system. The tertiary star appears as a compact bipolar nebula at visual wavelengths, as already known in the near-infrared. New, deeper adaptive optics observations made at the Canada-France-Hawaii Telescope show no point source in the nebula to a limiting magnitude of K >15. The results therefore confirm that HV Tau C is an optically thick circumstellar disk seen close to edge-on. Clear evidence for small, chromatic dust particles in the outer disk is provided by the color structure of the nebula: the thickness of the central dust lane shrinks by 30% between 0.55 μm and 2.2 μm. Bipolar jets extending 0.3-0.7″ perpendicular to the dust lane are seen in HST narrowband [S II] and [O I] images.

The continuum images are compared to multiple scattering models, with optimal density model parameters derived through χ^2 minimization. A disk density distribution provides a reasonable fit to the K band image, but is unable to reproduce the vertical extent of the nebula at I band without resorting to an unreasonably large scale height. Adding an envelope structure around the disk results in a much better fit to the HST image, and with a physically reasonable disk scale height. Our preferred model has a disk outer radius of 50 AU, inclination of 6°, and scale height of 6.5 AU at $r = 50$ AU. The thickness of the dark lane establishes a disk mass near $2{\times}10^{-3}$ $M_\odot$ (~ 2 $M_{\rm Jupiter}$) of dust and gas, if the dust grains have interstellar properties and remain fully mixed vertically. The envelope, with a much smaller mass $\sim 4 \times 10^{-5}$ $M_\odot$, would be very short-lived unless replenished by new material from the star or surrounding medium.

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Imprints of Dynamical Interactions on Brown Dwarf Pairing Statistics and Kinematics

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We present statistically robust predictions of brown dwarf properties arising from dynamical interactions during their early evolution in small clusters. Our conclusions are based on numerical calculations of the internal cluster dynamics as well as on Monte-Carlo models. Accounting for recent observational constraints on the sub-stellar mass function and initial properties in fragmenting star forming clumps, we derive multiplicity fractions, mass ratios, separation distributions, and velocity dispersions. We compare them with observations of brown dwarfs in the field and in young clusters. Observed brown dwarf companion fractions around $15 \pm 7\%$ for very low-mass stars as reported recently by Close et al. (2003) are consistent with certain dynamical decay models. A significantly smaller mean separation distribution for brown dwarf binaries than for binaries of late-type stars can be explained by similar specific energy at the time of cluster formation for all cluster masses. Due to their higher velocity dispersions, brown-dwarfs and low-mass single stars will undergo time-dependent spatial segregation from higher-mass stars and multiple systems. This will cause mass functions and binary statistics in star forming regions to vary with the age of the region and the volume sampled.

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http://www.sc.eso.org/ msterzik/BDDynamics/3382.ps

Stopping inward planetary migration by a toroidal magnetic field

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We calculate the linear torque exerted by a planet on a circular orbit on a disc containing a toroidal magnetic field. All fluid perturbations are singular at the so–called *magnetic resonances*, where the Doppler shifted frequency of the perturbation matches that of a slow MHD wave propagating along the field line. These lie on both sides of the corotation radius. Waves propagate outside the Lindblad resonances, and also in a restricted region around the magnetic resonances.

The magnetic resonances contribute to a significant global torque which, like the Lindblad torque, is negative (positive) inside (outside) the planet's orbit. Since these resonances are closer to the planet than the Lindblad resonances, the torque they contribute dominates over the Lindblad torque if the magnetic field is large enough. In addition, if $\beta \equiv c^2/v_A^2$ increases fast enough with radius, the outer magnetic resonance becomes less important and the total torque is then negative, dominated by the inner magnetic resonance. This leads to outward migration of the planet. Even for $\beta \sim 100$ at corotation, a negative torque may be obtained. A planet migrating inward through a nonmagnetized region of a disc would then stall when reaching a magnetized region. It would then be able to grow to become a terrestrial planet or the core of a giant planet. In a turbulent magnetized disc in which the large scale field structure changes sufficiently slowly, a planet may alternate between inward and outward migration, depending on the gradients of the field encountered. Its migration could then become diffusive, or be limited only to small scales.

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Radio continuum emission associated with Class II methanol maser sources

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Class II methanol masers are believed to be associated with high mass star formation. Recent observations by Walsh et al. (1998) and Phillips et al. (1998) reported a very low detection rate of radio continuum emission toward a large sample of 6.7 GHz methanol masers. These results raise questions about the evolutionary phase and/or the mass range of the exciting stars of the masers. Here we report the results of a VLA search for 8.4 GHz continuum emission from the area around five Class II methanol masers, four of which were not detected by Walsh et al. (1998) at 8.6 GHz. Radio continuum emission was detected in all five fields although only two of the nine maser spot groups in the five fields were found to be superimposed on radio continuum sources that appear to be UCHII regions. This suggests that continuum counterparts for some masers might be found in further surveys for which the sensitivity level is lower than 1 mJy beam^{-1}. Considering our results as well as observations from other studies of methanol masers we conclude that masers without radio continuum counterparts are most likely associated with high mass stars in a very early evolutionary stage, either prior to the formation of an ultra-compact HII region or when the HII region is still optically thick at centimeter wavelengths. With one exception all maser spot groups in the five fields were found to be associated with mid-infrared objects detected in the MSX survey.

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Detection of DCO^+ in a circumstellar disk

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We report the first detection of DCO^+ in a circumstellar disk. The DCO^+ J=5–4 line at 360.169 GHz is observed with the 15m James Clerk Maxwell Telescope in the disk around the pre-main sequence star TW Hya. Together with measurements of the HCO^+ and $H^{13}CO^+$ J=4–3 lines, this allows an accurate determination of the DCO^+/HCO^+ ratio in this disk. The inferred value of 0.035±0.015 is close to that found in cold pre-stellar cores and is somewhat higher than that measured in the envelope around the low-mass protostar IRAS 16293 -2422. It is also close to the DCN/HCN ratio obtained for pristine cometary material in the jet of comet Hale-Bopp. The observed DCO^+/HCO^+ ratio for TW Hya is consistent with theoretical models of disks which consider gas-phase fractionation processes within a realistic 2-D temperature distribution and which include the effects of freeze-out onto grains.

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A Holistic Scenario of Turbulent Molecular Cloud Evolution and Control of the Star Formation Efficiency. First Tests

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We compile a holistic scenario for molecular cloud (MC) evolution and control of the star formation efficiency (SFE), and present a first set of numerical tests of it. A *lossy* compressible cascade can generate density fluctuations and further turbulence at small scales from large-scale motions, implying that the turbulence in MCs may originate from the compressions that form them. Below a *sonic* scale λ_s, turbulence cannot induce any further subfragmentation, nor be a dominant support agent against gravity. Since progressively smaller density peaks contain progressively smaller fractions of the mass, we expect the SFE to decrease with decreasing λ_s, at least when the cloud is globally supported by turbulence. Our numerical experiments confirm this prediction. We also find that the collapsed mass fraction in the simulations always saturates below 100% efficiency. This may be due to the decreased mean density of the leftover interclump medium, which in real clouds (not confined to a box) should then be more easily dispersed, marking the "death" of the cloud. We identify two different functional dependences ("modes") of the SFE on λ_s, which roughly correspond to globally supported and unsupported cases. Globally supported runs with most of the turbulent energy

at the largest scales have similar SFEs to those of unsupported runs, providing numerical evidence of the dual role of turbulence, whereby turbulence, besides providing support, induces collapse at smaller scales through its large-scale modes. We tentatively suggest that these modes may correspond to the clustered and isolated modes of star formation, although here they are seen to form part of a continuum rather than being separate modes. Finally, we compare with previous proposals that the relevant parameter is the energy injection scale.

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The Circumstellar Disk of the Butterfly Star in Taurus

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We present a model of the circumstellar environment of the so-called "Butterfly Star" in Taurus (IRAS 04302+2247). The appearance of this young stellar object is dominated by a large circumstellar disk seen edge-on and the light scattering lobes above the disk. Our model is based on multi-wavelength continuum observations: (1) Millimeter maps, and (2) High-resolution near-infrared obtained with *HST*/NICMOS. The advantage of the combination of both observations is that they trace (a) different regions of the system and (b) different physical processes. On the one hand, the millimeter-observations are sensitive to the long-wavelength radiation being re-emitted from the dust in the central parts close to the midplane of the circumstellar disk. Thus, the geometry and small-scale density distribution of the disk has been studied. Furthermore, in contrast to the pure flux measurement, the resolved 1.3 mm image allows to discriminate between different disk models with a similar far-infrared/millimeter spectral energy distribution and therefore to disentangle the disk geometry much more precisely. On the other hand, the near-infrared observations trace the envelope structure and dust properties in the envelope and the disk surface.

We find disk and envelope parameters which are comparable with those of the circumstellar environment of other young stellar objects. A main result is that the dust properties must be different in the circumstellar disk and in the envelope: While a grain size distribution with grain radii up to 100 μm is required to reproduce the millimeter observations of the disk, the envelope is dominated by smaller grains similar to those of the interstellar medium. Alternatives to this grain growth scenario in the circumstellar disk are discussed in brief as well.

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Dissertation Abstracts

Luminosity and Mass Functions of Very Young Stellar Clusters

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We now know that the star formation process results in freely-floating objects with masses spanning nearly four orders of magnitude. However, both the distribution of these objects' masses at birth and the precise physics responsible for the shape of this initial mass function are poorly known and can be improved upon by focusing on very young star clusters just emerging from their parental molecular clouds. In this dissertation I have investigated the usefulness of the observed luminosity function of a very young cluster as a tool for deriving that cluster's underlying mass function. I find that a cluster's luminosity function is an excellent probe of the initial mass function over the entire range of stellar and substellar mass and can be utilized to acquire the statistics necessary for testing the hypothesis of a universal mass function.

To study the luminosity and mass functions of such clusters I developed a Monte Carlo based population synthesis algorithm applicable to pre-main sequence stars. Using this algorithm I performed numerical experiments testing the sensitivity of model luminosity functions to changes in fundamental cluster parameters. After showing that the luminosity function is intrinsically most sensitive to the form of the underlying mass function, I studied three young clusters, NGC 2362, IC 348 and the Trapezium, and performed deep near-infrared surveys to construct their K-band luminosity functions. Using the model luminosity function algorithm, I derived each cluster's underlying mass function and found them to be remarkably similar, with all forming broad peaks at subsolar massses. Where these census are sufficiently deep I find that the mass function turns over and declines in number throughout the substellar regime but appears to contain structure near the deuterium-burning limit. Regardless, I find that brown dwarfs do not dominate stars either by number or total mass. Lastly, I use a statistically significant sample of candidate brown dwarfs to show that these objects appear as likely to have been born with circumstellar disks as stars. Combining this finding with the continuity of the shape of the initial mass function across numerous environments suggests that a single physical mechanism may dominate the star formation process.

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Postdoctoral Position in Circumstellar Matter - Space Telescope Science Institute

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Attention: Dr. Margaret Meixner

Applications are invited for a postdoctoral research position at the Space Telescope Science Institute starting as early as summer 2003. The successful applicant will work with Dr. Margaret Meixner and collaborators on studies of *circumstellar dust shells found around main sequence stars, pre-main sequence stars and evolved stars*. This research will involve observations with HST, SIRTF, and ground based facilities. Independent research in related areas will be supported and encouraged. Research experience in the areas of planet formation, star formation, evolved stars, dust or radiative transfer is desirable. A PhD in astronomy or astrophysics is required.

The position is for two years, with a possible renewal for a third year. STScI, located on Johns Hopkins University Campus in Baltimore, Maryland, offers an excellent benefit package, competitive salaries, and a stimulating work environment. The minimum salary is $41,900; however, STScI's pay is commensurate to the year of Ph.D.

Applicants should send a cover letter with position applying for, curriculum vitae, list of publications, and a brief statement of research interests, accomplishments, and relevant technical expertise to the address above or email to meixner@stsci.edu, please cc: mccarty@stsci.edu. They should also arrange for three letters of recommendation to be sent directly to the same address. Completed applications received by 15 March 2003 are assured of full consideration. EOE/AA/M/F/D/V

New Graduate Program

Starting in August 2003, the Department of Chemistry and the Department of Physics & Astronomy at The University of Hawai'i at Manoa open the new interdisciplinary graduate program 'Reaction Dynamics, Laboratory Astrophysics, and Planetary Sciences' leading to a Ph.D. degree in chemistry and physics, respectively. The prime directive of this endeavor is to unravel the underlying mechanisms on how complex, (astrobiologically) important molecules and nanostructures are synthesized from the bottom up via single atoms, radicals, and small molecules in the interstellar medium, in atmospheres of planets and their satellites, cometary comae, as well as in combustion flames and chemical vapor deposition processes (http://www.chem.hawaii.edu/Bil301/program.htm).

In collaboration with research groups from the Hawaiian Institute of Geophysics and Planetology (HIGP), the Institute for Astronomy (IfA), and The Open University (UK), cutting edge laboratory experiments, electronic structure calculations, and astronomical observations will be linked to lecture courses outlining fundamental principles in physical chemistry, physics, reaction dynamics, astrochemistry, astrobiology, planetary chemistry, combustion sciences, and nanomaterial research. Interested candidates should send a letter of interest, three letters of recommendation, transcripts or equivalent documentation, and a curriculum vitae to Prof. Ralf I. Kaiser, Department of Chemistry, University of Hawai'i at Manoa, 2545 The Mall, Honolulu, HI 96822, USA (email: kaiser@gold.chem.hawaii.edu) or to Prof. Klaus Sattler, Department of Physics, University of Hawai'i, Honolulu, HI 96822, USA (email: sattler@hawaii.edu). Exceptionally well qualified candidates are offered teaching assistantships and full tuition fee waivers.

Meetings

Science with Adaptive Optics

ESO Workshop

September 16-19, 2003

Garching (near Munich), Germany

Over the past ten years, the concept of adaptive optics has matured from early experimental stages to a standard observing tool now available at many large optical and near-infrared telescope facilities. Indeed, adaptive optics has become an integral part of all present and future large telescope initiatives, and will be essential in exploiting the full potential of the large optical interferometers currently under construction. Adaptive optics has been identified as one of the key technologies for astronomy in the 21st century. Adaptive optics has already delivered exciting results covering areas from solar system astronomy (both the sun and the planetary system) over the star forming regions in the solar neighbourhood to Local Group galaxies and objects at cosmological distances. Recent highlights include:

- Evolution of small scale structures on the solar surface
- Discovery of binary asteroids and asteroids moons
- High-resolution studies of circumstellar disks around young stars
- Precise mass determination of the black hole in the Galactic Center
- Spatially resolved studies of extragalactic stellar populations

The present meeting intends to bring together users of adaptive optics from all fields of astronomy to discuss the latest scientific results obtained with diverse adaptive optics systems and to exchange ideas on how to reduce and analyse such observations.This ESO workshop aims also at educating the general astronomical community in Europe on the unique science potential of adaptive optics for all branches of astronomy. We want to bring together researchers working in many different areas of astronomy in order to provide a comprehensive picture of the utilisation of adaptive optics in astronomy. Synergy effects are expected from the comparison of different observing and data analysis strategies.

Scientific Organizing Committee:
Co-chairs: Wolfgang Brandner (MPIA), Markus Kasper (ESO)
Danielle Alloin (ESO), Laird Close (Steward Obs., Tucson, USA), Tim Davidge (Herzberg Inst., Victoria, Canada), Reinhard Genzel (MPE, Germany), Thomas Henning (MPIA, Germany), Christoph Keller (NSO Tucson, USA), Anne-Marie Lagrange (LAOG, France), Simon Morris (Durham, UK), Francois Rigaut (Gemini, USA), Daniel Rouan (Obs. de Paris, France), Hans Zinnecker (AIP, Germany)

For more details and registration, see **http://www.eso.org/aoscience03**

Symposium Secretary: Christina Stoffer

European Southern Observatory
Karl-Schwarzschild-Str. 2
D-85748 Garching bei München, Germany
FAX: +49 89 3200 6480
email: aoscience03@eso.org

SECOND ANNOUNCEMENT

This is the second information circular about the international conference

EXTRASOLAR PLANETS: TODAY AND TOMORROW

to be held from June 30 to July 4, 2003, at the Institut d'Astrophysique de Paris, France.

- **DEADLINE for abstracts submission:**

  Abstracts for contributed papers and posters should be submitted by **March 31, 2003** online at http://www.iap.fr/ActivitesScientifiques/SeminairesEtColloques/ColloqueIAP2003/index.html (click on "Pre-registration is opened").

- **DEADLINE for pre-registration:**

  Electronic pre-registration is due by **March 31, 2003** at http://www.iap.fr/ActivitesScientifiques/SeminairesEtColloques/ColloqueIAP2003/index.html (click on "Pre-registration is opened"). If you cannot pre-register online, please send an email to col2003@iap.fr by March 31, 2003.

  Please note that since we have to restrict number of participants to around 120 people, pre-registration does not guarantee acceptance to the conference. Applications will be reviewed by the SOC in April 2003, and applicants will be notified at the latest by April 30 of the status of their application. Although applicants who do not wish to deliver a paper or a poster will not be automatically rejected, we encourage people to submit an abstract. We ask people whose application has been accepted and who finally decide not to attend the conference to notify us as quickly as possible.

- **Invited reviews:**

  A list of invited talks is now available at http://www.iap.fr/ActivitesScientifiques/SeminairesEtColloques/ColloqueIAP2003/index.html (click on "program (invited contributions)").

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/ .