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Abstracts of recently accepted papers

The Balmer Wavelength Range of BP Tauri

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We have analyzed all the observations of BP Tauri taken by the International Ultraviolet Explorer in the low resolution ($\triangle\lambda \sim 6$Å), long wavelength (from $\lambda = 1850$Å to $\lambda = 3350$Å) range. This dataset contains 61 spectra. We observe variability in the ultraviolet continuum of $\triangle m_{cont.} \sim 1$ magnitude and variability in the MgII line flux of $\triangle m_{\rm MgII} \sim 0.8$ magnitudes. Moreover, these spectra do not show any correlation between the continuum flux and the MgII line flux, thus resolving a standing controversy in the literature concerning the origin of the MgII line flux. There is no correlation between the color temperature of the UV continuum and the average value of its flux. Using models of the accretion process developed by Calvet & Gullbring (1998), we obtain energy fluxes, accretion spot sizes, and accretion rates from the IUE observations of BP Tauri. We find average energy fluxes of 5.0 10^{11}ergs cm^{-2} s^{-1}, average spot sizes of 4.4 10^{-3} times the stellar surface, and average accretion rates of 1.6 10^{-8} $M_\odot$ per yr. Our analysis shows that the particle energy flux and the UV flux in the stellar surface are proportional to each other. Most strikingly, we observe a correlation between accretion rate and spot size, with the spot size increasing as the square of the accretion rate. Based on the results of a simulation, we conclude that geometrical effects (i.e. the varying inclination of the spot with respect to the observer) are not enough to account for this effect. Current models of the accretion process fail to reproduce such an effect, suggesting the need of using more realistic descriptions of the stellar field when treating magnetospheric accretion. There may also be an unmodelled efficiency factor that determines how matter is loaded into the field lines. Non-dipole fields, geometry, oblique shocks and the possibility of "limb brightening" should be taken into account when creating models and explaining the results of observations of T-Tauri stars.

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Web address for preprints: http://astron.berkeley.edu/˜ardila/pub.html

Optical and Near Infrared Study of the Cepheus E outflow, a very low excitation object

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We present images and spectra of the Cepheus E (Cep E) region at both optical and infrared wavelengths. Only the brightest region of the southern lobe of the Cep E outflow reveals optical emission, suggesting that the extinction close to the outflow source plays an important rôle in the observed difference between the optical and IR morphologies. Cep E is a unique object since it provides a link between the spectroscopic properties of the optical Herbig-Haro (HH) objects and those of deeply embedded outflows.

The observed H_2 infrared lines allow us to determine an excitation temperature of ~ 2300 K, an Ortho-to-Para ratio

of ~ 3, and an H_2 (1,0)/(2,1) S(1) line ratio of ~ 9. These results are consistent with the values observed for HH objects with detected NIR emission lines, with shock excitation as the main mechanism for their formation, and also with the values observed for embedded, NIR flows.

The optical spectroscopic characteristics of Cep E (HH 377) appear to be similar to the ones of low excitation HH objects. However, the electron density determined from the [SII]6731/6717 line ratio for this object ($n_e = 4100$ cm^{-3}), and the [OI]6300/Hα, [SII](6717+6731)/Hα ratios are higher than the values of all of the previously studied low excitation HH objects. This result is likely to be the consequence of an anomalously high environmental density in the HH 377 outflow.

The ionization fraction obtained for HH 377 is $x_e \sim 1\%$. From this result, together with the observed [OI]6300/Hα line ratio, we conclude that the observed Hα line emission is collisionally excited. From a comparison with shock models, we also conclude that the extinction towards HH 377 is very low. Comparing the observed Hβ and Hα fluxes of HH 377 with model predictions, we determine a shock speed between 15 and 20 km s^{-1}, although somewhat higher velocities also produce spectra with line ratios that qualitatively agree with the observations of HH 377.

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Infrared Observations of Hot Gas and Cold Ice toward the Low Mass Protostar Elias 29

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We have obtained the full 1-200 μm spectrum of the low luminosity (36 $L_\odot$) Class I protostar Elias 29 in the ρ Ophiuchi molecular cloud. It provides a unique opportunity to study the origin and evolution of interstellar ice and the interrelationship of interstellar ice and hot core gases around low mass protostars. We see abundant hot CO and H_2O gas, as well as the absorption bands of CO, CO_2, H_2O and "6.85 μm" ices. We compare the abundances and physical conditions of the gas and ices toward Elias 29 with the conditions around several well studied luminous, high mass protostars. The high gas temperature and gas/solid ratios resemble those of relatively evolved high mass objects (e.g. GL 2591). However, none of the ice band profiles shows evidence for significant thermal processing, and in this respect Elias 29 resembles the least evolved luminous protostars, such as NGC 7538 : IRS9. Thus we conclude that the heating of the envelope of the low mass object Elias 29 is qualitatively different from that of high mass protostars. This is possibly related to a different density gradient of the envelope or shielding of the ices in a circumstellar disk. This result is important for our understanding of the evolution of interstellar ices, and their relation to cometary ices.

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http://www.submm.caltech.edu/~boogert/publ.html

The hot core of the solar-type protostar IRAS 16293−2422: H_2CO emission

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We model the H_2CO and $H_2^{13}CO$ line emission observed towards the solar-type protostar IRAS16293-2422. Based upon previous analysis of the physical structure of the envelope surrounding IRAS16293-2422, we develop a model in which the H_2CO lines are emitted by two components: a cold H_2CO-poor outer envelope and a warm H_2CO-rich core. We find that the model reproduces successfully all the available H_2CO and $H_2^{13}CO$ data for a H_2CO abundance equal to $(1.1 \pm 0.3) \times 10^{-9}$ in the outer and $(1.1 \pm 0.4) \times 10^{-7}$ in the inner regions of the envelope respectively. We interpret this increase of the H_2CO abundance as due to the evaporation of the grain mantles when the dust temperature exceeds 100 K at about 150 AU from the center, forming a hot core like region. Assuming that all mantle constituents evaporate and are detected in the gas phase, we derive that the H_2CO-ice abundance is about 3% of the H_2O-ice abundance. This is the first measurement of the H_2CO abundance in grain mantles around a low-mass protostar.

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http://www-laog.obs.ujf-grenoble.fr/activites/starform/formation.html#new

Windows through the Dusty Disks Surrounding the Youngest Low Mass Protostellar Objects

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The formation and evolution of young low mass stars are characterized by important processes of mass loss and accretion occurring in the innermost regions of their placentary circumstellar disks. Because of the large obscuration of these disks at optical and infrared wavelengths in the early protostellar stages (Class 0 sources), they were previously detected only at radio wavelengths using interferometric techniques. We have detected with the Infrared Space Observatory (ISO) the mid-infrared emission associated with the Class 0 protostar VLA1 in the HH1-2 region located in the Orion nebula. The emission arises in the three wavelength windows at 5.3, 6.6 and 7.5 μm where the absorption due to ices and silicates has a local minimum that exposes the central parts of the youngest protostellar systems to mid-infrared investigations. The mid-infrared emission arises from the central source with a 4 AU diameter at an averaged temperature of $\sim$ 700 K, deeply embedded in a dense region with a visual extinction of A_v = 80-100mag.

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Photometric observations of weak-line T Tauri stars. II. WTTS in Taurus-Auriga, Orion and Scorpius OB2-2

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We present *uvby*-β photometry of 116 X-ray flux-selected active stars in the directions of the Orion (40), Taurus-Auriga (58) and Scorpius OB2-2 (18) star forming regions. Additionally, we give near IR *JHK* photometry of 20 active stars in the Taurus-Auriga direction. The program stars were selected from the *ROSAT* All Sky Survey and *EINSTEIN* X-ray surveys and are spectroscopically confirmed weak-line T Tauri stars and weak-line T Tauri star candidates. The photometry confirms the young nature of the program stars and also indicates that a significant fraction of the sample could be foreground objects. The data given here probably represent the largest homogeneous *uvby*-β photometric sample of new *WTTS* and *WTTS* candidates. Many objects in the sample are observed photometrically for the first time.

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The birth of massive twins in M 17

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We have imaged the ultra-compact H II region M 17-UC1 at J, K, N, Q and 1.3 cm. A comparison with results from earlier epochs reveals an increase of the emitted flux both in the mid-infrared and radio continuum. Our N and Q images exhibit a second source of comparable strength 5″ southwest of M 17-UC1. While M 17-UC1 is not visible at J, faint at K but very bright at 1.3 cm, the second southern source shows rather opposite characteristics, namely being very bright at infrared wavelengths but invisible in the radio continuum, probably due to self-absorption. The spectral energy distributions indicate that the sources are still surrounded by the remnants of their proto-stellar cocoons. The observed luminosities measured between 1.2 and 20.0 μm of about $10^3\ L_\odot$ for both sources leads to the conclusion that they represent the youngest population of early type stars in M 17. The projected linear distance of 8900 AU between M 17-UC1 and its southern companion qualifies them to be a likely binary star system of O or early B-type stars.

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http://www.astro.ruhr-uni-bochum.de/nielbock/research/cd041/cd041.ps.gz

Microjets from T Tauri stars resolved by adaptive optics

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Using adaptive optics techniques, we have obtained the first [O I] and [S II] images at 0.1 arcsec ($\simeq$ 15 AU) resolution of the jets in CW Tau, DG Tau and RW Aur. In all three jets, the emission is dominated by knots and is resolved transversally down to 56 AU with similar inner jet widths of 0.2-0.25 arcsec. The RW Aur and CW Tau jets are straight, their FWHM slowly increasing with distance with opening angles of $\simeq$ 3-4 degrees. In contrast, the DG Tau jet seems to be precessing and its FWHM reaches 1.3 arcsec at 335 AU, where contamination by strong bow-shock wings most likely occurs. The widths of the CW Tau and RW Aur jets are strikingly similar to those measured in HH 30 and HL Tau, two active TTs, on similar spatial scales. The derived upper limit on the density collimation size scale of $\simeq$ 50 AU and intrinsic jet widths of $\simeq$ 30 AU over the central 100 AU are in quantitative agreement with predictions from current MHD wind models. In DG Tau we confirm the bow-shaped morphology and detect a high proper motion (194 km s^{-1}) for the knot located at 3.3 arcsec. The properties of this knot strongly support the model of internal working surfaces produced by variable ejection.

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UV spectra of T Tauri stars from Hubble Space Telescope: RW Aur

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Ultraviolet spectra of the classical T Tauri star RW Aur A observed with the Hubble Space Telescope were analysed. Absorption lines of neutral and singly ionized metals, blueshifted ~ 50 km s^{-1} relative to the star, were found. They originate in a dense ($N > 10^{10}$ cm^{-3}) gas outflow, whose extension along the line of sight is less than $3R_*$. The gas temperature of the wind is definitely below 10 000 K, but metals (and probably sulfur) are almost completely singly ionized by strong stellar emission in the hydrogen lines of the Lyman series. Stellar Ly_α quanta are responsible for

a significant population of hydrogen upper levels. Their photoionization is the main source of free electrons and subsequent gas heating. Strong fluorescent lines of H_2 and Fe II pumped by stellar Ly_α quanta were found in the RW Aur spectra.

The emission in C IV and Si IV lines is strongly suppressed by Fe II and Ni II wind absorption features. Superposition of strong H_2 emission lines onto residual profiles additionally disturbs the picture, so C IV and Si IV line fluxes derived from low resolution IUE spectra are erroneous.

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Preprints are available via anonymous ftp from: lnfm1.sai.msu.ru pub/PEOPLE/lamzin/HST_Papers directory.

Interstellar Na I D lines toward the Southern Coalsack

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The interstellar Na I D absorption-line profiles observed for 15 stars with lines of sight towards the Southern Coalsack are analysed. The method of profile fitting was used in an attempt to determine column densities, line widths, and velocities for the individual interstellar clouds contributing to the observed absorption lines. In common, the observed spectra show a prominent component which is probably associated with the nearest absorbing material composing the Coalsack. The obtained spatial velocity distribution shows great similarity with earlier results from CO emission. In addition, the Na I D data reveal evidence for the existence of two or three other structures with radial velocities of about -22, -33 and $-40\,\mathrm{km\,s^{-1}}$. Such components may be the counterparts of interstellar structures observed in diffuse Hα and CO emission. The assumption that at least one of these components was originated in the Carina arm imposes ~0.9–1.0 kpc as the maximum distance to the near side of that arm.

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Looking at the photon-dominated region in NGC2024 through FIR line emission

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We present the ISO-LWS spectra (45-200 μm) of both the molecular cloud NGC2024 and its associated HII region. We observed the two Class 0 objects FIR3 and FIR5 and the infrared source IRS2. All the spectra appear quite similar, with approximately the same strength high-J CO rotational lines (from J_{up}=17 to J_{up}=14), and atomic and ionic lines from oxygen, carbon and nitrogen. This uniformity suggests the bulk of the emission is from the extended cloud, and is not related to the local source conditions. The molecular emission has been modeled with a large velocity gradient (LVG) code, and the results imply that the emission originates in a clumpy, extended PDR with a temperature $T \sim$ 100 K and a density $n_{H_2} \sim 10^6$ cm^{-3}. CO column densities in excess of 10^{18} cm^{-2} are derived for this molecular component. A line intensity ratio I([OI] 63 μm)/I([OI] 145 μm) of about 5 is found through all the region, indicating either that these two lines are both optically thick at the same temperature of CO, or, more likely, that the 63 μm line is strongly a bsorbed by cold foreground gas.

The ionised emission lines have been consistently modeled with CLOUDY; the lines arise from gas illuminated by an O9.5 star or its UV equivalent, representing the ionising capability of the whole OB cluster present in the region. From the intensity ratios of the ionic lines, relevant physical properties of the ionised gas (N/O abundance, electron

density) are derived.

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Multi-transition HCO^+ Study in NGC 2264G: Anomalous Emission of the J=1→0 line

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We present multi-transition observations of the HCO^+ molecule toward the very young star forming region associated with the NGC 2264G molecular outflow. Anomalous emission is observed in the lowest rotational transition: the J=4→3 and J=3→2 transitions clearly trace the dense core encompassing the exciting source of the molecular outflow, whereas the HCO^+ J=1→0 is barely detected at a much lower intensity and has a much broader line shape. Analysis of the data strongly suggests that the HCO^+ J=1→0 emission arising from the core is being absorbed efficiently by a cold low density envelope around the core or a foreground cloud. This result seems exceptional, yet the J=1→0 HCO^+ and HCN emission from other dense cores (especially those in giant molecular clouds) may be affected. In these cases, the rare isotopes of these molecules and higher rotational transitions of the main isotopes should be used to study these regions. Two quiescent clumps, JMG99 G1 and G2, are detected in the blue lobe of the NGC 2264G molecular outflow, close to shock excited near-IR H_2 knots. These clumps belong to the class of radiatively excited clumps, i. e., the radiation from the shock evaporates the dust mantles and initiates a photochemical process, enhancing the emission of the HCO^+.

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http://www.astro.uiuc.edu/~jgirart/curro.html

High Resolution Near-Infrared Spectra of Protostars

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We present new high resolution ($R \simeq 21,000$) near-infrared ($\lambda = 2\mu$m) spectroscopic observations of a sample of Class I and flat-spectrum protostellar objects in the ρ Ophiuchi dark cloud. None of the five Class I spectra show CO v = $0 - 2$ absorption features, consistent with high K-band continuum veilings, $4 \leq r_k \leq 20$ and fast stellar rotation, assuming that the underlying protostellar photospheres are of late spectral type, as is suggested by the low luminosities of most of these objects. Two of the flat-spectrum protostellar objects also show no absorption features and are likely to be highly veiled. The remaining two flat-spectrum sources show weak, broad absorptions which are consistent with an origin in quickly rotating (v sin $i \approx 50$ km s^{-1}) late-type stellar photospheres which are also strongly veiled, $r_k \simeq 3 - 4$. These observations provide further evidence that: 1)-Class I sources are highly veiled at near-infrared wavelengths, confirming previous findings of lower resolution spectroscopic studies; and 2)- flat-spectrum protostars rotate more rapidly than classical T Tauri stars (Class II sources) , supporting findings from a recent high resolution spectroscopic study of other flat-spectrum sources in this cloud. In addition our observations are consistent with the high rotation rates derived for two of the Class I protostellar objects in our sample from observations of variable hard X-ray emission obtained with the ASCA satellite. These observations suggest that certain Class I sources can rotate even more rapidly than flat-spectrum protostars, near breakup velocity.

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An IUE Atlas of Pre-Main Sequence Stars II. Far UV Accretion Diagnostics in T Tauri Stars

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We use our ultraviolet (UV) atlas of pre-main sequence stars constructed from all useful, short wavelength, low resolution spectra in the *International Ultraviolet Explorer* (IUE) satellite Final Archive to analyze the short wavelength UV properties of 49 T Tauri stars (TTS). We compare the line and continuum fluxes in these TTS with each other and with previously published parameters of these systems, including rotation rate, infrared excess, and mass accretion rate. The short wavelength continuum in the classical TTS (CTTS) appears to originate in a $\sim 10,000$ K optically thick plasma, while in the naked TTS (NTTS - stars without dusty disks) the continuum appears to originate in the stellar atmosphere. We show that all of the TTS in our sample lie in the regime of "saturated" magnetic activity due to their small Rossby numbers. However, while some of the TTS show emission line surface fluxes consistent with this saturation level, many CTTS show significantly stronger emission than predicted by saturation. In these stars, the emission line luminosity in the high ionization lines present in the spectrum between 1200 and 2000 Å correlates well with the mass accretion rate. Therefore, we conclude that the bulk of the short wavelength emission seen in CTTS results from accretion related processes and not from dynamo driven magnetic activity. Using CTTS with known mass accretion rates, we calibrate the relationship between $\dot{M}$ and $L_{\rm C\ IV}$ to derive the mass accretion rate for some CTTS which for various reasons have never had their mass accretion rates measured. Finally, several of the CTTS show strong emission from molecular hydrogen. While emission from H_2 cannot form in gas at a temperature of $\sim 10^5$ K, the strength of the molecular hydrogen emission is nevertheless well correlated with all the other emissions displayed in the IUE short wavelength bandpass. This suggests that the H_2 emission is in fact fluorescent emission pumped by the emission (likely Lyman-α) from hotter gas.

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http://plasma2.ssl.berkeley.edu/∼cmj/html/preprints

Magnetohydrodynamic Instabilities in Shearing, Rotating, Stratified Winds and Disks

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We investigate shear and buoyancy instabilities in radially stratified, magnetized, cylindrical flows, for application to magnetocentrifugally driven winds and to magnetized accretion disks. We identify and study nine principal types of instabilities/overstabilities. When magnetic fields are predominantly toroidal, as in protostellar winds, the system exhibits axisymmetric fundamental (FM) and toroidal resonance modes, axisymmetric and non-axisymmetric toroidal buoyancy (TB) modes, and non-axisymmetric magnetorotational instability (MRI) modes. Winds with sufficiently steep field gradients are unstable to the FM, which promotes narrow dense jets in the centers of wider winds. The TB instabilities promote small-scale radial mixing. The MRIs have very low growth rates under low-temperature wind conditions. The stabilization of buoyancy instabilities by shear, and of MRIs by compressibility, may be important in allowing protostellar winds to propagate over vast distances in space. When magnetic fields are predominantly poloidal, as in winds close to their source or in astrophysical disks, the system exhibits axisymmetric Balbus-Hawley (BH), poloidal buoyancy (PB), non-axisymmetric geometric buoyancy (GPB), and poloidal resonance modes. The BH mode has the fastest growth rate. The axisymmetric PB mode promotes radial mixing on small scales. The GPB mode at high m is readily stabilized by shear. We extend previous MRI analyses to focus on compressibility. We introduce a "coherent wavelet" technique to derive closed-form expressions for instantaneous instability criteria, growth rates, and net amplification factors for non-axisymmetric MRIs in compressible flows with both poloidal and toroidal fields. We confirm that these are in excellent agreement with the results of shearing-sheet temporal integrations.

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The molecular outflows in NGC 1333

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We present the results of CO(J=3→2) mapping using the James Clerk Maxwell Telescope of the active star formation region NGC 1333, supplemented by CO(J=1→0) mapping from the Onsala Space Observatory millimetre telescope. These maps provide a detailed overview of the complex cluster of overlapping molecular outflows associated with Herbig-Haro (HH) objects and shocked H_2, and the far-infrared and submillimetre sources that drive these outflows. We identify about ten molecular outflows and in most cases their driving source. Many of the outflow-driving stars are confirmed or probable Class 0 protostellar objects which drive highly collimated CO jets.

We identify HH 12 as the leading bow shock of a large outflow driven by SSV 13 B with an orientation close to the plane of the sky.

The present rate of energy injection into molecular gas by the outflows, if maintained over a time scale $\sim 10^7$ yr, appears sufficient to disperse the entire NGC 1333 cloud. On the shorter time scale of the current generation of star forming activity ($\sim 10^5$ yr), it appears that the star forming core has been broken up by the outflows into a number of low-density shells with star formation activity confined to dense ridges on their periphery.

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Preprints are available at http://www.drao.nrc.ca/ knee/preprints

Far Infrared Study of IRAS 00494+5617 & IRAS 05327-0457

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High angular resolution far-infrared observations at 143 & 185 μm, using the TIFR 1-m balloon borne telescope, are presented for two Galactic star forming complexes associated with IRAS 00494+5617 and 05327-0457. The latter map also reveals the cold dust in OMC-3. The HIRES processed IRAS maps at 12, 25, 60 & 100 μm have also been presented for comparison. Both these regions are illuminated at the edges by high mass stars with substantial UV flux.The present study is aimed at quantifying the role of the nearby stars vis-a-vis embedded young stellar objects in the overall heating of these sources. Based on the FIR observations at 143 & 185 μm carried out simultaneously with almost identical angular resolution, reliable dust temperature and optical depth maps have been generated for the brighter regions of these sources. Radiative transfer modeling in spherical geometry has been carried out to extract physical parameters of these sources by considering the observational constraints like : spectral energy distribution, angular size at different wavelengths, dust temperature distribution etc. It has been concluded that for both IRAS 00494+5617 and IRAS 05327-0457, the embedded energy sources play the major role in heating them with finite contribution from the nearby stars. The best fit model for IRAS 00494+5617 is consistent with a simple two phase clump-interclump picture with $\sim 5\%$ volume filling factor (of clumps) and a density contrast of ≈ 80.

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Disk Accretion in the 10 Myr-old T Tauri Stars TW Hya and Hen 3-600A

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We have found that two members of the TW Hydrae association, TW Hya and Hen 3-600A, are still actively accreting, based on the ballistic infall signature of their broad Hα emission profiles. We present the first quantitative analysis of accretion in these objects, and conclude that the same accretion mechanisms which operate in the well- studied 1 Myr-old T Tauri stars can and do occur in older (10 Myr) stars. We derive the first estimates of the disk mass accretion rate in TW Hya and Hen 3-600A, which are 1-2 orders of magnitude lower than the average rates in 1 Myr-old objects. The decrease in accretion rates over 10 Myr, as well as the low fraction of TW Hya association objects still accreting, points to significant disk evolution, possibly linked to planet formation. Given the multiplicity of the Hen 3-600 system, and the large UV excess of TW Hya, our results show that accretion disks can be surprisingly long-lived in spite of the presence of companions and significant UV ionizing flux.

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The Migration and Growth of Protoplanets in Protostellar Discs

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We investigate the gravitational interaction of a Jovian mass protoplanet with a gaseous disc with aspect ratio and kinematic viscosity expected for the protoplanetary disc from which it formed. Different disc surface density distributions have been investigated. We focus on the tidal interaction with the disc with the consequent gap formation and orbital migration of the protoplanet. Nonlinear two–dimensional hydrodynamic simulations are employed using three independent numerical codes.

A principal result is that the direction of the orbital migration is always inwards and such that the protoplanet reaches the central star in a near circular orbit after a characteristic viscous time scale of $\sim 10^4$ initial orbital periods. This was found to be independent of whether the protoplanet was allowed to accrete mass or not. Inward migration is helped through the disappearance of the inner disc, and therefore the positive torque it would exert, because of accretion onto the central star. Maximally accreting protoplanets reached about four Jovian masses on reaching the neighbourhood of the central star. Our results indicate that a realistic upper limit for the masses of closely orbiting giant planets is ~ 5 Jupiter masses, if they originate in protoplanetary discs similar to the minimum mass solar nebula. This is because of the reduced accretion rates obtained for planets of increasing mass.

Assuming some process such as termination of the inner disc through a magnetospheric cavity stops the migration, the range of masses estimated for a number of close orbiting giant planets (Marcy, Cochran, & Mayor 1999; Marcy & Butler 1998) as well as their inward orbital migration can be accounted for by consideration of disc–protoplanet interactions during the late stages of giant planet formation.

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On the Nature of Linear Structures in the Helix and Orion Nebulae

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Linear features of up to one quarter parsec length are seen in both the Helix Nebula and the Orion Nebula. These features are most evident in emission line ratio images. It is demonstrated that in both objects the features are along projections of lines between the dominant star and an optically thick compact feature (the cometary knots in the Helix and the proplyds in Orion). In general, these features are caused by shadowing of Lyman continuum radiation from the photoionizing star, although in the case of the Helix features extinction by entrained dust plays a role. Some

of the rays have neutral hydrogen cores. It is shown that the characteristics of these linear features can be used to analyze the three dimensional structure of the nebulae. If the most recent model for these rays is correct and the electron temperature of the shadowed gas is only two thirds that of the ambient material, then these rays play a small but measurable role in solving the t^2 problem.

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High Angular Resolution Determination of Extinction in the Orion Nebula

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The optical appearance of the Orion Nebula is significantly altered by the presence of interstellar extinction. Since Orion is high above the Galactic plane and is nearby, most of this extinction is due to material immediately in front of the associated star cluster. This extinction fundamentally alters the optical appearance of the Orion Nebula. We have quantitatively determined the extinction correction by comparing the surface brightness of the nebula at a resolution of about 1.7″ in the radio continuum and the Hα emission line. The results compare well with new determinations made from Hα and Hβ line ratios. Extinction corrected optical images are generated and discussed. The most important extinction feature, the Dark Bay that obscures the east side of the nebula, has a mass of about 3 $M_\odot$ and possesses numerous small knots of material in addition to a feature that appears to be a shock. We also find that the thin main emitting layer on the front of the parent Orion Molecular Cloud is marked by numerous walls and plateaus. Only one such structure had been previously known, which produces a Bright Bar across the southeast portion of the nebula. The sharpest structure is associated with the complex of molecular outflow and infrared sources near the region called Orion-S and is likely to be the result of uncollimated outflow from an imbedded young star.

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Accelerating Star Formation in Clusters and Associations

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We use our own, recently developed pre-main-sequence evolutionary tracks to investigate the star formation histories of relatively nearby associations and clusters. We first employ published luminosities and effective temperatures to place the known members of each region in the HR diagram. We then construct age histograms detailing that region's history. The groups studied include Taurus-Auriga, Lupus, Chamaeleon, ρ Ophiuchi, Upper Scorpius, IC 348, and NGC 2264. This study is the first to analyze a large number of star-forming regions with the same set of theoretical tracks.

Our investigation corroborates and extends our previous results on the Orion Nebula Cluster. In all cases, we find that star formation began at a relatively low level some 10^7 yr in the past, and has more recently undergone a steep acceleration. This acceleration, which lasts several million years, is usually continuing through the present epoch. The one clear exception is the OB association Upper Scorpius, where the formation rate climbed upward, peaked, and has now died off. Significantly, this is also the only region of our list that has been largely stripped of molecular gas.

The acceleration represents a true physical phenomenon that cannot be explained away by incompleteness of the samples; nor is the pattern of stellar births significantly affected by observational errors or the presence of unresolved binaries. We speculate that increasing star formation activity arises from contraction of the parent cloud. Despite the short time scale for acceleration, the cloud is likely to evolve quasi-statically. Star formation itself appears to be a critical phenomenon, occurring only in locations exceeding some threshold density. The cloud's contraction must reverse itself, and the remnant gas dissipate, in less than 10^7 yr, even for aggregates containing no massive stars. In this case, molecular outflows from the stars themselves presumably accomplish the task, but the actual dispersal mechanism is still unclear.

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NGC1333/IRAS4: A multiple star formation laboratory

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We present SCUBA observations of the protomultiple system NGC1333/IRAS4 at 450um and 850um. The 850um map shows significant extended emission which is most probably a remnant of the initial cloud core. At 450um, the component 4A is seen to have an elongated shape suggestive of a disk. Also we confirm that in addition to the 4A and 4B system, there exists another component 4C, which appears to lie out of the plane of the system and of the extended emission. Deconvolution of the beam reveals a binary companion to IRAS4B. Simple considerations of binary dynamics suggest that this triple 4A-4BI-4BII system is unstable and will probably not survive in its current form. Thus IRAS4 provides evidence that systems can evolve from higher to lower multiplicity as they move towards the main sequence. We construct a map of spectral index from the two wavelengths, and comment on the implications of this for dust evolution and temperature differences across the map. There is evidence that in the region of component 4A the dust has evolved, probably by coagulating into larger or more complex grains. Furthermore, there is evidence from the spectral index maps that dust from this object is being entrained in its associated outflow.

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MHD Models of Axisymmetric Protostellar Jets

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We present the results of a series of axisymmetric time-dependent magnetohydrodynamic (MHD) simulations of the propagation of cooling, overdense jets. Our numerical models are motivated by the properties of outflows associated with young stellar objects. A variety of initial field strengths and configurations are explored for both steady and time-variable (pulsed) jets. For the parameters of protostellar jets adopted here, even apparently weak magnetic fields with strengths $B \gtrsim 60\mu$G in the pre-shocked jet beam can have a significant effect on the dynamics, for example by altering the density, width, and fragmentation of thin shells formed by cooling gas. Strong toroidal fields ($\geq 100\mu$G) with a radial profile that peaks near the surface of the jet result in the accumulation of dense shocked gas in a "nose cone" at the head of jet. We suggest that this structure is unstable in three-dimensions. A linear analysis predicts that axisymmetric pinch modes of the MHD Kelvin-Helmholtz instability should grow only slowly for the highly supermagnetosonic jets studied here; we find no evidence for them in our simulations. Some of our models appear unstable to current-driven pinch modes, however the resulting pressure and density variations induced in the jet beam are not large, making this mechanism an unlikely source of emission knots in the jet beam. In the case of pulsed jets, radial hoop stresses confine shocked jet material in the pulses to the axis, resulting in a higher density in the pulses in comparison to purely hydrodynamic models. In addition, if the magnetic field strength varies with radius, significant radial structure is produced in the pulses (the density is strongly axially peaked, for example) even if the density and velocity in the jet follow a constant "top-hat" profile initially.

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Injection of Radioactivities into the Presolar Cloud: Convergence Testing

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According to the hypothesis of the triggered origin of the solar system, the formation of our planetary system was initiated by the impact of an interstellar shock wave on a molecular cloud core. The shock wave originated from a nearby explosive stellar event and carried with it radioactivities produced in the stellar source. In addition to triggering the collapse of the molecular cloud core, the shock wave also deposited some of the freshly synthesized radioactivities into the collapsing system. These radioactivities were then incorporated into the first solar system solids, in this manner leaving a record of the event in the meteoritic material. The viability of the scenario can be assessed by numerical simulations studying the processes involved in injecting shock wave material into the collapsing system. Calculations performed at different resolutions confirm the previously suggested conclusions: injection occurs through Rayleigh-Taylor instabilities, the injection efficiency is approximately 10%, and temporal and spatial heterogeneities in the abundances of the radioactivities in the early solar system are possible. The results are used to estimate dilution factors for different stellar sources.

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The C–C–C bending modes of PAHs: A new emission plateau from 15 to 20 μm

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We have obtained 2.5–45 μm spectra of a sample of compact H II regions, YSOs and evolved stars in order to study the origin and evolution of interstellar Polycyclic Aromatic Hydrocarbon molecules (PAHs). Besides the well–known, strong PAH bands at 3.3, 6.2, 7.7, 8.6, and 11.2 μm, these spectra reveal for the first time, a ubiquitous emission plateau from 15 to 20 μm. While the overall shape of this plateau is very similar in all sources, the detailed profiles vary from source to source. In particular, some sources show a distinct emission feature at 16.4 μm. Moreover, the integrated intensity of this plateau varies relative to the PAH emission features by a factor 10 in our sample.

We attribute this 15–20 μm plateau to a blend of many emission features due to the interstellar or circumstellar PAH family present in these sources. Laboratory studies and quantum chemical calculations show that PAH molecules invariably possess emission features in this wavelength region, arising from C–C–C bending modes which cause in– and out–of–plane distortion of the carbon skeleton. These modes are very sensitive to the molecular structure of the specific PAHs present and hence different molecules emit at different wavelengths. Analysis of the available data on the IR characteristics of PAHs show that a collection of PAHs will give rise to a broad plateau in this region.

We have analyzed the size distribution of PAHs giving rise to the IR emission spectra of the sources in our samples. While much of the 15–20 μm plateau is thought to arise in relatively large PAHs and PAH clusters , we attribute the 16.4 μm feature to the small end of the interstellar PAH size distribution. We conclude that the observed increased strength of the 15–20 μm plateau relative to the shorter wavelength IR emission features in regions of massive star formation is caused by a preponderance of larger PAHs and PAH clusters in those sources. Possibly this reflects the importance of coagulation in the dense molecular cloud environment from which these stars are formed.

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On the stability of colliding flows: radiative shocks, thin shells, and supersonic turbulence

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High-resolution numerical simulations reveal the turbulent character of the interaction zone of colliding, radiative, hypersonic flows.

As the shocked gas cools radiatively, the cooled matter is squeezed into thin, high density shells. The remaining kinetic energy causes supersonic turbulence within these shells, before it is finally dissipated by internal shocks and vortex cascades. The density is far from homogeneous. High density filaments and large voids coexist. Its mean value is significantly below the stationary value. Similarly, areas with supersonic velocities are found next to subsonic regions. The mean velocity is slightly below or above the sound speed. While quasi uniform flow motions are observed on smaller scales the large scale velocity distribution is isotropic. Part of the turbulent shell is occupied by relatively uniform flow-patches, resembling coherent structures.

Astronomical implications of the turbulent interaction zone are multifarious. It probably drives the X-ray variability in colliding wind binaries as well as the surprising dust formation on orbital scales in some WR-binaries. It lets us understand the knotty appearance of wind-driven structures as planetary and WR-ring nebulae, symbiotics, supernova remnants, galactic supperbubbles. Also, WR and other radiatively driven, clumpy winds, advection dominated accretion, cooling flows and molecular cloud dynamics in star-forming regions may carry its stamp.

Colored pictures and mpeg-videos can be taken from http://www.astro.phys.ethz.ch/staff/walder/

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Preprints can be obtained by contacting walder@astro.phys.ethz.ch
or via WWW on http://www.astro.phys.ethz.ch/staff/walder/walder.html

High Resolution, Wide Field Imaging of the HL Tau Environment in ^{13}CO(1-0)

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We present a high-resolution image of the region near HL Tau in ^{13}CO(1-0) over a region of $3'$ made with the BIMA array, supplemented by data from the NRAO 12m telescope to include emission structures with low spatial frequencies. We find evidence for a shell of dimensions $\sim 2' \times 1.5'$ ($\sim 0.08 \times 0.06$ pc), with XZ Tau being the closest known source to its center. The ^{13}CO map is consistent with an expanding bubble which has blown out on the far side from earth. Portions of the bubble wall are seen in optical scattered light. HL Tau is situated in the bubble wall; the evacuated region corresponds to the truncation in the reflection nebula northeast of HL Tau. Although it is thought that a remnant protostellar envelope is still infalling onto HL Tau, the existence of the expanding bubble makes it difficult to interpret the geometry and kinematics of the HL Tau circumstellar material. Our results demonstrate the importance of including low-spatial frequency emission for the interpretation of interferometer maps.

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http://cfa-www.harvard.edu/cfa/youngstars/ under: publications; http://cfa-www.harvard.edu/sfgroup/

VLA Imaging of the Disk Surrounding the Nearby Young Star TW Hya

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The TW Hya system is perhaps the closest analog to the early solar nebula. We have used the Very Large Array to image TW Hya at wavelengths of 7 mm and 3.6 cm with resolutions $0\farcs1$ (~ 5 AU) and $1\farcs0$ (~ 50 AU), respectively. The 7 mm emission is extended and appears dominated by a dusty disk of radius > 50 AU surrounding the star. The 3.6 cm emission is unresolved and likely arises from an ionized wind or gyrosynchrotron activity. The dust spectrum and spatially resolved 7 mm images of the TW Hya disk are fitted by a simple model with temperature and surface density described by radial power laws, $T(r) \propto r^{-0.5}$ and $\Sigma(r) \propto r^{-1}$. These properties are consistent with an irradiated gaseous accretion disk of mass ~ 0.03 $M_\odot$ with an accretion rate $\sim 10^{-8}$ $M_\odot$ yr^{-1} and viscosity parameter $\alpha = 0.01$. The estimates of mass and mass accretion rates are uncertain as the gas-to-dust ratio in the TW Hya disk may have evolved from the standard interstellar value.

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ISO–SWS observations of pure rotational H_2O absorption lines toward Orion–IRc2

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First detections of thermal water vapor absorption lines have been made toward Orion IRc2 using the *Short Wavelength Spectrometer* (SWS) on board the *Infrared Space Observatory* (ISO). Grating spectra covering wavelengths 25–45 μm yield 19 pure rotational lines, originating from energy levels 200–750 K above ground. Fabry-Perot spectra of 5 transitions resolve the line profiles and reveal the H_2O gas kinematics. The fact that all lines are seen in absorption is in striking contrast with data from the ISO *Long Wavelength Spectrometer* (LWS), where the H_2O lines appear in emission. At least one line displays a P-Cygni type profile, which suggests that the water is located in an expanding shell centered on or near IRc2. The expansion velocity is 18 km s^{-1}, in agreement with the value inferred from H_2O maser observations by Genzel et al. (1981). Because the continuum is intense and likely formed in or near the water-containing gas, the excitation of the observed transitions is dominated by radiative processes. A simple, generalised curve-of-growth method is presented and used to analyze the data. A mean excitation temperature of 72 K and a total H_2O column density of 1.5×10^{18} cm^{-2} are inferred, each with an estimated maximum uncertainty of 20%. Combined with the H_2 column density derived from ISO observations of the pure rotational H_2 lines, and an assumed temperature of 200–350 K, the inferred H_2O abundance is 2–5$\times10^{-4}$ in the warm shocked gas. This abundance is similar to that found recently by Harwit et al. (1998) toward Orion using data from the LWS, but higher than that found for most other shocked regions by, for example, Liseau et al. (1996).

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Dissertation Abstracts

Parsec-scale Structure in Star-forming Molecular Clouds

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In this thesis, I present high resolution, fully-sampled ^{12}CO and ^{13}CO surveys of Orion A, the Perseus giant molecular cloud, and two smaller clouds: L1551 and Circinus. The large scale structure in these molecular clouds appears to be shaped by energy injection from neighboring OB associations through their UV radiation, winds, and supernovae. The small scale structure of these clouds appears to be shaped by energy injection by outflows from young stellar objects, HII regions, and gravity. I study in detail outflow properties and their impact on the host clouds. I introduce a technique of mass estimation which accounts for the velocity dependence of the ratio of isotopic opacities for like rotational transitions. This technique has the effect of steepening the mass spectra of outflows by up to 50% in the high velocity wings. Finally I investigate the statistical properties of star-forming regions.

The specific results of the thesis are listed here.

• L1551 appears to be a cometary cloud which is is marked by about a dozen overlapping outflows. The main bipolar outflow is energetically supported by at least three outflows; two from L1551 IRS5 and one (possibly two) from L1551 NE. The very prominent low velocity east – west mono-polar outflow has a well-defined, limb-brightened cavity that points back toward the IRS5 and L1551NE sources; no direct evidence has been found that either source drives this flow.

• The morphology of the Circinus molecular cloud is being shaped by at least ten currently active outflows.

• The large scale structure and kinematics of the Perseus giant molecular cloud appears to be driven by the neighboring OB2 association. I present evidence that the star-forming clouds within the complex are not gravitationally bound to each other. Currently active outflows from young stellar objects can provide the requisite energy injection to sustain observed turbulent motions. A model of super-alfvenic random flows provides a superior description of the cloud statistics than that of magneto-hydrodynamic flows.

• The large scale structure and kinematics of the Orion A cloud appears to be driven by the Orion OB1a & b associations located to the north of the cloud. The small scale structure ($\lesssim$ 5 parsecs) is being driven by influence of outflows, the blister HII region, and gravity. There are dozens of young stellar objects driving overlapping outflows which run the length of the cloud. One of the largest, the BN/KL outflow has produced a $\sim$ 2 pc bipolar cavity to the northwest and southeast with a collimation of $\sim$ 2.

These star-forming clouds are evidently driven by energy injection on many scales. This contrasts the theory that molecular clouds are fundamentally fractal in nature, wherein spatial and kinematic structure is the result of a turbulent cascade from some large-scale energy injection mechanisms down to the subparsec scale.

Light Scattering and Evolution of Protoplanetary Disks and Planetary Rings

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Ph.D degree awarded: May 2000

This thesis examines observations and modeling of young circumstellar disks in the Orion nebula. Three separate arguments suggest that the disks are dominated by large particles, and we are witnessing earliest stages of planetary formation.

I) I used a Monte Carlo nine-parameter 3D disk model to fit Hubble Space Telescope observations in eleven bands from 0.2 – 1.9 μm. The best-fit models are consistent with extinction caused by large particles, $r > \lambda$ in the outer disk edge. II) Interferometric observations at 1.3 mm reveal no measurable flux from the disks, implying that the optical depth is low and thus particles have grown to $r > 1$ mm. III) Numerical models of particle growth within a photoevaporative environment indicate that grain growth happens rapidly and predicts particle sizes similar to those constrained observationally. The model includes a) grain growth in a turbulent disk, b) ice loss by photosputtering, and c) gas and dust loss by entrainment of small particles in a photoevaporative flow. The disks are photoevaporated on timescales of 10^{4-6} yr by O stars in the Trapezium region.

The numerical model indicates that formation of Jovian planets within the Orion region and other OB associations may be difficult; however, formation of terrestrial planets is not affected. I reproduce the observed sharp edge termination in the Orion disks. The existence of Jovian planets within our solar system suggests that our disk is not sharply terminated, and the Edgeworth-Kuiper belt may extend significantly beyond that presently detected.

I apply a similar numerical model to evolution of Saturn's G ring, based on spectroscopic observations at the 1995-96 ring plane crossing, coupled with a light scattering model for realistic, processed small particles. Best-fit solutions indicate that the ring was formed by catastrophic disruption of a satellite $10^7 - 10^8$ years ago and is sustained in steady-state by an unseen population of km-sized parent bodies.

http://bogart.Colorado.EDU/~throop/research.html#latest_results

Hot and Cold: A Study of H_2 Jets and CO Molecular Outflows from Young Stars

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Ph.D degree awarded: March 2000

This thesis examines outflows from young low-mass accreting protostars. The outflow phenomenon appears to be ubiquitous to all newborn stars, and is often the first observational evidence for embedded young stars. Outflows may be crucial to removing angular momentum from the accretion disk, thereby allowing material to accrete onto the stellar core. In addition, since they can transport supersonic gas over parsec-scale distances, outflows probably contribute to changing the chemistry of the molecular cloud, adding to the cloud's overall turbulence, and may even affect the efficiency of star formation by physically disrupting the infall environments around other protostars. Because young stellar objects (YSOs) are usually still embedded within their parent molecular clouds, they are shrouded by the gas and dust that they are born from, and hence are invisible at optical wavelengths. Outflows are however often energetic enough to punch out of the densest parts of the molecular clouds into less extincted regions. A proper study of all the aspects of protostellar flows [including optical Herbig-Haro (HH) objects, near-infrared (NIR) jets in the $v = 1$–0 $S(1)$ H_2 line at 2.12 μm, and molecular maps of outflows in various transitions of ^{12}CO] thus requires observations at a variety of lines that are populated under different excitation conditions, and which are detected at a wide range of wavelengths.

This thesis consists of new observations and interpretations of two regions: the Barnard 5 cloud containing the IRS 1 flow, and the OMC-2 and OMC-3 cloud cores, containing a rich cluster of young stars and criss-crossing H_2 jets. ^{12}CO $J = 2$–1 mapping, H_2 and optical emission line imaging, and high resolution optical and NIR spectroscopy have revealed the locations of the H_2 emission with respect to the molecular gas; provided support for bow shock entrainment models for the acceleration of CO bearing gas; showed evidence for H_2 heating by a magnetic precursor or HH-object-induced fluorescence; and showed that many H_2 knots can be described as bow shocks with forward and reverse shock line profiles.

In addition, comparisons of CO, Hα, and H_2 structures within $20''$ of the Barnard 5 IRS 1 source supports an outflow acceleration model where both a jet and a wide angle wind emanate from the YSO or accretion disk. CO filaments found parallel to the IRS 1 flow may trace magnetosonic perturbations excited by major mass loss episodes of IRS 1. Luminosity masses of the outflow lobes are derived using a new technique which corrects for the optical depth of the line at each velocity channel. A comparison of mass spectra of flows from this work as well as from other authors reveals possible differences in how low and high mass YSOs entrain ambient gas into outflows as they evolve. Finally the numbers of flows found in the observed clouds are consistent with the hypothesis that outflows can provide part of the turbulent support within molecular clouds. The efficiency of this pressure support however drops in the case of OMC-2/3 where the main cloud is a narrow ridge.

http://casa.colorado.edu/∼kachun/thesis

New Jobs

LECTURESHIP IN ASTROPHYSICS
Department of Physics
UMIST

Applications are invited for the above tenured post in the Department of Physics. We are seeking a dynamic individual with a strong research record and interests to complement and extend those of the current members of the Astrophysics Group (T J Millar, G A Fuller and A A Zijlstra). Research interests of the Group, which are supported by three PPARC Rolling Grants, include astrochemistry, high and low mass star formation, interstellar and circumstellar matter, and the late stages of stellar evolution. We are interested particularly in candidates with a background in theoretical aspects of molecular astrophysics, including hydrodynamics, although some experience in observational astrophysics is also welcomed. The appointee will be expected to play a role in the development of astrophysics courses for undergraduates in physics. The Department of Physics has undergone a period of expansion in recent years and contains five internationally recognised research groups with a sixth group in Biomolecular Physics in the process of being established.

It is hoped that the successful candidate can be in post by 1 August 2000 but a slightly later appointment may be possible by mutual consent. Informal enquiries may be made to Professor T J Millar on +44-(0)161-200-3677, or via e-mail to Tom.Millar@umist.ac.uk. Information on Astrophysics at UMIST may be found on the WWW at: http://saturn.phy.umist.ac.uk:8000/.

Commencing salary (under review) will be within the Lecturer A or B scale (17,238 - 30,065 pounds sterling per annum).

Application form and further details are available from: The Personnel Office, UMIST, P O Box 88, Manchester M60 1QD, UK (phone +44-(0)161-200-4058, fax +44-(0)161-200-4037, or via e-mail to Rachel.Peacock@umist.ac.uk). The closing date for applications is **15 May 2000**. Please quote reference: PHY/A/102.

STUDENTSHIP IN ASTROPHYSICS
Department of Physics
UMIST

The Astrophysics Group within the Department of Physics at UMIST will have a PPARC-funded Postgraduate Research Studentship available from 1st October 2000.

The group has research interests in all branches of molecular astrophysics including the physics and chemistry of interstellar clouds and circumstellar regions, millimetre and submillimetre observations of protostellar regions, the dynamics of outflows and jets from young stars and in observational studies of the late stages of stellar evolution. Information on the types of project available are included in the Physics Department Postgraduate Brochure. However, members of the Group are interested in a wider range of astrophysics than indicated in this Brochure. The successful applicant will work with Professor T J Millar, Dr G A Fuller or Dr A A Zijlstra.

Applicants can get further information from Professor T J Millar, Dr. G. A. Fuller or Dr. A. A. Zijlstra, Department of Physics, UMIST, PO Box 88, Manchester M60 1QD (Tel. 0161-200-3677) or via e-mail (Tom.Millar@umist.ac.uk, G.Fuller@umist.ac.uk, A.Zijlstra@umist.ac.uk).

Application forms can be obtained from The Graduate School Office, UMIST, PO Box 88, Manchester M60 1QD.

Announcements

Hα survey Questionnaire

Deadline for replies: 12 May

The AAO UK Schmidt Telescope (UKST) is undertaking an H-alpha survey of the Southern Galactic Plane and Magellanic Clouds with an unprecedented combination of coverage, resolution and sensitivity. This should be superior to any other survey of optical line emission in our Galaxy.

With the move to on-line catalogues there are currently no plans to reproduce the H-alpha and associated matched short-red (SR) surveys as film copies. The intention is to provide the community with on-line access to digital data from SuperCOSMOS scans of the survey films. This will be the only way for most people to access the survey.

This questionnaire is intended to gauge the level of community interest and support for the H-alpha survey in general and to determine the form and scope of the digital data products that the community would like in particular.

We would be grateful if you could spare a few moments answering the web based questionnaire at:

http://www.roe.ac.uk/wfau/halpha/questionnaire.html

Answers to these questions will have a very real impact on the quality of the survey made available and the level of support offered. If demand is low then only a rudimentary level of survey product will be produced.

Details and further background to the H-alpha survey in general can be found at:

http://www.roe.ac.uk/wfau/halpha/halpha.html

Many thanks in anticipation

Quentin Parker

Wide Field Astronomy Unit, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, UK

Release of the INES Archive

The International Ultraviolet Explorer (IUE) Archives have been delivered to the world scientific community on 21st March. ESA, in collaboration with the Spanish Laboratory of Space Astrophysics and Theoretical Physics (LAEFF) belonging to INTA (National Institute of Air and Space Technology), has developed and set up the INES system to access IUE Data.

INES (IUE Newly Extracted Spectra) is a complete astronomical archive and data-distribution system. Its release to the community represents the final activity by ESA in the context of the IUE project. From now LAEFF, on behalf of the international astronomical community, will be responsible of maintaining INES, making it available and providing world-wide support to scientists using IUE data.

The IUE Archive contains more than 110,000 spectra of more that 11,000 astronomical objects. All data are fully reduced and calibrated. The INES archive consists of:

- an access catalog containing the parameters required to query the archive and evaluate the observations,

- a publications catalog which links each spectrum to the publications in which it has been used via the ADS,

- and the data themselves (low dispersion spectra, high dispersion spectra rebinned to the low resolution wavelength step, full high dispersion concatenated spectra, and bi-dimensional low dispersion images).

The INES Archive can be accessed at http://ines.vilspa.esa.es. Users can consult the catalogue, preview the spectra and download the data with a standard browser from the Principal Centre at LAEFF, its Mirror Centre located at the Canadian Astronomical Data Centre or any of the National Centres spread in all continents. This distributed system guarantees the availability and efficient access to the data.

Questions about the INES archive can be directed to the INES Help Desk at

ineshelp@iuearc.vilspa.esa.es or at http://iuearc.vilspa.esa.es/ines_jb/HelpDesk/.

Web Infrared Tool Shed (WITS)

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We present World Wide Web tools for the analysis of PhotoDissociation Region (PDR) and dust continuum observations. The Web Infrared Tool Shed (WITS) consists of two "toolboxes," The PDR Toolbox (PDRT) and the Dust Infrared Toolbox (DIRT). These toolboxes provide an extensive grid of PDR and dust continuum models. We have recently upgraded DIRT to shorten the time required to access and display models and to greatly expand the model data base.

The PDR toolbox (PDRT) provides emission diagnostics based on the models of Kaufman, et al. 1999, ApJ, 527, 795. Using the observed IR line fluxes and line ratios, users can determine the PDR gas density and temperature, and the incident far-ultraviolet field strength. The Dust Infrared Toolbox (DIRT) is geared toward modeling the dust continuum from envelopes of young and evolved stars. Users can automatically fit their data by searching grids of pre-calculated models. Model outputs include the dust temperature and density distributions, and the flux as a function of wavelength and beamsize. Over 300,000 models are currently stored in the DIRT model database with future expansion to include several additional grain models plus the emission from a disk source.

WITS is available at http://dustem.astro.umd.edu and
http://wits.ipac.caltech.edu.

Moving ... ??

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