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Abstracts of recently accepted papers

Short-term variability of photospheric lines in the pre-main sequence Herbig Ae star AB Aur

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During the multi-site MUSICOS 92 campaign, the pre-main sequence Herbig Ae star AB Aur was monitored primarily in the He I 5876 Å line, but two of the telescopes were equipped with cross-dispersed echelle spectrographs. The wide spectral domain covered by these instruments allows us to study simultaneously the variability of many photospheric lines.

These data are supplemented with additional observations obtained at Observatoire de Haute-Provence 2 years later.

We find that the photospheric lines of AB Aur have variable profiles, and that distortions cross the line profiles from blue to red, on a time scale of a few hours. These distortions tend to extend significantly blueward of the projected rotation velocity boundary of the line. This implies that localized outflows with velocities of the order of 100 kms⁻¹ must be present in the photosphere and affect photospheric line formation.

The photosphere of AB Aur may be affected by azimuthal structures creating the observed variability through the effect of stellar rotation, as are the overlying chromosphere and wind, although more data are needed to establish this point unambiguously.

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IRAS 20050+2720: An Embedded Young Cluster Associated with a Multipolar Outflow

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We obtained near-IR images at 1-5 μm of IRAS 20050+2720, a very red far-infrared source with a multipolar outflow (Bachiller et al. 1995). Of the 212 sources we detected, half of them are probably members of an embedded cluster around the IRAS source. More than 50% of the cluster members show near-IR excesses, suggesting that they are pre-main sequence stars with circumstellar emission. The luminosity functions of the cluster show turnovers and slopes consistent with pre-main-sequence model predictions for an average cluster age of ~1 Myr. Three subclusters are identified within the cluster. One of them (subcluster A) appears to be associated with denser molecular gas and higher extinction than the other two subclusters. It also coincides with the IRAS source, a compact millimeter continuum source, and the center of the multipolar CO outflow. We identified in subcluster A several deeply embedded sources

with sharply rising spectral energy distributions. These results strongly support the suggestion that the multipolar outflow is the result of simultaneous star formation within 0.1 pc of the IRAS source. We suggest that the cluster was formed in several episodes of star formation over the last ~ 1 Myr, and that subcluster A represents the most recent episode in which multiple young stars were formed within ~ 0.1 Myr.

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The Structure and Emission of Accretion Disks Irradiated by Infalling Envelopes

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We calculate the emission from steady viscous disks heated by radiation from an opaque infalling protostellar envelope. For typical envelope parameters used to explain the spectral energy distributions of protostellar sources, we find that the envelope heating raises the outer disk temperature dramatically. The resulting temperature distribution in the disk is a complicated function of both radial distance and vertical height above the disk midplane. We show that the visibility flux at $\lambda = 0.87$ mm and the spectral energy distribution from submm to radio wavelengths of the flat-spectrum T Tauri star HL Tau can be explained by emission from an accretion disk irradiated by its infalling envelope, whereas thermal emission from an infalling envelope or radiation from a steady viscous accretion disk cannot explain the observations. Our results suggest that the radiation fields of collapsing protostellar envelopes may strongly affect the structure of pre-main sequence accretion disks.

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3-D Simulations of Protostellar Jets in Stratified Ambient Media

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We present fully three-dimensional hydrodynamical simulations of radiative cooling jets propagating into stratified isothermal ambient media with power-law density and pressure distributions. The parameters used are mainly suitable for protostellar jets but results applicable to extragalactic jets are also presented. Comparisons are made with previous simulations of jets through homogeneous media. We find that for radiative cooling jets propagating into regions where the ambient medium has an increasing density (and pressure) gradient, the ambient gas tends to compress the cold, low-pressure cocoon of shocked material that surrounds the beam and destroy the bow shock-like structure at the head. The compressing medium collimates the jet and promotes the development of Kelvin-Helmholtz instabilities which cause beam focusing, wiggling and the formation of internal traveling shocks, *close to the head*, via pinching along the beam. This remarkably resembles the structure of some observed systems (e.g. Haro 6-5B northern and HH 24G jets). These effects are larger for jets with smaller density ratio between jet and environment η (tested for $\eta=1, 3$, and 10) and larger Mach number $M_a = v_j/c_a$ (tested for $M_a=12$ and 24, where v_j is the jet velocity and c_a the ambient sound speed). In an ambient medium of decreasing density (and pressure), the beam is poorly collimated and relaxes, becoming faint. This could explain "invisible" jet sections, like the gap between the parent source and collimated beam (e.g., in HH30 jet). Although, on average, jets propagating into an increasing (decreasing) density environment are decelerated (accelerated) by the increasing (decreasing) ram pressure of the ambient medium, we find that their propagation velocities have an oscillating pattern. The internal traveling shocks that develop in jets propagating into positive density gradient environments display a similar velocity variation, in qualitative agreement with recent measurements of fluctuations in the tangential velocity of the knots of Haro 6-5B jet. Finally, runs of adiabatic jets into similar stratified environments indicate that they are less affected by the effects of stratification than the cooling jets because their higher pressure cocoons are better able to preserve the beam structure.

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Water in Galactic Hot Cores

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We have detected the quasi-thermal $3_{13} - 2_{20}$ line of H_2^{18}O with a $12''$ resolution in 13 of 26 galactic sources of massive star formation. No lines were detected toward 6 evolved stars. We also made searches for deuterated water, HDO, in the $4_{22} - 4_{23}$ and $3_{12} - 2_{21}$ transitions, detecting 9 sources of HDO emission. Using an LTE analysis, we infer that the average fractional abundance of gas phase water, $[\text{H}_2\text{O}]/[\text{H}_2]$, toward the sources in our sample is $\sim 10^{-5}$. The ratio $[\text{HDO}]/[\text{H}_2\text{O}]$ is $\sim 3 \times 10^{-4}$. The inferred $[\text{HDO}]/[\text{H}_2\text{O}]$ ratio should be much more reliable than the $[\text{H}_2\text{O}]/[\text{H}_2]$ ratio since the column density of H_2 is rather uncertain. Our maps of H_2^{18}O and HDO toward Orion IRC2 and Sgr B2 indicate that the emission from these sources is small compared to the size of the telescope beam. Toward Sgr B2, the emission from H_2^{18}O peaks on Sgr B2(N); if there is any emission toward Sgr B2(M), it is $\lesssim 25\%$ the intensity of the emission from Sgr B2(N). The inferred abundances, compact sizes and distributions of the emission regions lead us to believe that evaporation of grain mantles in the hot cores of massive star forming regions must play an important role in the formation of interstellar gas phase water in these regions. Implications concerning the oxygen budget of the interstellar medium and the cooling of hot molecular cloud cores are also discussed.

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Linear and Circular Imaging Polarimetry of the Chamaeleon Infrared Nebula

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We present linear and circular imaging polarimetry observations of the Chamaeleon Infrared Nebula, a bipolar reflection nebula in the Chamaeleon I dark cloud, at near infrared (JHK_N) wavelengths. These are amongst the first imaging circular polarimetry results of a star forming region. The detection of both high degrees of linear polarization and a significant degree of circular polarization in the extended nebulosity allows us to comment on the scattering geometry and the range of particle sizes present. We develop a model incorporating a polarized source which can successfully account for the observed linear and circular polarimetry and for the asymmetries in nebular brightness (the ‘bright rim’ structures) seen in this and other objects (*e.g.* NGC2261/R Mon). In order to do so, the model requires a non-axisymmetric illumination of the nebula and we discuss possible origins for this asymmetry including disruption of a circumstellar disc by binary protostars.

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Preprints available from <http://star.herts.ac.uk/preprints.html>

Orbital decay of protostellar binaries in molecular clouds

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Recent discoveries of large numbers of pre-main-sequence (PMS) binary systems, in both high-mass and low-mass star-forming regions, indicate that binaries are formed very early in the star formation process. The evolution of a protostellar binary system is investigated while it is embedded in its parent molecular cloud core, and is acted upon by gas drag due to dynamical friction. Approximate analytical results are obtained for the energy and angular momentum evolution of the orbit in the limiting cases, where the velocity is much smaller than, and much larger than the velocity dispersion of the gas. The general case is solved numerically. It is found that dissipation due to drag causes a decay of the orbit to smaller separations in relatively short periods of time. For typical molecular cloud core parameters,

with density $\sim 10^6 \text{ cm}^{-3}$ and velocity dispersion $\sim 1.5 \text{ kms}^{-1}$, a one solar mass binary system with initial separation of 10^4 AU decays to $\sim 1500 \text{ AU}$ in 10^6 years. It is suggested that decay of the orbit due to dynamical friction can circumvent the problem of forming close binaries, as long-period binaries get dragged and evolve to shorter periods.

Observations of MS and PMS binary systems show the presence of a distinct peak in the frequency distribution of periods. The dynamical friction timescale, being proportional to the velocity (and hence period) of the binary components, is different for binaries with different orbital periods. The initial frequency distribution of periods with which the binary systems are formed, is thus expected to change with time. Binary populations have therefore, been statistically generated and evolved, for comparison with observations of the frequency distributions with period of MS and PMS binaries. Two initial distributions (a) equal number of binaries per separation interval, and (b) equal number of binaries per logarithmic separation interval, were considered. It is found that in both cases, drag due to dynamical friction causes a peak in frequency distribution, as found observationally.

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The Spectral Variability of the T Tauri Star DF Tau

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We analyze 117 echelle spectra of the T Tauri star DF Tau, concentrating on variations in the optical continuum veiling and the strong emission lines. Although this star was the inspiration for the original suggestion of magnetospheric accretion in TTS, this hypothesis is only partially supported in our data. We find that variations in the Ca II infrared triplet lines correlate with the veiling variations; there is some evidence that the broad component of the He I line does too. The narrow component of He I is shown to arise at the stellar surface, but it correlates with the broad component. There is a surprising lack of periodicity in the lines and it does not occur where expected when seen. The correlation between continuum veiling and the line components expected to be most related to the veiling is poor. There is a great deal of variability in all the lines and line components; a snapshot spectrum is a poor way to characterize the star as a whole.

The total Balmer line fluxes are poorly correlated with the veiling, unlike previous results on a large sample of TTS. Red-shifted absorption components are found in the weaker lines, but are not common. The strength of the blue-shifted absorption feature in $H\alpha$ is correlated with the veiling but changes in it perhaps occur before veiling changes by about one day. This time delay supports the idea that the wind originates at some distance from the stellar surface, and is related to accretion. Spherically symmetric wind models are unable to reproduce well the relative absorption levels on the blue side of the $H\alpha$ and $H\beta$ lines simultaneously. $H\alpha$ does not display the asymmetries expected of magnetospheric accretion, but is sometimes suggestive of azimuthally asymmetric co-rotating structures. The line wings indicate that the formation region of the $H\alpha$ line is dominated by high turbulence. $H\beta$ does show more of the asymmetry expected of magnetospheric accretion.

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Structure of L1521B: CO observations of a dense core in Taurus

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L1521B is a dense core near B216 in one of the long filaments of the Taurus molecular cloud complex. The core is not associated with any known IR sources and shows no apparent signs of star formation. We have mapped the cloud in $^{13}\text{CO}(1-0)$ and $\text{C}^{18}\text{O}(1-0)$ using a grid of 1 arc minute. This area, altogether some 140 square arc minutes, contains the density maximum as well as some parts of the filament north-west of the cloud centre. At the centre

position we derive a column density $N(\text{C}^{18}\text{O})=4\cdot 10^{15}\text{cm}^{-2}$ and an optical depth of about 1.3 for C^{18}O . Using a value of $r=140\text{pc}$ for the distance we estimate that the total mass contained within a radius of 3 arc minutes around the density maximum is about 20 solar masses. The visual extinction has been estimated from the C^{18}O column density and through star counts of two fields observed at $2.2\mu\text{m}$. The extinction in the central region is $A_V \approx 20^m$.

We have also mapped part of the B216 filament about one degree north-west of the centre of L1521B in $\text{C}^{18}\text{O}(1-0)$. This area contains two IRAS point sources which are probably associated with class I protostars.

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A Double Outflow from a Deeply Embedded Source in Cepheus

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We report near-infrared and submillimeter line and continuum measurements toward the embedded source IRAS 23011+6126 in the Cepheus E molecular cloud. The source has a luminosity of $70 \pm 10 L_{\odot}$ and is not detected in the $2\mu\text{m}$ continuum. Its spectral energy distribution is characterized by a very low bolometric temperature ($T_{\text{bol}} = 60\text{K}$), placing it in the Class 0 category. The source is associated with a relatively compact (0.18 pc) molecular cloud core with a mass of $8 M_{\odot}$. Also associated with this source are four lobes of outflowing molecular gas. These lobes can easily be grouped into two well-collimated bipolar outflow structures with position angles differing by 52° . The small-scale outflow structure is associated with strong line emission from vibrationally-excited molecular hydrogen with line ratios consistent with C-shocks, while the large-scale outflow structure shows no associated molecular hydrogen emission. If one source is responsible for both flows, then the outflow mechanism must be both temporally and angularly variable. An alternate possibility is that the observed luminosity and outflow structures are generated by two sources, separated by less than 10^4 A. U. on the sky. These two sources must both be very deeply embedded, and presumably quite young.

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Maps of the 36 GHz Methanol Emission

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We have used the Effelsberg 100-meter telescope to map the 36 GHz $4(-1)-3(0)$ methanol transition in galactic star forming regions where methanol masers were previously detected. In most sources, the emission consists of one or several narrow (maser) features superimposed on a broader, presumably quasi-thermal component. The line shapes and positions of the narrow features are often similar to those observed in the other Class I methanol maser transitions (at 25, 44, 84 and 95 GHz), but with some exceptions. Our observations confirm that, unlike the strong Class II methanol masers (at 12.2 and 6.6 GHz), the Class I methanol masers are offset from the compact HII regions, infrared sources and OH/H₂O masers. In outflow sources, these are located at the edge of the molecular lobes.

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Thermal Radio Emission From Disk-Driven Centrifugal Winds

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Disk-driven centrifugal winds can produce considerable bremsstrahlung radiation that could account for the radio observations of many low-luminosity young stellar objects. The wind is generated by ions which are centrifugally flung

out along magnetic field lines threading the disk. Collisional drag between ions and neutrals heats the gas, giving rise to a hot ($T \sim 10^4$ K), partially ionized ($\frac{n_{H^+}}{n_H} \sim 0.1$) region in the wind. The thermal radio emission from this hot region is computed for several wind models, and it is shown that the flux in the radio regime ($1 \lesssim \nu \lesssim 20$ GHz) is consistent with the observed values of and upper limits on the flux from classical T Tauri stars. Synthetic radio maps are calculated for different observed inclinations and are found to be compatible with the observed morphologies. Inclinations near 90° (edge-on to the disk) result in elongated radio maps, whereas smaller inclinations yield more circular contours. The models considered in this study have outflow rates of $\sim 10^{-7} M_\odot \text{ yr}^{-1}$ and electron densities in the range inferred from observations of forbidden lines. In particular, a general parameter study within the context of the model indicates that electron densities from $\sim 10^7$ to $\sim 10^{12} \text{ cm}^{-3}$ at a distance of ~ 1 AU from the central protostar are required to produce the range in observed radio luminosities and spectral shapes. The calculated wind models turn out to be partially optically thick, implying that any peristellar nonthermal emission would in general be unobservable. This could explain why classical T Tauri stars lack the nonthermal emission found in weak-lined T Tauri stars.

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A Sub-Millimeter-Wave “Flare” from GG Tau?

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We have monitored the millimeter and submillimeter emission from the young stellar object GG Tau, a T Tauri binary system surrounded by a massive circumbinary disk. We find that between 1992 and 1994, the flux has increased significantly at 800, 1100, and 1300 μm , resulting in a steepening of the observed spectral energy distribution at those wavelengths. Such an increase appears consistent with a modest increase in disk luminosity (a factor of two). The increase in the effective disk temperature might arise from a slight change in the disk heating processes. Alternatively, the flux increase may reflect a sudden change in the underlying dust optical properties.

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Interferometric Imaging of IRAS 04368+2557 in the L1527 Molecular Cloud Core: A Dynamically Infalling Envelope with Rotation

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We report new interferometric observations of IRAS 04368+2557 (L1527) in ^{13}CO ($J = 1 - 0$), C^{18}O ($J = 1 - 0$), and 2.7 mm continuum emission using the Nobeyama Millimeter Array. The continuum map shows a well defined emission peak with slightly extended features. The extended features are consistent with an 800 μm continuum map. The ^{13}CO map shows blueshifted and redshifted outflowing shells characterized by a bipolar V-shape structure with a wide opening angle toward the east and west of the central source. Near the systemic velocity, a slightly blueshifted X-shaped condensation was detected in ^{13}CO with its peak coincident with the central source. The symmetrical distribution of the X-shaped condensation centered on the central source suggests that it is a circumstellar envelope surrounding the central source. The C^{18}O map shows a flattened structure elongated in the north-south direction, perpendicular to the outflow axis, centered on the central source. This flattened structure spatially correlates with the ^{13}CO X-shaped condensation. Both eastern and western edges of the flattened structure are concave as the ^{13}CO X-shaped condensation also shows, and are spatially well anti-correlated with the distribution of the outflowing shells in both blueshifted and redshifted velocities. The flattened structure is hence naturally interpreted as a disklike flattened envelope with an almost edge-on configuration. Its radius and gas mass are estimated to be ~ 2000 AU and $\sim 0.038 M_\odot$, respectively.

The edge-on flattened envelope has both rotational and radial motions with the latter dominant. The large specific angular momentum carried by the envelope gas implies that the radial motion can be infall rather than outflow. The infall and rotation velocities are $\sim 0.3 \text{ km s}^{-1}$ and $\sim 0.05 \text{ km s}^{-1}$, respectively, at the envelope radius of 2000 AU. The flattened envelope is clearly not supported by rotation, but is dynamically infalling. Its mass infall rate is $\sim 1.1 \times 10^{-6} M_{\odot} \text{ yr}^{-1}$ at 2000 AU in radius. This mass infall rate is consistent with that estimated from the bolometric luminosity of $1.4 L_{\odot}$ and the mass of $0.1 M_{\odot}$ of the central star. On the assumption that the mass infall rate is constant with time, the age of the central star is estimated to be $\sim 10^5 \text{ yr}$, which is comparable to the typical age of protostars in Taurus, even though the central star in L1527 is identified as a very young Class 0 source. The rotating motion of the flattened envelope is opposite to the large scale rotation of the L1527 cloud, suggesting that the rotation of the flattened envelope did not originate from the large scale rotation.

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The nature of the Molecular Line Wing Emission in the Rosette Molecular Complex

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We present ^{12}CO and ^{13}CO J=3 \rightarrow 2 and J=2 \rightarrow 1 observations of the Rosette Molecular Complex. These observations show that broad line wings, originally observed in CO J=1 \rightarrow 0, also exist in the higher-J lines in high signal-to-noise spectra towards individual positions and in positionally averaged spectra. We show that the wing emission can be explained by the superposition of individual high and low velocity clumps, some of which are spatially resolved at high angular resolution, and at least two embedded outflow sources. Our results call in question an earlier interpretation of this weak line wing emission as originating from a low density, ubiquitous, molecular interclump gas. A multiline analysis implies that the wing emission originates in gas with densities comparable to the density of the bulk emission. We note that the physical conditions derived from this relatively simple single component excitation analysis do not give a fully consistent picture of these clumps, leaving any conclusion on their dynamical state and evolution rather speculative.

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A Study of the Mutual Interaction Between the Monoceros R2 Outflow and Its Surrounding Core

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We present high resolution (12-24'') ^{12}CO (J=2-1), ^{13}CO (2-1), CS(2-1), CS(3-2), and CS(5-4) maps of the central $4' \times 4'$ of Mon R2 and study the bipolar outflow, the dense core, and their mutual interaction. The high velocity ^{12}CO and ^{13}CO emissions, that trace the bipolar outflow, show that the outflow lobes are limb-brightened shells of accelerated gas that have the Mon R2 IR cluster near their apex and extend approximately towards the north and south. These shells of gas are clumpy, and their emission at the highest velocities arises from discrete condensations that move with the flow but each has a slightly different speed. The CS data, on the other hand, trace the ambient core at low velocities, but also trace the accelerated gas of the outflow at higher speeds. The ambient CS emission shows that the core has a cavity along the path of the outflow, and that the walls of this cavity coincide in position and orientation with the shells of the bipolar flow. The accelerated CS emission concentrates along the cavity walls and arises from the same clumpy shells of gas that form the outflow lobes in ^{12}CO and ^{13}CO . This outflow material, therefore, is rather dense, and a solution of the CS radiative transfer shows that it is as dense as the gas in core ($\approx 4 \times 10^5 \text{ cm}^{-3}$), suggesting that what we see as outflow is in fact gas from the dense core that has been set into motion.

With the same radiative transfer analysis of the CS lines, we estimate that from a total of $1000 M_{\odot}$ of dense gas in the core, more than $170 M_{\odot}$ have been accelerated and incorporated into the bipolar flow. In addition, the CS spectra show a systematic enhancement of the line width towards the IR cluster that suggests the outflow has increased the gas turbulence in its vicinity. The amount of kinetic energy contained in both the bipolar and turbulent motions is comparable to the total binding energy of the dense gas, and this shows that the action of the outflow on the core can be strong enough to affect the distribution of dense gas in the core. We therefore propose that the cavity in the dense gas is the result of the evacuation of a channel by the outflow, and that the material initially filling its volume has been accelerated and incorporated into the flow. The Mon R2 system therefore, illustrates how bipolar molecular outflows form through the acceleration of ambient molecular gas, and that the process of molecular outflow formation is accompanied by a partial destruction of the dense gas environment of the newly formed stars.

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Preprint available from <ftp://cfa0.harvard.edu/outgoing/tafalla>

A Search for Larson-Type Relations in Numerical Simulations of the ISM. Evidence for Non-Constant Column Densities

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We present results from a statistical study of clouds in two-dimensional numerical simulations of the interstellar medium. The clouds in the simulations exhibit a differential mass spectrum $dN(M)/dM \sim M^{-1.44 \pm 0.1}$ and a velocity dispersion-size relation $\Delta v \sim R^{0.41 \pm 0.08}$. However, the clouds do *not* exhibit a clear density-size relation. At a given mean density, clouds span a range of sizes from the smallest resolved scales up to a maximum given by a Larson-type relation $R_{\max} \sim \rho^{\alpha}$, with $\alpha = -0.81 \pm .15$, although numerical effects cannot be ruled out as responsible for the latter correlation. Clouds span a range of column densities N of two orders of magnitude, supporting the suggestion that the observational density-size relation may be an artifact of survey limitations. In this case, the Δv - R relation can be interpreted as a direct consequence of a k^{-2} turbulent spectrum, characteristic of a field of shocks, verified in the simulations, rather than of virial equilibrium of clouds with a $\rho \propto R^{-1}$ law. However, we also discuss the possibility that the clouds are in balance between self-gravity and turbulence, but with a scatter of at least a factor of 10 in the Δv - R relation, and of 100 in the density-size relation, according to the equilibrium relation $\Delta v \sim (NR)^{1/2}$. Finally, we compare these results with observational data. We propose a simple model suggesting that recent results finding nearly constant column densities for dark IRAS clouds may be an artifact of a temperature gradient within the clouds induced by external radiative heating. As a consequence, we emphasize that IRAS surface brightness maps are not appropriate for measuring column densities.

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Gzipped postscript file available at <ftp://kepler.astroscu.unam.mx/incoming/enro/papers/lowdens.ps.gz>. Mpeg video of Run 28 available at <http://www.astroscu.unam.mx/hp/Movies/den.mpg>.

The peculiar B[e] star HD 45677: I. Photometric observations

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This short paper presents previously unpublished, as well as new, photometric observations of the peculiar B[e] star HD 45677. The photometric measurements were made in the Walraven *WULBV*, Strömgren *uvby*, Johnson/Cousins *UBV(RI)_C* and the ESO *JHKLM* photometric systems between 1977 and 1994. Together with all the previously published photometry, these data will be analyzed in a separate paper, which will also investigate the spectroscopic behaviour of this fascinating object.

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A preprint of this paper is available via the WWW at <http://www.astro.uva.nl/preprints/preprints.html>

The peculiar B[e] star HD 45677: II. Photometric behaviour and spectroscopic properties

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The photometric behaviour of the peculiar B[e] star HD 45677 over the last 25 years is investigated. We conclude that the photometric variations ($V = 7^m 22 - 8^m 85$) on such a time scale can be well explained by obscurations, possibly due to large ($> 1 \mu\text{m}$) circumstellar (CS) dust grains which were created after an explosive event around 1950. Intermediate time scale variations are also identified and can be well explained by infall of CS material.

Evidence is also found for smaller, pulse-like, amplitude variations. The time scale of this “flickering” ranges from days down to hours and is explained by instabilities in accretion flows towards HD 45677. The accretion mechanisms can be the origin of the hypothesized existence of a bipolar flow.

HD 45677, seen edge-on, shows evidence for the presence of a circumstellar disk. The significant accretion flows in this disk probably increased some time after the 1950 event, either due to a fall-back of part of the ejected material by a blow-out around 1950 or either due to the explosive dissociation of a large cometary-like body. Dynamic effects of such infalling and outflowing material close to the stellar surface are also detected by high resolution spectroscopy in the $H\alpha$ and He I profiles. These short time scale variations are also seen in the cool material as detected by the variations in the violet part of the Na I *D* profiles, which are probably due to collisions of the outflowing material with the outer disk.

The presence of a disk is often indicated and here by the emission of the sodium lines with a strong absorption component at the systemic velocity (about 20 km s^{-1}). Most detected lines, except $H\alpha$, are well centered at this velocity. Apart from the red [S II] lines, all other nebular lines as well as many other emission lines, including the Fe II emission spectrum, were seen in spectra taken far before and after the 1950 event as well as in the latest spectra. So, the situation of the gaseous stellar environment seems to be stable in spite of the large photometric variations. The Fe II emission lines are double peaked with a velocity separation of about 32 km s^{-1} . This could mean that the inner disk material, in which these lines are thought to be formed, rotates with about 16 km s^{-1} . In our 1992 data this rotation velocity seems to range up to 30 km s^{-1} , which could be due to material accelerated by the 1950 event.

We discuss in this paper the evolutionary status of HD 45677. Because of its rather isolated position in the sky and because of the very fast evolution of a B2 type star, we think that HD 45677 could be young, but not in the sense of being a pre-main sequence object. Options like an evolved object such as a LBV or PN are not suitable because of the probable luminosity class III, IV or V and its rather cool central source, respectively. HD 45677 shows no evidence of any companion. The slight possibility of it being symbiotic can be added as well as instabilities in its unknown post-main sequence phase and the option that HD 45677 could be a hot post-AGB star.

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Broad Band X-Ray Observations of the Orion Region with ASCA

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Broad band X-ray images and spectra of the Orion nebula region were obtained with the X-ray satellite ASCA. Fifty two point-like sources were resolved, including the Orion Trapezium. A large fraction of the optical counterparts of the ASCA sources were classified as G-M type stars. Spectral model fits and count ratios (flux ratio between soft and broad bands) revealed that most of the point sources exhibit high-temperature plasma of $\sim 2\text{--}5$ keV. Model fits of X-ray spectra from extended regions around the Orion nebula (M 42), the reflection nebula NGC 1977, and the sky between these nebulae required at least two-temperature components of typically 0.7–1 keV and 3–5 keV. From selected high-flux sources, we also found that the model of a 2-temperature thin thermal plasma is more likely than that of a single-temperature. X-ray light curves from these sources were time variable but showed no large flares. We thus suggest that the hard X-rays are generated even in relatively quiescent states.

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Detection of Infall Motion from the Circumstellar Disk associated with the Exciting Source of HH 111

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Results from high-resolution interferometric observations towards the exciting source of the highly collimated bipolar jet HH 111 in the CS (2–1) line and 98 GHz continuum are presented. Intense emission in both the line and continuum has been detected. The continuum emission at 98 GHz is peaked at the VLA source detected by Rodríguez & Reipurth (1994) while the peak of CS emission is $2''$ shifted to the west, consistent with the earlier ^{13}CO observation by Stapelfeldt & Scoville (1993).

Detailed velocity structure of the molecular gas has been revealed under the high velocity resolution of this observation. A molecular disk with an observed extent of ~ 0.04 pc ($=8 \times 10^3$ AU) and a total velocity range of 2.9 km s⁻¹ around the exciting source of HH 111 is identified from both the morphological and velocity structures of the CS emission. This disk, resolved at different velocity channels, is oriented almost perpendicular to the collimated optical jet and to the previously known bipolar molecular outflow and its direction of rotation has been determined.

The velocity fields of the disk can be explained in terms of both infall and rotation motions in the disk plane. From the comparison between the observed velocity fields and those expected from simple kinematic models which involve both the infall and rotation, The observed velocities can be fitted approximately by an infall component parametrized as $V_{infall} = -0.5/(r/15'')^{1/2}$ km s⁻¹ and a lower-amplitude rotating component as $V_{\phi} = 0.3/(r/15'')^{1/2}$ km s⁻¹. The disk infall rate deduced from the observed quantities is 6.9×10^{-6} M_⊙ yr⁻¹, comparable with the accretion rate to the central star at current epoch.

The orientation of the molecular disk with respect to the collimated optical jet of HH 111 suggests that the infalling disk is associated with the driving source of HH 111. Additional support of this conclusion comes from the identification of a blueshifted outflow component of CS along the direction of the ^{12}CO molecular outflow associated with HH 111.

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Isotopic CO Images Near the Young Triple Star GSS30

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We present synthesized images of gas and dust associated with the nearby, low-mass core GSS30, in the J=1-0 line of $^{12}\text{C}^{18}\text{O}$ and $^{13}\text{C}^{16}\text{O}$, and in 2.7 mm continuum emission. We detected a flattened core roughly orthogonal to the major axis of the bipolar infrared reflection nebula. The core has a mass of about $0.5 M_{\odot}$ and size of $30'' \times 20''$. The molecular gas in the core forms a 2400 AU shell expanding at a speed of 0.7 km s^{-1} . This region seems to represent a dense core disrupted by an episode of star formation in the recent past.

The 2.7mm continuum emission is detected toward the youngest component IRS3 (LFAM1) of the three embedded sources. The continuum source remains unresolved at $8''.9 \times 4''.6$ resolution. The deconvolved size of $5''$ sets an upper limit of 800 AU on the size of circumstellar material. Molecular gas emission does not peak at any of the known infrared sources. This suggests that the dust and gas may not evolve simultaneously in the star forming cores.

Accepted by Astrophysical Journal

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, where you can access it via the ESO Portal (<http://http.hq.eso.org/eso-homepage.html>). You can also access it through the University of Massachusetts Astronomy World Wide Web server, the URL for its home page is <http://www-astro.phast.umass.edu/>

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Meetings

First Announcement

ISO'S VIEW ON STELLAR EVOLUTION

July 1–4, 1997

Noordwijkerhout, The Netherlands

A scientific conference to highlight new results of the Infrared Space Observatory (ISO) in the area of stars and circumstellar matter.

Goal of the conference

The Infrared Space Observatory ISO was successfully launched on November 17, 1995 and has now entered its routine phase operations. First results of the four focal plane instruments have been presented at a workshop in ESTEC at the end of May of 1996. It is expected that by summer of next year (1997) many observers will have had the opportunity to study ISO data and therefore the time would be appropriate to organise a scientific meeting in the context of ISO.

We propose to organise a symposium on stars and circumstellar matter. It has become clear in the past decade that circumstellar matter plays a crucial role in stellar evolution, both when stars are in their infancy and when they approach the end of their life. It is expected that ISO will provide a major break-through in our understanding of the evolution of stars and their circumstellar environment. A large fraction of ISO's observing time is aimed at the study of circumstellar matter throughout the life of stars.

The conference has three major topics: (1) the birth of stars and planetary systems, (2) the winds of hot stars as viewed from the IR, (3) late stages of stellar evolution. While these three areas cover a wide scope, we believe that bringing researchers from these different disciplines together in the context of ISO will give important new impulses to these fields, since the physical and chemical conditions that prevail in circumstellar matter around objects in very different evolutionary stages are often similar, i.e. diagnostic tools are alike.

Scientific Organising Committee

Mike Barlow, Eric Becklin, Steve Beckwith, Thijs de Graauw, Harm Habing, Thomas Henning, Karel van der Hucht (chairman LOC), Teije de Jong, Rolf Kudritzki, Pierre-Olivier Lagage, Antonella Natta, Timo Prusti, Daniel Rouan, Takashi Tsuji, Christoffel Waelkens (co-chairman), Rens Waters (chairman)

More information on this conference can be obtained through the WWW at

<http://www.astro.uva.nl/isostar/>

or by sending an e-mail with the appended registration form to

isostar@astro.uva.nl

You will then receive more information in the second announcement, which we expect to send out by November. A third and final announcement will be sent out in April of 1997. Deadline for registration and abstracts is March 1, 1997.

Registration Form

please email this form to isostar@astro.uva.nl

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Please tick one of the following:

I am interested in this conference, please keep me informed

I plan to attend

I will definitely attend

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