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Abstracts of recently accepted papers

High-velocity hot ammonia in bipolar outflows

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We have detected high-velocity ammonia emission associated with four bipolar molecular outflows excited by young stars (L1157, L1448, IRAS3282, and NGC2071). The high-velocity emission is more prominent in the (3,3) line, although it is also detected in the (1,1), (2,2) and (4,4) lines. We deduce that the accelerated gas is heated to more than 50- 100 K, i.e. a factor of 3- 7 over the ambient temperatures (which are in the range 12- 26 K). Such temperatures, when taken into account in the analysis of previous SiO observations, confirm that the shocked material is rather dense ($n(\text{H}_2) \geq 10^5 \text{ cm}^{-3}$). The NH_3 (3,3) lines, similarly to the SiO emission, arise from shocked material placed along highly-collimated jets or at the lobe ends, and are thus better understood in the frame of jet-driven models for bipolar outflows.

Accepted by *Astrophys. J. Letters*

Molecular Hydrogen in the IRAS03282+3035 Stellar Jet

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We detected shock excited $2.122 \mu\text{m}$ molecular hydrogen from the blueshifted lobe of the highly collimated CO outflow associated with the young stellar object IRAS03282+3035 in the Perseus molecular cloud. The H_2 emission has a peak surface brightness of $5 \times 10^{-4} \text{ ergs s}^{-1} \text{ cm}^{-2} \text{ sr}^{-1}$, making this one of the brightest shock excited molecular hydrogen sources associated with a low-mass young stellar object. The emission has knotty structure with faint tails lying parallel to the mean outflow axis. These knots coincide with molecular “bullets” B3 and B4 located near the end of the highest velocity CO emitting component and may be bow shocks where a fast jet interacts with the surrounding medium. The bulk of the lower velocity CO emission is located downwind from the H_2 emission zone. We discuss the complex morphology in the context of jet-driven CO outflow models, and argue that the H_2 emission delineates regions where CO bearing gas is entrained in the flow and accelerated, thereby producing the more slowly moving CO outflow. The H_2 luminosity radiated by this outflow is about 10% of the bolometric luminosity of the central driving source. This is the largest ratio of $L(\text{H}_2)/L_{\text{bol}}$ for any known young stellar object.

Accepted by *The Astrophysical Journal* (Letters)

IRAS sources beyond the solar circle. IV. Maps of far-outer Galaxy molecular clouds.

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We present the results of $^{12}\text{CO}(J=1-0)$ observations of molecular clouds located in the far-outer Galaxy. All clouds have distances from the galactic center $R \geq 16$ kpc, and all contain at least one IRAS point source with a FIR spectral distribution typical of star forming regions.

The data are presented in the form of maps of integrated intensity and peak temperature, and we show channel maps where relevant. For each cloud the mass is calculated both using a constant ratio (X) between $\int T_{\text{mb}}(\text{CO})dV$ and $N(\text{H}_2)$, and according to the virial theorem. The equivalent radius of each cloud is determined in two ways: from the area, and from an intensity-weighted average of the detected positions. Additional observations of $^{12}\text{CO}(J=2-1)$, $^{12}\text{CO}(J=3-2)$, $^{13}\text{CO}(J=1-0)$, and $^{13}\text{CO}(J=2-1)$, mostly at the IRAS position, are also presented. A detailed analysis and discussion of the results, as well as a comparison with inner Galaxy clouds, will be given in a following paper.

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H II regions and IRAS PSC sources: the reliability of the association

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The IRAS Point Source Catalogue has been compared with a catalogue of 462 (diffuse) H II regions detected in hydrogen radio recombination lines. To distinguish the true IRAS counterpart of the H II region from chance coincidences the distribution of offset and the position in colour-colour plots as a function of $F(60 \mu\text{m})$ are investigated. It is found that sources with $F(60 \mu\text{m}) < 100$ Jy have a high probability of being chance coincidences. The far infrared properties of the H II regions are investigated for a subsample of 252 IRAS PSC sources which have a high ($> 80\%$) probability of being true coincidences. The majority satisfy the Wood and Churchwell colour criteria which identify ultracompact H II regions; therefore, these criteria select ultracompact as well as more diffuse H II regions, or, alternatively, diffuse H II and ultracompact H II regions may often be mixed, as predicted by the sequential star formation theory.

The luminosity of a single star required to produce the observed H II line emission correlates very well with the far infrared luminosity and is, on the average, higher than the observed value. Consequently, the stars ionizing the extended H II regions can account for the bulk of the observed FIR emission and no contribution from lower mass stars of the cluster is necessary.

Accepted by Astronomy and Astrophysics

Star formation at compressed interfaces in turbulent self-gravitating clouds

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Supersonic turbulence in both self-gravitating and diffuse clouds can produce self-similar, hierarchical density structures and broad line-wings on a wide range of scales, making these two cloud types look similar and giving the clumps in each the same scaling laws. We show that the dense compressed regions that form between converging turbulent flows should collapse to form dense cores and ultimately stars in self-gravitating clouds, whereas they only disperse and reform intermittently in diffuse clouds. Star formation in turbulence-compressed regions should be as hierarchical as the turbulence, leading to clusters and multiple star systems instead of single stars; some binary stars may form by gravitational capture of stars in nearby turbulent clumps. Reasonable mass functions for clumps and stars are estimated from the theory. The slope of the initial stellar mass function is steeper than that for the clumps because of the increasing lifetime for clumps with larger mass.

Accepted by ApJ Letters

A chemical study of the photodissociation region NGC 7023

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To investigate the effects of the UV radiation on the chemistry of nitrogenated molecules in molecular clouds, we have carried out an observational study of the photodissociation region (PDR) associated with the reflection nebula NGC 7023. We mapped a region of 3 arcmin \times 3 arcmin over the PDR in millimeter transitions of ^{12}CO , ^{13}CO , C^{18}O , HCO^+ , HCN , HNC and N_2H^+ . Spectra of CS , CN and C_2H and of the rarer isotopic species H^{13}CO^+ , H^{13}CN , and HN^{13}C , were also obtained at selected positions. We find evidences of selective photodissociation in the estimated $^{13}\text{CO}/\text{C}^{18}\text{O}$ ratio. Furthermore, all molecular abundances, except those of CN and perhaps C_2H , decrease towards the star, and significant gradients in the values of some molecular abundance ratios (the HNC/HCN ratio decreases by a factor of 5, the $\text{N}_2\text{H}^+/\text{HCO}^+$ ratio decreases by a factor of 12, the CN/HCN ratio increases by a factor of 8 and the $(\text{CN}+\text{HCN}+\text{HNC})/\text{NH}_3$ ratio increases by a factor of 30 towards the star position) reveal the existence of important chemical changes in this direction.

Chemical equilibrium model calculations have been also carried out in order to interpret the observed behavior. Our results show that the variations found in molecular abundances cannot be explained by the kinetic temperature and/or the hydrogen density gradients measured in this region. The observed behavior is well explained by the influence of the stellar UV radiation on the chemistry of the molecular gas if the emission arises in a region at a visual extinction between 6 and 10 mag from the star. Molecular destruction in this region ($A_v \sim 6$ mag) is due mainly to reactions with H^+ , C , H , C^+ , O , and to electronic recombination. The CN/HCN ratio is suggested as a tracer of enhanced UV fields.

Accepted by Astron. Astrophys.

Are Wide Pre-Main-Sequence Binaries Coeval?

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We have observed a sample of 39 wide (projected separations 400 AU – 6000 AU) pre-main-sequence binary pairs spectroscopically and with optical and near-infrared images. The observations enable us to place 26 of the pairs in an HR-diagram and to determine masses and ages of the primary and secondary according to three sets of pre-main-sequence evolutionary tracks. In two-thirds of the cases the primary and secondary lie along the same isochrone to within the observational errors. However, real age differences appear for about one-third of our sample pairs – there is no set of non-intersecting theoretical isochrones that can make the primary and secondary have the same age for all pairs in our sample. In the cases where there are significant age differences between the component stars, the less massive star is usually younger than the more massive star. There is no correlation of the age differences with the presence or absence of accretion disks around the young stars. Hence, while disk accretion may affect the evolutionary tracks of pre-main-sequence stars HR-diagram, we see no clear evidence of this effect among the pairs in our sample. The age differences also do not depend systematically on the apparent separation, the mass ratio, or the ages of the stars.

Accepted by the Astrophysical Journal

High-Resolution Millimetre and Submillimetre Continuum Observations of M17SW – II. Identification of Embedded Sources Associated with H_2O masers

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The M17SW molecular cloud core has been mapped in continuum emission at 450, 600, 800, 1100 and 1300 μm , using the James Clerk Maxwell Telescope, with an angular resolution of 8 arcsec for the shortest wavelength. The 450- and 600- μm maps, in particular, show the dust emission to be highly clumped; these clumps are, in some cases, identified with those seen in previous optically thin line observations. The continuum observations are consistent

with a single greybody at a temperature of 30 K, and suggest masses of 7600 and 1300 M_{\odot} for the entire M17SW region and the northern condensation respectively; the corresponding total integrated luminosities for each region are 2.4×10^5 and $4.2 \times 10^4 L_{\odot}$. Using an analytical inversion technique, however, which allows for a continuous range of dust temperatures, we find a mass-weighted average temperature of ≈ 18 K, and masses for M17SW and the northern condensation alone of 1.6×10^4 and 2000 M_{\odot} respectively. The flux from the northern condensation is dominated by three main components, each of which lies within a few arcsec of an H_2O maser. All these objects have central densities greater than the Jeans critical density, and have masses in the range 300 to 450 M_{\odot} with luminosities of 8000 to 12 000 L_{\odot} ; these values are consistent with them containing very deeply embedded young stellar objects of mass $\sim 10 M_{\odot}$.

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A Maximum Entropy Method for Reconstructing Dust Temperature Distributions from Millimetre and Submillimetre Fluxes

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We present a numerical, maximum entropy technique for reconstructing the distribution of dust mass as a function of temperature from a set of thermal continuum fluxes. The particular formulation used can accommodate an arbitrary wavelength dependence of dust emissivity, but does require the emission to be optically thin. The dust emission spectrum of the M17SW molecular cloud is analysed, assuming a dust emissivity $\kappa_{\nu} \propto \nu^2$, and the resulting dust temperature distribution is found to differ markedly from that predicted by the analytical inversion technique of Xie et al. (1993).

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A Deeply Embedded Companion to LkH α 198

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The region around the Herbig Ae/Be star LkH α 198 was imaged with the $10\mu\text{m}$ CAMIRAS camera mounted on the Canada France Hawaii Telescope and on the Nordic Optical Telescope. We discovered, 6" north of LkH α 198, a deeply embedded ($A_V > 35$) source, which may play an important role in the region, as indicated by its observed flux ($\sim 40\%$ of LkH α 198 at $12.3\mu\text{m}$) and its position on the optical images (on the axis of the elliptical optical nebula). It is quite likely that it is in fact the new embedded source, and not LkH α 198, which drives the CO molecular outflow seen in this region. At the resolution of our observations (FWHM = 1.3"), LkH α 198 appears point-like, so that the mid infrared excess from this object cannot be due to an extended envelope of transiently heated small grains.

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The young stellar population associated with the HII region NGC 3576

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JHK images and photometry of sources associated with the HII region NGC 3576 are presented together with an 8 – $13\mu\text{m}$ CVF spectrum of the most conspicuous source in the region, Irs 1. A total of 135 sources were detected in *K* in the surveyed area of 340×340 square arc seconds. From the spatial distribution and photometry we deduced the presence of a very young massive star cluster deeply embedded in the molecular cloud. Comparison of the apparent *K* luminosity distribution of the cluster region with that of surrounding areas, suggests that the cluster contains more

than fifty members brighter than $K \simeq 13$, the majority of which (> 40) show significant IR excess. A steep gradient in the near-infrared colour is seen from the north-east to the south-west of the cluster indicating that the formation of stars started further out of the cloud and as the older population expands, it has progressed to deeper parts into the cloud where the more recent events are taking place. In the core, the star formation efficiency is found to be 0.19. The distance to this cluster is estimated to be 2.4 kpc.

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Young Stars associated with the Vela Molecular Ridge. I. VMR clouds C and D, Collinder 197 and Vela R2

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An objective prism survey for H α -emission-line stars towards the H II regions RCW 27, 32 and 33 and the northwestern parts of the Vela Molecular Ridge is presented. 278 H α -emitting objects have been found and their relation to the H II regions and to dark clouds in the area is discussed. We identify what appears to be two new large associations of T Tauri stars, Vela T1 and T2. The relation of low-mass H α -emission stars with the Vela Molecular Ridge is discussed.

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ROSAT-detection of a giant X-ray flare on LkH α 92

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We report the detection of a giant X-ray flare on the classical T Tauri star LkH α 92 with the ROSAT PSPC. In this flare the PSPC count rate rose by a factor of more than 100 in a time interval of about 2000 sec. Our X-ray observations cover most of the rise phase as well as part of the decay phase of the flare.

We model the X-ray spectra obtained at different flare phases to determine temperature and emission measure of the flaring plasma. Combining the thus derived X-ray luminosity with the observed decay time scale of ≈ 7800 sec, we estimate the total energy release of the flare in the ROSAT PSPC band (0.1 – 2.4 keV) to be $\approx 4 \times 10^{36}$ erg, which is more than a factor of 10^4 greater than the energy release in the strongest solar flares and still more than a factor of 100 greater than that in typical flares on T Tauri stars.

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A Numerical Study of Viscous Flows in α Accretion Disks

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Two-dimensional axisymmetric solutions of the equations of hydrodynamics, including radiation transport and local energy generation due to viscosity, are presented for the case of non-self-gravitating protoplanetary disks around young solar-type stars. The parameters that are varied include the accretion rate in the disk, the magnitude of the viscosity parameter α , the boundary conditions, and the initial conditions. In general, for $\alpha > 0.05$ and for distances > 0.5 AU, the flow pattern is found to consist of a radial outflow near the equatorial plane and a radial inflow near the disk surface. Unlike one-dimensional vertical structure models in this regime, the flow is stable to convection, implying a physically inconsistent model in which the convective turbulence required to generate the viscosity is actually not present. Reduction of α to order 10^{-3} is necessary to regain consistency. However, in the warmer regions interior to 0.5 AU, where the opacity rises steeply as a consequence of hydrogen ionization, a physically consistent turbulent flow is found even for $\alpha = 0.05$. Model results are compared with one-dimensional vertical structure calculations.

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The Kinematics of Molecular Outflows

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If molecular outflows represent turbulent material entrained by a central jet, then the surfaces of constant velocity should spread outward from the jet axis. Using the results of CO observations, I propose an empirical velocity distribution of this character. Outflows with this distribution display the well documented “acceleration” phenomenon, *i.e.*, the increase in terminal velocity away from the driving star

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A Multiwavelength Study of Star Formation in the L1495E Cloud in Taurus

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We have carried out a deep ($t=30000s$) x-ray search of the eastern portion of the L1495 cloud centered on the well known weak line T Tauri star (WTTS) V410 Tau using the ROSAT PSPC. This deep exposure enabled a search for candidate pre-main sequence (PMS) objects in this cloud to a limit ~ 20 times more sensitive than that typical of the fields examined with the *Einstein* searches. Despite assertions that the PMS population in Taurus-Auriga is nearly completely known, this x-ray survey revealed 8 new PMS objects in a region $50'$ in diameter, as compared to a previously known stellar population of 12 objects, including deeply embedded IRAS sources.

Spectroscopic and photometric observations enable us to place these objects in the HR Diagram. The newly discovered objects are predominantly stars of spectral type M0 and later, and a large fraction (6/8) appear to be surrounded by circumstellar accretion disks as judged by their infrared excess and $H\alpha$ emission. We combined the data for these x-ray discovered objects with extant and new data for the previously identified PMS stars in this region to examine the history of star formation and the frequency distribution of stellar masses in this cloud.

If the “post ROSAT” population is either complete or representative, we conclude (1) that star formation in L1495 East took place $\sim 1 \times 10^6$ yrs ago and that the spread in ages is small; (2) the frequency distribution of masses, $N(M)$, in this apparently coeval group appears to peak near $\log M = -0.5$ (using masses derived from the recently published PMS tracks of D’Antona & Mazzitelli (1993) and Swenson et al. (1993)) and to decline toward lower masses. The derived $N(\log M)$ for L1495E compares well with the IMF derived from studies of stars in the solar neighborhood, a result which suggests that the Taurus-Auriga clouds are currently producing stars whose mass spectrum approximates the time/space averaged IMF for the solar neighborhood.

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Shear in the IRAS 03282 outflow

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We have observed with high-resolution the ammonia emission around IRAS03282, a young star with a highly collimated molecular outflow. Our data show the outflow, passing through the core, accelerates the dense gas and produces a shear-like velocity field. The acceleration occurs along the walls of a cavity which the outflow seems to have evacuated.

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Speckle imaging of T Tauri stars in the L and M near-IR bands

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We present the results of speckle observations of 10 classical T Tauri stars (CTTS) in the L' ($3.87\mu\text{m}$) and M ($4.8\mu\text{m}$) near-IR bands. These wavelengths were selected in order to search for cold companions to CTTS with a strong IR excess. No new companions were found but known close IR companions were measured in L', most of which had previously been detected at K, thus providing the K-L color of each component. No extended structures beyond 15 AU are detected in any of the observed T Tauri stars. The young binary system Z CMa has also been resolved at M but the extended structure reported by Malbet et al. (1993) is not seen in our data to an upper limit in flux ratio of 5%.

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A new catalogue of members and candidate members of the Herbig Ae/Be (HAEBE) stellar group

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A new up-to-date catalogue of Herbig Ae/Be (HAEBE) stars and related objects is certainly needed, for both well-seasoned researchers and, in particular, for new investigators starting to study the many interesting astrophysical properties of these very young objects. We present a brief discussion of the current observational characteristics that distinguish this class from their main sequence counterparts. The HAEBE and related stars are listed in five tables, containing 287 objects. Table I contains all Ae and Be stars which historically are recognized as true HAEBE stars or potential candidate members. Table II gives the stars of spectral type Fe, and emission line stars with very uncertain or unknown spectral type. In Table III are given all known Extreme Emission Line Objects (EELOs), of which most have not been identified to belong to any specific group. Table IVa and b list other Bep or B[e] stars with strong IR-excess and unknown spectral type. Table V contains the non-emission line possible young objects. Furthermore, Table VI contains 35 stars rejected from former published lists of HAEBE stars. In these tables we are including coordinates, spectral types, visual magnitudes, ranges in photometric variability and references of several key publications related to each object. Relevant remarks, such as the presence of a nebula in the vicinity of an object, are also given.

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Infrared Spectroscopy and Imaging Polarimetry of the disk around the T Tauri Star RNO 91

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We present 3 to 5 μm spectra and a 2.2 μm polarimetric image of the T Tauri star RNO 91. We report the detection of three absorption bands centered at 3250 cm^{-1} ($3.08\mu\text{m}$), 2139 cm^{-1} ($4.68\mu\text{m}$), and 2165 cm^{-1} ($4.62\mu\text{m}$) in spectra of RNO 91. These features are due to frozen H₂O, CO and possibly XCN along the line of sight toward RNO 91. Our 2187 to 2107 cm^{-1} spectrum of RNO 90, the only other T Tauri star in the dark cloud L43, does not show the CO or XCN absorption bands. By comparing our observed polarimetric image with modeled images of scattered light from bipolar nebulae or circumstellar disks as well as with the known morphology of the RNO 91 bipolar outflow, we demonstrate that the reflection nebulosity seen in the near-infrared is most likely a circumstellar disklike structure with a radius of ~ 1700 AU. The location of both RNO 90 and RNO 91 in front of or near the front of L43 suggests that the intracloud optical depths toward both stars are small and, therefore, that the frozen H₂O, CO and XCN

molecules are located on grains in circumstellar material around RNO 91 at distances from the central star of perhaps 10 to 1700 AU. This frozen material may represent precometary grains orbiting RNO 91.

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Maps of 92 GHz Methyl Cyanide Emission in Orion-KL

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We present $4'' - 6''$ images of the methyl cyanide (CH_3CN) $J = 5_K - 4_K$ lines toward the Orion-KL region obtained with the Hat Creek millimeter interferometer. The morphology of the low excitation lines closely follows the distribution of dust emission, while the higher excitation lines are confined to a $\sim 10''$ region near IRc2. Methyl cyanide emission is found associated with all of the previously recognized source substructures, including the hot core, CS1 condensation (“10 kms^{-1} feature”), compact ridge (“8 kms^{-1} feature”), western clump, extended ridge, and northwest filament. Methyl Cyanide, like other symmetric top molecules, makes an excellent thermometer. Statistical equilibrium calculations constrain the temperature of the CS1 condensation to the range 52 – 83 K and the temperature of the southern ridge to the range 120 – 170 K. Dynamical interactions with the IRc2 outflow likely contribute to heating these regions. Much higher temperatures, > 250 K, are indicated for the hot core, where the CH_3CN abundance is enhanced by at least two orders of magnitude, presumably due to grain chemistry.

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A Well-Shaped Bipolar Outflow Shell in Mon R2

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We report some results of a study of the massive bipolar outflow in the central region of the giant molecular cloud Monoceros R2. We find in our $CO J = 1 - 0$ maps an “eggplant-shaped”, thin bipolar outflow shell which outlines the extended blue lobe of the bipolar outflow. The projected length and width of the shell are about 5.3 pc and 2.7 pc respectively, and the averaged projected thickness of the shell is ~ 0.3 pc. The outflow shell’s symmetry axis is inclined by $\sim 70^\circ$ with respect to the line of sight. We make a quantitative comparison of our results with the Shu *et al.* outflow model incorporating a radially directed wind, and find that this simple model naturally explains the shape of the observed shell. Although the model predicts with reasonable parameters too much mass at the smallest polar angles, as previously pointed out by Masson & Chernin, it provides a reasonable fit to the data at larger polar angles. We feel that it is possible that this discrepancy is a result of density inhomogeneities on different scales which are not considered in the current model.

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Dissertation Abstracts

Star formation: variability of pre-main sequence objects

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Ph.D degree awarded: September 1993

We have studied the optical continuum variability of 24 pre-main sequence objects and its relation to the accretion and mass loss processes.

We have selected a sample of 24 low and intermediate mass pre-main sequence objects (classical T Tauri stars and Ae/Be Herbig stars), some of which show evidences of high mass loss rate. In order to study the optical continuum variability we carried out photometric observations, UBV(RI)_c system, for four years (July 1988 - August 1992). We have also carried out spectroscopic observations of the H α region (July 1989 - August 1990).

The variable stars of our sample show an irregular continuum variability. This irregular behaviour is not an observational bias since the temporal interval between consecutive measurements is shorter than the time scale of the variations. We have proved that, despite this irregular nature we can get some conclusions on the origin of the variability from the comparison between the observational results and the stellar spots models or the inhomogeneous circumstellar model. From the results of these comparisons we find that for one classical T Tauri star the observational results can be reproduced by a cold spot and for another 5 by hot spots. Nevertheless, for these 5 stars the variability in the U band (3600 Å) cannot be reproduced by the hot spot model, there must be another mechanism that causes the anomalous behaviour at short wavelengths. The variable Ae/Be Herbig stars do not always show a regular behavior with wavelength so we can only assign an origin for the variability of two of them.

Our observational results suggest a trend: the larger the mass loss rate, the larger the amplitude of the optical continuum variations. This trend is analyzed in detail through the comparison between the amplitude of the optical continuum variations and the equivalent width of the H α emission. The optical continuum arises from the stellar photosphere, while the H α emission is assigned to the internal regions (close to the star) of the wind. For the Ae/Be Herbig stars there is not a clear relation between both quantities, but we have found a direct relation for the classical T Tauri stars: for those objects with H α equivalent width lower than 30 Å we found variations lower than 0.1 mag and for the others there is a direct relation between the continuum variability and the equivalent width of the H α emission. Taking into account the correlation found by Cabrit et al. (1990) between H α emission and the excess of infrared luminosity, that is, between mass loss and mass accretion, we conclude that there is a relation between the optical continuum variability and the accretion process: for those objects with larger accretion rate the amplitude of the variability is larger (variability due to hot spots). As has been already suggested, these hot spots could be the regions of the stellar surface where the material from the accretion disks falls.

Tidally-induced warps in the disks of young stellar objects

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Observations show that a majority of T Tauri stars are binary systems. This led us to study tidal effects induced by a stellar companion on the disk surrounding a T Tauri star.

We first calculated the tidally-induced perturbation in both cases of self-gravitating and accretion circumstellar disks. In order to obtain an analytical solution, we assumed that the perturbation was small. The amplitude of the obtained deformation then reaches 1% of the radius of the disk in the case of an accretion disk, and 10% in the case of a self-gravitating disk.

To evaluate the influence of this deformation on the spectral energy distribution, we then calculated the energy emitted in a given direction by the warped disk and its central star, taking into account the shadowing of the star by the disk and of the disk by the star.

We applied these computations to young stellar objects. In the case of small perturbations, when the separation between the two stars is greater than a hundred of astronomical units, tidal effects in circumstellar disk have a significant effect on the submillimetric range of the spectral energy distribution. We demonstrated that the energy emitted in this range is 2 to 20 times the energy emitted by a flat disk. This result will be tested by future submillimetric observations.

In order to evaluate the possible influence of tidal effects in closer binary systems, we then parametrized the deformation. This model allowed us to reproduce spectral energy distributions of T Tauri stars with strong infrared excess. Also, the resulting spectral energy distributions led us to propose a new interpretation of Class I young stellar objects: a Class I spectral energy distribution can result from hiding a T Tauri star in a warped disk. Possible observational support of this model is given by recent millimetric observations of Andre and Montmerle, who showed that the mass of matter surrounding Class I objects may not be very different from the mass of matter surrounding T Tauri stars.

Finally, we performed a preliminary study of the influence of the deformation on the accretion rate in the disk and concluded that tidal forces in the disk acts as a pseudo-viscosity that may produce disk accretion.

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