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Abstracts of recently accepted papers

Near-IR monitoring of the pre-main sequence star SSV13 October 1990 to December 1993

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We present the results of a near-IR photometric and spectroscopic monitoring campaign to further investigate the outburst of the young, pre-main sequence star, SSV13. Our dataset covers a 3 years time period and starts at the time when SSV13 first became optical visible. We find that over our monitoring period, SSV13 has remained close to its post-outburst brightness. Some brightness fluctuation, however, are detected. These have a typical (max-to-min) timescale of ~ 500 days with brightness modulations of $\sim 0.5^m$. During these variations, no significant changes in near-IR colour are observed. The spectroscopic emission features seen in SSV13 remained constant in strength over the same period. We discuss our data in relation to earlier observations and suggest that our data lend further support for the SSV13 being an EXor rather than FUor.

Accepted by Astron. Astrophys.

Near-IR imaging photometry of the J-K>4 sources in the Lk H α 101 infrared cluster

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We present J, H, K and narrow band L (nbL) near-IR (NIR) imaging photometry of the fields immediately surrounding the 16 very red objects (J-K>4) discovered by Barsony, Schombert & Kis-Halas (1991), in the immediate vicinity of the Herbig Ae/Be star Lk H α 101. Based on their location in the K vs. J-K colour-magnitude diagram, these sources were provisionally designated Class I sources i.e. highly obscured accreting protostars. Due to a lack of photometry in three NIR passbands, no detailed investigation of the thermal emission characteristics and NIR excesses in the sources could be made. Our aims here are to quantify the NIR colours of these sources, determine whether they are truly Class I sources, and further investigate the pre-main sequence (PMS) stellar population around Lk H α 101.

At $2.2\mu\text{m}$, we find 51 stellar objects to a 5σ limiting magnitude of K=16.8 within the 16 ($38'' \times 36''$ or $0.14\text{pc} \times 0.15\text{pc}$) fields around Lk H α 101. Of these stars, 47 were detected at J, H and K. A total of nine sources (including Lk H α 101) were found with J-K>4; two of these objects show a significant $2\mu\text{m}$ NIR thermal excess. At nbL, 17 of the 51 stellar objects were detected to a 5σ limiting magnitude of L=11.8. Of the nine J-K>4 sources, seven were detected at nbL, five show NIR $3\mu\text{m}$ thermal excess emission. In total, 15 out of the 51 sources ($\sim 30\%$) show evidence suggesting they are in a PMS evolutionary state.

We conclude that i) a cluster of young PMS stars does exist around Lk H α 101, confirming the discovery of Barsony, Schombert & Kis-Halas (1991), ii) a population of highly reddened (J-K>4) PMS objects are present in this cluster; determining whether these objects are true accreting protostars requires a more complete definition of their respective spectral energy distributions, and iii) NIR J-H vs. H-K colour-colour diagrams are generally incomplete in their identification of the young PMS population showing thermal NIR excess. We finally note that a complete J, H, K and nbL survey is a good way to fully explore the membership and extent of the PMS population in a region of embedded star formation.

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ROSAT HRI Observations of Hot Stars in the Orion Nebula

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ROSAT HRI observations of hot (O6-A5) stars in the Orion nebula region are presented. Fourteen of 21 O6-B5 stars were detected and all of them appear to have X-ray luminosities and L_x/L_{bol} ratios similar to field O6-B5 stars. The brightest star in the Trapezium, the O7V star θ^1 C Ori, has notable variation in its X-ray emission; the variation seems to have the same phase dependence as recently found for the star's H α emission. A maximum of six of 27 B6-A5 stars observed were detected; we argue that the most likely explanation for their X-ray emission is that it arises from unseen, low-mass binary companions.

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Near-infrared imaging of HH 1/2 in shocked molecular hydrogen and [FeII]

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We report here on near-infrared imaging of the HH 1/2 region in the H₂ v=1-0 S(1) (2.121 μm) and [FeII] (1.645 μm) lines. These observations reveal in detail the morphology of low and intermediate-velocity shocks in this area. In H₂ only the eastern boundary of the HH 1 bow shock is observed, presumably because of an asymmetrical distribution of ambient gas. Diffuse emission is also seen north-west (downstream) of HH 1. The VLA1 jet is found to be more continuous, but of a similar length compared to that in the optical. A bright H₂ knot is found along the jet. Close to, and within, HH2 we see evidence for the first time of a possible counter jet: in H₂ the faint optical tail to the north-west of HH2 is seen as a series of clumps, while a string of fainter knots runs through HH2 (and along the outflow axis) towards its south-eastern corner. Many of the H₂ knots in HH2 can be identified with corresponding optical knots, though there are clear differences in morphology and relative brightness. In particular their arc-shaped geometry in H₂ is indicative of “mini-bow shocks” which may result from a collection of “bullets” within HH 2. Features in the [FeII] images are in general similar to the brightest optical emission observed in the [SII] $\lambda\lambda$ 6717,6731 low-excitation lines.

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Multiwavelength Study of the Magnetically Active T Tauri Star HD 283447

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We observed the luminous T Tauri star HD 283447 = V773 Tauri simultaneously at X-ray, ultraviolet, optical photometric and spectroscopic, and radio wavelengths for several hours on UT 1992 September 11. *ROSAT*, *IUE*, VLA and an intercontinental VLBI network, and three optical observatories participated in the campaign. The star is known for its unusually high and variable nonthermal radio continuum emission. High levels of soft X-ray and Mg II line emission are discovered, with luminosity $L_x = 5.5 \times 10^{30}$ ergs s⁻¹ (0.2-2 keV) and $L_{MgII} = 1 \times 10^{29}$ ergs s⁻¹, respectively. Optically, the spectrum exhibits rather weak characteristics of ‘classical’ T Tauri stars. A faint broad

emission line component, probably due to a collimated wind or infall, is present.

During the campaign, the radio luminosity decreased by a factor of 4, while optical/UV lines and X-ray emission remained strong but constant. The large gyrosynchrotron emitting regions are therefore decoupled from the chromospheric and coronal emission. Five models for the magnetic geometry around the star are discussed: solar-type activity, dipole magnetosphere, star-disk magnetic coupling, disk magnetic fields, and close binary interaction. The data suggest that two magnetic geometries are simultaneously present: complex multi-polar fields like those on the Sun, and a large-scale field possibly associated with the circumstellar disk.

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Line profiles of ions with high ionization potential and the nature of the emission regions of T Tauri stars.

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We have reanalyzed high resolution IUE archival spectra of four T Tauri stars (RU Lup, T Tau, TW Hya and DR Tau) to study profiles of resonant lines of C III, C IV, Si III and Si IV ions. It was found, in contrast to widely spread opinion, that signal to noise ratio of these spectra is good enough to make at least qualitative conclusions about profiles of the most intensive spectral lines of issue. We demonstrate, for example, that both components of C IV resonant doublet have similar double peaked redshifted structure in the spectra of all investigated stars.

We argue that observed line profiles can be explained as a result of disk accretion on to young star, if its global magnetic field stops accretion disk at some distance from the stellar surface. Pre- and post-shock zones of the accretion shock wave, which appears near stellar surface are regions where emission lines of ions with high ionization potential are formed.

Accepted by Astronomy Reports (former Soviet Astronomy)

Magnetic Field Structure in Monoceros R2

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We have carried out polarimetric observations to investigate the geometry of the magnetic field in the giant molecular cloud Monoceros R2. This study is based upon deep R-band CCD polarimetry, covering a total area of 0.5 deg² of the giant molecular cloud. The data were calibrated using a new technique that relies on obtaining broad band photometry of stars simultaneously with polarimetric photometry of the Mon R2 fields, thus providing an accurate means of measuring the electric vectors of starlight which is polarized by the foreground dust grains aligned by the magnetic field in the Mon R2 GMC. In this work: (1) we were able to continuously trace magnetic field lines from the largest scales in Mon R2 to the detailed structure of the field in the dense core, as determined from infrared polarimetry, and (2) we have found that the ambient field is apparently modified by a large scale structure in the Mon R2 cloud. The mean angle of polarization for the complete sample we measured is 158 degrees, which is roughly coincident with the local Galactic magnetic field (155 degrees). The dispersion in the angle of polarization is 33 degrees, similar to that found in the Orion GMC. The dispersion in angle of polarization for stars located along the western side of the three CCD fields is 22 degrees. The CCD fields are bisected by a dense ridge of gas defining the boundary of an expanding gas-shell that recent observational results at mm wavelengths now reveal dominates the Mon R2 GMC. Our results suggest that the expanding shell has distorted the magnetic field lines extending from the core to the northern gas structure comprising Mon R2

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Evidence for HCO^+ infall toward T Tauri?

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High spectral and spatial resolution observations of the HCO^+ molecule toward the T Tau binary system obtained with the Owens Valley Millimeter Array reveal a broad emission line profile ($V_{\text{LSR}} = 7.2 \text{ km s}^{-1}$, $\Delta V = 2.0 \text{ km s}^{-1}$) upon which a narrow, redshifted absorption feature ($V_{\text{LSR}} = 8.5 \text{ km s}^{-1}$, $\Delta V \approx 0.5 \text{ km s}^{-1}$) is superposed. One possible interpretation of the absorption is that it arises from infall of molecular cloud envelope material onto the immediate circumbinary region, which would imply that large scale dynamic accretion processes are still active well into the optically visible stages of star formation. Provided the mass is deposited at radii sufficiently close to the young stars, estimates of the accretion rates indicate that infall may add enough material to the system to account for the FU Orionis type flares recently observed in T Tau in $\lesssim 100 \text{ yr}$.

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Star formation by infall of high velocity clouds on the galactic disk

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We review the observational data on prominent nearby star-formation regions like the Chamaeleon, ρOph , Orion and Taurus-Auriga-Perseus, which stand out of the galactic plane, to show that there are strong arguments in favor of a common explanation for the displacement of these molecular clouds with respect to the galactic plane in terms of impact of high-velocity clouds on the gas of the galactic disk. We propose that star formation by infall of high velocity clouds is a dominant process in the solar neighborhood. With a simple hydrodynamical model we show that recently formed stars tend to separate from the gas in which they formed, since they are no longer subject to hydrodynamical braking or acceleration, and tend to form aligned groups of stars in a sequence of ages. The model reproduces many aspects of the morphology of the cloud complexes studied, as well as the relative position of young clusters of stars associated with them, and their age sequence. Our model constitutes an alternative to the traditional sequential star formation model. A number of implications of this new interpretation of the evolution of the nearby molecular clouds are briefly discussed.

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Shock Interactions With Magnetized Interstellar Clouds.

I. Steady Shocks Hitting Nonradiative Clouds

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We study the interaction of a steady, planar shock with a nonradiative, spherical, interstellar cloud threaded by a uniform magnetic field. For strong shocks, the sonic Mach number scales out, so two parameters determine the evolution: the ratio of cloud to intercloud density, and the Alfvén Mach number. We focus on the case with initial field parallel to the shock velocity, though we also present one model with field perpendicular to the velocity. Even with 100 zones per cloud radius, we find that the magnetic field structure converges only at early times. However, we can

draw three conclusions from our work. First, our results suggest that the inclusion of a field in equipartition with the pre-shock medium can prevent the complete destruction of the cloud found in the field-free case considered by Klein, McKee, and Colella (1994). Second, the interaction of the shock with the cloud can amplify the magnetic field in some regions up to equipartition with the post-shock thermal pressure. In the parallel-field case, the shock preferentially amplifies the parallel component of the field, creating a “flux rope”, a linear structure of concentrated magnetic field. The flux rope dominates the volume of amplified field, so that laminar, rather than turbulent, amplification is dominant in this case. Third, the presence of the cloud enhances the production of X-ray and synchrotron emission. The X-ray emission peaks early, during the initial passage of the shock over the cloud, while the synchrotron emission peaks later, when the flow sweeps magnetic field onto the axis between the cloud and the main shock.

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Shock Propagation and the Generation of MHD Wave Fields in Inhomogeneous Molecular Clouds

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We develop a simple one-dimensional model for the interaction of a steady, thin, planar shock wave with a nonrigid cloud which may be in motion relative to the surrounding medium, and we apply the model to shocks impinging on, and propagating through, molecular clouds. Both “adiabatic” ($\gamma = 5/3$) and radiative ($\gamma = 1$) shocks are considered and we allow for the presence of a uniform magnetic field directed either parallel or perpendicular to the shock normal. The former field orientation is equivalent to the hydrodynamic case, and the latter involves only fast MHD shocks. We focus on the manner in which such shocks can generate internal kinetic motions in the cloud on a range of size and density scales through the direct acceleration of cores and clumps by shocks transmitted into them and through the generation of an MHD wave field via the reflection of the incident shock at the clump boundaries. We find that stronger incident Mach numbers and smaller density contrasts lead to more efficient cloud acceleration, as do isothermal intercloud shocks and small intercloud magnetic field strengths. The acceleration efficiency is insensitive to the adiabatic index and the magnetic field strength in the cloud itself. For typical parameter choices, the direct acceleration of clouds and clumps by strong shocks is found to be substantial and could at least in part account for their observed velocity dispersions. If the shocks are moderately weak, the final velocity of the cloud is linearly related to its initial velocity, with higher acceleration giving shallower slopes (i.e. final velocity distributions which are less sensitive to the initial distribution). Compared to the kinetic energy of the post-shock cloud, the energy given to the wave field at each encounter is small, and the heating of the inter-clump medium by the dissipation of this wave field is found to be insufficient to balance the cooling rate in the cloud as a whole (although it may be important in certain regions), even if this medium is warm, unless it is also extremely tenuous ($n \leq 0.1 \text{ cm}^{-3}$). Nevertheless, the correction for the velocity imparted to the cloud leads to a substantial increase in the critical incident Mach number for wave emission over that reported by Spitzer for the rigid case. The implications of our model for shock-induced star formation are discussed briefly.

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A CO and CS study of three low luminosity PMS candidates in Chamaeleon II

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We present the first maps of the $^{12}\text{CO } J = 1 \rightarrow 0$, $^{13}\text{CO } J = 1 \rightarrow 0$ and CS $J = 2 \rightarrow 1$ molecular lines of three selected PMS candidates in the nearby Chamaeleon II dark cloud: IRAS F12452–7709, IRAS F12479–7634 and IRAS 12553–7651. Our aim is to see if high density molecular material is associated with these low luminosity objects. The first two are unclassified sources detected at 60 and 100 μm only, whilst the third may be an embedded (proto)stellar

object. The three molecular lines have been detected in all three fields, except for CS in IRAS F12452–7709, for which we have a 3σ upper limit of 0.2 K. The ^{12}CO line is optically thick. It gives the kinetic temperature of the large scale molecular cloud (9 K), but does not give information on substructures associated with the FIR sources. The ^{13}CO spectra show always two line components in the three observed regions. By using the velocity information in IRAS 12553–7651 a clump around the IRAS source can be isolated from the large scale molecular cloud. In IRAS F12479–7634 the line components seem to come from two distinct molecular clouds, whose interface goes approximately through the IRAS source. In IRAS F12452–7709 ^{13}CO shows quite a complex morphology. The CS $J = 2 \rightarrow 1$ line is always very weak (0.5 K at maximum, in IRAS 12553–7651). Its emission is extended and centred on the FIR source in IRAS 12553–7651, but offset in velocity with respect to the ^{13}CO component. In IRAS F12479–7634 it peaks at a slightly offset position. Our observations suggest that IRAS 12553–7651 is indeed a young low luminosity stellar object, which has formed near the centre of a molecular condensation.

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A molecular jet and bow shock in the low mass protostellar binary NGC1333-IRAS2

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We present new molecular spectral line and (sub)millimetre continuum observations of the IRAS2 region of NGC1333. Our data locates the (sub)millimetre counterpart of the IRAS source. This source is located at the centre of symmetry of two bipolar molecular outflows. The older ‘fossil’ outflow extends approximately north–south while a younger, highly collimated, jet-like east–west outflow terminates in a well-defined molecular bow shock. Multi-transition methanol line data suggests that the molecular bow shock is very cold and that shock interactions have greatly enhanced the methanol abundance. This source provides a striking example of a molecular counterpart to the frequently observed optical Herbig-Haro type bow shock structures and provides a valuable specimen for detailed shock chemistry studies.

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Variable extinction in HD 45677 and the evolution of dust grains in pre-main sequence disks

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Changes in the UV extinction and IR emission were searched for in the Herbig Ae/Be star candidate HD 45677 (=FS CMa) by comparing ultraviolet, optical, and infrared observations made approximately 10 years apart. HD 45677 varied significantly, becoming more than 50% brighter in the ultraviolet and optical than it was a decade ago. A comparison of the observations between epochs indicates that if the variations are due to changes in dust obscuration, the dust acts as a gray absorber into the near infrared and must be depleted in grains smaller than $1 \mu\text{m}$. This is similar to the results obtained on the circumstellar disks of stars like Vega and β Pictoris, and suggests that radiation pressure may be responsible for the small-grain depletion. In addition, the total infrared flux seems to have declined, indicating a decrease in the total mass of the dust envelope that contributes to the infrared emission in this part of the spectrum. Due to the anomalous nature of the extinction, the use of normal extinction curves to deredden the spectral energy distributions of stars with circumstellar dust may lead to significant errors, and should be used with great caution.

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T Tauri Stars as Differential Rotators

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A model for rotating pre-main sequence stars is presented. The hypothesis explored here is that the lower mass T Tauri stars ($M < 1.5 M_{\odot}$), dominated by convection, are in differential rotation with the equator rotating considerably faster than the poles (consistent with the sun). In this context, weak-line T Tauri stars (WTTS), the stand-alone objects, possess surface activity in the form of starspots predominantly at low latitudes ($\pm 20^{\circ}$). In contrast, the classical T Tauri stars (CTTS), influenced by an accretion disc via a strong dipole magnetic field, are spotted only at high latitudes ($\pm 60^{\circ}$).

The many consequences are all consistent with the observations: (i) a bimodal distribution of *photometric* rotation periods with the CTTSs as the slow rotators yet (ii) no equivalent distinction between the *spectroscopic* periods of the two groups, (iii) the period relationship extends to high-mass T Tauri stars provided they maintain a significant convection zone, (iv) a fundamental difference in the spot temperature between the two classes (v) coronal and chromospheric activity, such as the X-ray emission, directly related only to the inherent stellar properties independent of the environment, (vi) abrupt changes to the light-curve period or the simultaneous presence of two distinct periods and (vii) spots on many CTTSs which are inconsistent with any orientation angle of the rotation axis if rigid rotation is assumed. Further predictions, speculations and problems are discussed based on a general Reynolds stress scheme. The large differential rotation is consistent with the generation of a dipole magnetic field capable of disrupting the innermost part of an accretion disc and directing the flow towards the poles.

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The Early Evolution of Protostellar Disks

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We consider the origin and initial growth of the disks that form around protostars during the collapse of rotating molecular cloud cores. These disks are assumed to be inviscid and pressure-free, and to have masses small compared to those of their central stars. We find that there exist three distinct components – an *outer disk*, in which shocked gas moves with comparable azimuthal and radial velocities, an *inner disk*, where material follows nearly circular orbits, but spirals slowly toward the star because of the drag exerted by adjacent infalling matter, and a turbulent *ring* adjoining the first two regions.

Early in the evolution, *i.e.*, soon after infalling matter begins to miss the star, only the outer disk is present, and the total mass accretion rate onto the protostar is undiminished. Once the outer disk boundary grows to more than 2.9 times the stellar radius, first the ring, and then the inner disk appear. Thereafter, the radii of all three components expand as t^3 . The mass of the ring increases with time, and is always 13 percent of the total mass that has fallen from the cloud. Concurrently with the buildup of the inner disk and ring, the accretion rate onto the star falls off. However, the protostellar mass continues to rise, asymptotically as $t^{1/4}$.

We calculate the radiated flux from the inner and outer disk components due to the release of gravitational potential energy. The flux from the inner disk is dominant, and rises steeply toward the stellar surface. We also determine the surface temperature of the inner disk as a function of radius. The total disk luminosity decreases slowly with time, while the contributions from the ring and inner disk both fall as t^{-2} .

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Near infrared images of galactic masers: I. Association between infrared sources and masers.

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We present the first results of an extensive near infrared survey of galactic H₂O and OH masers in high-luminosity star forming regions (SFR) aimed to see if there are near-infrared (NIR) sources directly associated with the masers. Seventeen fields for which accurate VLA positions of the masers were available have been imaged in the three J, H, and K NIR broad band filters with pixel resolution of 1.34 arcsec/pixel and a field of view of roughly 3' × 3'. All observed fields show a high density of K-band sources, completely undetected in previous surveys, probably stellar clusters located in the SFR. From numerical simulations we find that the distributions of the observed first-neighbour K-band source to the maser is very unlikely due to chance coincidence with uniformly distributed field sources. For this reason, the infrared source nearest to the maser ($\lesssim 10$ arcseconds) is considered to be associated with the maser. All these sources have distinctive characteristics: they are weak and detected only in K, or if the H magnitude is measurable, they show an H–K colour index greater than 2. Although not in all sources there are high sensitivity–high resolution radio continuum observations, only few of the K-band/maser sources are closely associated with known ultracompact (UC) H II regions. After considering several plausible alternatives we find that the observed NIR emission is produced by a young stellar object (YSO) surrounded by a dusty circumstellar envelope. In the evolutionary scheme of SFR this result places the NIR/maser sources in a stage preceding that of UCH II regions, in which the radio continuum from ionized gas is undetectable with present sensitivities either because so much reduced by self-absorption or by dust absorption of stellar UV photons in the very dense envelope of the YSO or intrinsically weak due to low UV photon fluxes.

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Dense Cores in Dark Clouds. IX. Observations of ¹³CO and C¹⁸O in Vela, Chamaeleon, Musca, and the Coalsack.

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One hundred one condensations with average optical size less than 7 arc minutes and visual extinction greater than 2.5 mag have been selected from ESO J plates, extinction maps, and catalogs of southern hemisphere dark clouds for observation in the ¹³CO and C¹⁸O J:1-0 transitions. These regions are condensations in the dark molecular clouds Musca, Coalsack, Chamaeleon II, Chamaeleon III, and cometary globules in Vela and the Gum nebula.

A search for IRAS point sources shows that these condensations have at most seven associated young stellar objects - far fewer than in Taurus and Ophiuchus. These 101 condensations generally have lower ¹³CO and C¹⁸O line intensity, C¹⁸O optical depth, and ¹³CO line width than do 90 condensations in Taurus, Ophiuchus, and Cepheus. Similarly, 47 of these southern condensations having star-count estimates of visual extinction generally have less extinction than do the 19 condensations in Taurus having extinction estimated by the same method.

The ¹³CO to C¹⁸O line width ratio for the cometary globules in the Vela region is greater than for the other clouds, indicating that the ¹³CO linewidth observed toward dark cloud condensations is related to the more extended and less dense inter-condensation gas. Radial velocities suggest that the system of Vela globules has velocity dispersion 4.7 kms⁻¹, with is at least two times greater than the dispersion determined from formaldehyde observations. The Musca filament has velocities which are slightly higher, by 0.5 kms⁻¹, in the center than at the ends of the filament. Chamaeleon III has 0.2 kms⁻¹pc⁻¹ velocity gradient, and Chamaeleon II has no indication of velocity gradients. The Chamaeleon clouds and the Musca filament appear close to virial equilibrium.

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Multiple Scattering of Polarized Radiation in Circumstellar Dust Shells

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On the basis of recently developed modification of the Monte Carlo approach (the method of symmetrized trajectories), a numerical code for the transfer of the polarized radiation in circumstellar shells has been created. This code allows to study light scattering by dust grains in prolate or oblate spheroidal shells of a moderate optical thickness ($\tau \leq 5 - 8$) seen at various angles. The description of the Monte Carlo approach and various tests are presented. The extensive calculations were performed for the cases of Rayleigh scattering (grain albedo $\Lambda = 0.1, 0.5,$ and 1.0) and Mie scattering (silicate-graphite mixtures, wavelength range $1000 \text{ \AA} - 1 \mu\text{m}$). The dependencies of the intensity and polarization on the parameters of dust grains and homogeneous circumstellar shells are examined.

It was found that the light scattered by circumstellar dust is a noticeable fraction of the observed stellar radiation in the visual and ultraviolet spectral regions. The fraction of scattered radiation grows with increasing Λ and decreasing the shell semiaxes ratio. The ratio of the scattered radiation intensity to the direct stellar one has a maximum at about $2000 - 3000 \text{ \AA}$ and can reach $I_{\text{sca}}/I_* \approx 0.3 - 0.4$ for the uniform oblate spheroidal shell. In some cases, the summary influence of the scattered radiation and the circumstellar (and interstellar) extinction can produce the wavelength independent extinction curves. Such curves cannot be analyzed by the colour-excess method.

The degree of linear polarization usually does not exceed $1 - 2 \%$ and has a weak wavelength dependence in the visual and red regions of the spectrum. At the ultraviolet wavelengths, the polarization has a maximum in the region of the bump ($\lambda \approx 2200 \text{ \AA}$) and a minimum at $\lambda \approx 1800 - 2000 \text{ \AA}$.

We have also considered the case of the screening of stellar radiation by dense circumstellar clouds which occurs for some young stars (e.g., Herbig Ae/Be stars). If only the scattered radiation is observed, the upper limit on the stellar brightness variations is of $1^{\text{m}} - 2^{\text{m}}$ in the ultraviolet and $3^{\text{m}} - 4^{\text{m}}$ in the red wavelength region. The maximum degree of linear polarization grows with increasing wavelength and can reach $8 - 10 \%$.

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CO and CI observations of shock excited gas in IC443

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The blast-wave at the edge of the supernova remnant IC443 is colliding with nearby quiescent gas. In this paper a multi-transition study of CO $J = 1 \rightarrow 0 \rightarrow 4 \rightarrow 3$ is presented of one of these clouds, IC443C, and the detection of atomic carbon, *CI*, reported. The CO is optically thin with $T_{\text{ex}} \sim 45\text{K}$, a *measured* isotopic ratio $[\text{CO}]/[^{13}\text{CO}] = 80$, and $N(\text{CO}) \sim 2 - 4 \cdot 10^{17} \text{ cm}^{-2}$. Atomic carbon emission was detected *for the first time in shocked gas* only towards the IC443C *C*-shocked region, with an abundance ratio $[\text{CI}]/[\text{CO}] \sim 1.3 - 2.9$. *CI* is overabundant by \sim one order of magnitude compared with quiescent molecular cloud cores, suggesting that shock(s), or an enhanced cosmic ray flux density, has increased the $[\text{CI}]/[\text{CO}]$ ratio. A narrow CO absorption line towards the shocked region IC443G has $T_{\text{ex}} \sim 13\text{-}18\text{K}$, and $n(\text{H}_2) \sim 2\text{-}3 \cdot 10^3 \text{ cm}^{-3}$, which may be typical of conditions in the pre-shock gas.

The detailed conclusions are;

a) The CO emission from IC443C is optically thin, with a ratio $[\text{CO}]/[^{13}\text{CO}] = 80$; close to the terrestrial isotope ratio. The column densities towards IC443C1 and C2 agree within a factor of two using either the optically thin integrated emission of ^{13}CO , or by LVG modelling of the CO $J = 1 \rightarrow 0 \rightarrow 4 \rightarrow 3$ line ratios. There is no selective enhancement of the C^{18}O abundance ≥ 50 percent. The value of the CO excitation temperature is $\sim 45\text{K}$, and the column densities towards IC443C1 and IC443C2 are $= 2.3 \cdot 10^{17} \text{ cm}^{-2}$ and $3.8 \cdot 10^{17} \text{ cm}^{-2}$ respectively.

b) Atomic carbon emission is detected in the *C*-shocked gas of IC443C2, but not in the *J*-shocked region IC443C1. The abundance ratio $[\text{CI}]/[\text{CO}]$ is $< 0.4 - 0.8$ and $\sim 1.3 - 2.9$ towards IC443C1 and IC443C2 respectively, hence *CI*

emission is overabundant by an order of magnitude in IC443C2 relative to that of quiescent cloud cores, suggesting that shock(s), or an enhanced cosmic ray flux density has been important in increasing the $[CI]/[CO]$ ratio.

c) A narrow line seen in absorption against the shocked region IC443G is found to be typical of gas in a quiescent molecular cloud, with $T_{ex} \sim 13-18K$, and a gas density $\sim 2-3 \cdot 10^3 \text{ cm}^{-3}$, and is probably illustrative of conditions in the pre-shock material surrounding IC443.

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This issue and all past issues of the Star Formation Newsletter are available, each as an individual file in LaTeX format, by anonymous ftp from [ecf.hq.eso.org](ftp://ecf.hq.eso.org) (134.171.11.4) in directory /pub/star-formation. The contents of all issues are additionally free-text searchable using WAIS, a publicly available information retrieval package. A file in the above anonymous ftp directory, called WAIS-FAQ.txt, provides further details on WAIS. The procedure to follow is also described in a 'readme' file.

Meetings

10th IAP Astrophysics Meeting
EARA Astrophysics Meeting

Circumstellar Dust Disks and Planet Formation

4 – 8 July 1994

Institut d'Astrophysique, Paris

The study of disks around both pre-main sequence and main sequence stars is a rapidly expanding area of research. Detailed observations over many wavelengths are allowing characterization of the prototypical disk around Beta Pictoris, and the number of main-sequence stars known to possess disks is increasing. These disks are far less bright than the disks seen about most T-Tauri stars. The differences between these systems whether due to planetary accretion or ejection of material from the systems, provides constraints on the planet formation process. The conference will focus on dust disks around main sequence stars, their relationship to disks around pre-main sequence stars and the implications of the evolution of circumstellar disks for the process of planetary growth.

I. Observations

- A. Beta Pic
- B. Other Stars
- C. Solar System Analogs

II. Models

- A. Steady-state particle creation
- B. Inner boundary - a planet?
- C. Falling evaporating bodies

III. Planet Formation

- A. General scaling laws
- B. Jupiter's effect on the evolution of the solar system
- C. Stability of orbital configurations
- D. Very early solar system
- E. Extra solar planets search techniques

Scientific organizing committee:

P. Feldman (Johns Hopkins, Baltimore), R. Ferlet (IAP), A.-M. Lagrange (Grenoble), J. Lissauer (SUNY, Stony Brook), A. Omont (IAP), T. Owen (U. of Hawaii), B. Sicardy (Meudon), A. Vidal-Madjar (IAP).

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FIRST ANNOUNCEMENT

Conference on

DISKS AND OUTFLOWS AROUND YOUNG STARS

Honoring Prof. Hans Elsässer

Sept. 6 – 9, 1994
Heidelberg, Germany

Scientific Organizing Committee

S. Beckwith (Chair, Heidelberg), C. Bertout (Grenoble), C. Lada (Cambridge, MA), A. Natta (Florence), T. Ray (Dublin), S. Strom (Amherst)

Local Organizing Committee

R. Blythe, J. Fried, A. Glindemann, Ch. Leinert, C. Marien, R. Mundt (Chair), A. Quetz, J. Staude

Topics

The major topics of the meeting will deal with observational and theoretical results on: gas and dust envelopes around young stellar objects (YSOs), protoplanetary and accretion disks, disk formation, disk winds, FU Orionis stars and their outbursts, atomic/molecular winds and outflows from YSOs, Herbig-Haro objects, YSO jets.

Format

The meeting will consist of 6 sessions, each with one invited review talk of 1 hour's duration (including discussion), and 4 – 5 contributed talks of 25 minutes' duration (including discussion). The conference will highlight poster presentations for which ample viewing time will be allocated.

Invited Speakers

A. Königl (theory of outflows), R. Mundt (observations of outflows and jets), F. Palla (YSOs in general), J. Pringle (disk theory), A. Sargent (disk observations), F. Shu (evolution of disks and outflows).

Location

Heidelberg is an old University town famous for its castle and its beautiful location in the Neckar valley. The climate in early September is usually very pleasant.

Contact Address for further information

Those people interested in receiving further information through the Second Announcement (to be issued at the end of April) are asked to send a short message with their *complete* postal and e-mail address by April 8 to:

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