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Abstracts of recently accepted papers

A CS and NH_3 Survey of Regions with H_2O Maser Emission

Guillem Anglada[1], Robert Estalella[1], Josefa Pastor[1], Luis F. Rodríguez[2] and Aubrey D. Haschick[3]

[1] Departament d'Astronomia i Meteorologia, Universitat de Barcelona, Av. Diagonal 647, E-08028 Barcelona, Spain
[2] Instituto de Astronomía, UNAM, Apdo. Postal 70-264, 04510 México, D.F., Mexico
[3] Haystack Observatory, Off Route 40, Westford, MA 01886, USA

E-mail contact: guillem@fareb1.am.ub.es

We present CS(J=1→0) and NH_3(1,1) observations towards 172 different star forming regions (99 observed in both molecules) associated with H_2O maser emission. We make a comparative study between the physical parameters obtained from the CS and NH_3 spectra, and their relationship with the H_2O maser emission. We compare the detection rates, line intensities, line widths and central velocities of the CS and NH_3 emissions. We find a relationship between the velocity range of the H_2O maser emission and its luminosity, being the masers with high velocity components more luminous than masers without high velocity components, suggesting that the maser pumping mechanism is related to kinetic energy dissipated when small maser condensations move through the molecular cloud. We find that both the CS and the NH_3 lines are significantly wider in regions with H_2O masers than in other regions. Furthermore, for the first time, we find evidence that these line widths increase with the H_2O maser luminosity. These results suggest that the presence of H_2O maser emission is intrinsically associated with an increase of the thermal and turbulent energy of the ambient cloud, in agreement with the current models which propose that the H_2O maser emission originates in shocked regions, such as those associated with the outflows from young stellar objects.

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(a postcript copy of the paper, masersp.ps, is available via anonymous ftp to fareb1.am.ub.es in the /pub directory)

Wave Propagation in Molecular Clouds

Dinshaw S. Balsara

National Center for Supercomputing Applications University of Illinois at Urbana Champaign, USA

We study the linear propagation of waves in a partially ionized, magnetized, self-gravitation plasma. Three dispersion studies are presented. The first study is carried out in the strong coupling approximation without self-gravity. The second is done for the strong coupling approximation with self-gravity. The third is done in the two fluid approximation where the strong coupling approximation is dropped. The eigenvectors for ideal, isothermal MHD are also constructed and examined. They provide important insights into the results that we obtain from the stability analysis.

We find that for parameters typical of molecular clouds, where the Alfven speed exceeds the sound speed, the slow waves propagate without significant damping on short wavelengths while the fast and Alfven waves undergo rapid damping. Moreover, as the angle between the direction of propagation of the slow waves and the magnetic field is reduced the damping of the slow waves is reduced. When this angle is zero the waves propagate undamped. By examining the structure of the eigenvectors for ideal, isothermal MHD we show these propagation characteristics of the waves at short wavelengths to be physically justified. At long wavelengths the slow waves bifurcate into a pair of modes, one of which is purely growing and the other is purely damped. Thus the gravitational collapse is carried entirely by the slow family of waves. The fast and Alfven waves propagate without significant damping at long wavelengths. From the two fluid dispersion analysis we find the length scale where the single fluid approximation breaks down and examine wave propagation for wavelengths shortward of that wavelength.

These results allow us to see why observed line profiles in molecular clouds indicate turbulent motions that are supersonic but sub-Alfenic. We build up an analog of the Reynolds number for partially ionized plasmas. We show it to be physically well justified. We realize that weak turbulence in a molecular cloud cannot be Alfvenic on length scales of interest. Further insights into the nature of turbulence in partially ionized, magnetized, self-gravitationg plasmas are also gained from this work. We build up a dimensionless number called the "turbulent pressure support to gravitational collapse number". When this number drops below unity the turbulent pressure support to the self-gravitation gas is diminished. We identify gravitational collapse as an alternative source for sustaining the turbulence when energy input from massive star formation is not available. This provides an explanation for the fact that the Maddalena-Thaddeus molecular cloud has significant line widths even though it shows little or no evidence for massive star formation

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Evolution of outflow activity around low-mass embedded young stellar objects

S. Bontemps[1], P. André[1], S. Terebey[2] and S. Cabrit[3,4]

[1] CEA/DAPNIA, Service d'Astrophysique, C.E. Saclay, F-91191 Gif-sur-Yvette Cedex, France
[2] IPAC 100-22, Caltech, Pasadena, CA 91125, USA
[3] Observatoire de Grenoble, BP 53, F-38041 Grenoble Cedex, France
[4] DEMIRM, Observatoire de Paris, 61 Av. de l'Observatoire, F-75014 Paris, France

E-mail contact: bonte@ariane.saclay.cea.fr

We present a detailed study of outflow activity in a sample of 45 low-luminosity embedded young stellar objects (YSOs). We use maps in the J=2–1 line of ^{12}CO to characterize this activity for YSOs that are still sufficiently embedded to show molecular outflows. Our CO outflow survey benefits from coordinated millimeter continuum measurements of circumstellar masses which allow us to estimate the evolutionary states of the central driving sources. Our sample comprises 36 near-IR (Class I) protostars and 9 far-IR/submm (Class 0) protostars, and should be representative of the "self-embedded" phase of (low-mass) protostellar evolution characterizing young stars still surrounded by significant circumstellar envelopes. We find that virtually all the objects in our sample have detectable CO outflow activity. We make homogeneous estimates of the outflow momentum flux deposited in the close environment of the driving sources in order to assess the dynamical properties of the underlying driving winds/jets. As is well-known, a tight correlation between outflow energetics and driving source luminosity is found for Class I sources. However, Class 0 sources lie a factor of ~ 10 above this correlation, suggesting they have qualitatively different (e.g., more powerful) CO outflows. In addition, we find that the outflow momentum flux correlates well with the circumstellar envelope mass of the exciting source for *both* Class I and Class 0 sources. We show that this new correlation is independent of the $F_{\rm CO}$–$L_{\rm bol}$ correlation and most likely results from a more or less continuous decrease of outflow power with time during the accretion phase. For a young star of final mass ~ 0.6 M$_\odot$, the outflow momentum flux is typically $F_{\rm CO} \sim 10^{-4}$ M$_\odot$km s^{-1}yr^{-1} at the early Class 0 stage and $F_{\rm CO} \sim 2\times10^{-6}$ M$_\odot$km s^{-1}yr^{-1} at the late Class I stage. We suggest that this decrease of outflow energetics reflects a corresponding decay in the mass accretion/infall rate.

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A Monthly Survey of Water Masers Associated with Low Mass Stars

M. J Claussen[1], B. A. Wilking[2], P. J. Benson[3], H. A. Wootten[4], P. C. Myers[5] and S. Terebey[6]

[1] National Radio Astronomy Observatory, Socorro, NM
[2] Department of Physics and Astronomy, Univ. Missouri-St. Louis, St. Louis, MO
[3] Whitin Observatory, Wellesley College, Wellesley, MA
[4] National Radio Astronomy Observatory, Charlottesville, VA
[5] Harvard-Smithsonian Center for Astrophysics, Cambridge, MA
[6] IPAC, JPL, Caltech, Pasadena, CA

E-mail contact: mclausse@nrao.edu

We have performed a multi-epoch survey of water masers toward low-luminosity young stellar objects. These objects were selected to be in an early phase of stellar evolution based on IRAS colors and association with molecular outflows or dense cores. The sample was restricted to YSOs in nearby clouds (d $\leq$450 pc) with luminosities < 120 $L_\odot$.

Seven new sources of maser emission have been found resulting in a total of 22 YSOs with L < 120 $L_\odot$ known to display maser activity. We present monitoring data (at least two epochs of observation) for 47 sources. Four objects were monitored on a semi-regular basis for more than 5 years. Based on a coherent 13-month subset of this survey, we estimate that the maser phase in low-mass embedded sources occupies about one-third of the duration of the embedded phase of evolution. Some spectrally isolated water maser features are seen to appear and disappear on timescales less than about 2 months. This characteristic timescale is consistent with shock crossing times for reasonable values of the shock velocity and size, and is thus suggestive that the masers originate in the shocked gas. Some embedded sources can have long periods of inactivity ($\sim$ 5 years) when no masers are seen to our detection limit. Sources with stronger masers and more complex spectra can maintain emission over this same time period. We determined threshold values of the CO mass-loss rate (4×10^{-5} $\dot{M}_\odot$ yr^{-1}), 6 cm radio luminosity (0.25 kpc^2 mJy), and the IRAS in-band luminosity (25 $L_\odot$) above which water masers were always detected.

The isotropic luminosity of the water masers in any given source can vary over more than two orders of magnitude in a period of several months. Thus a single epoch measurement of this luminosity may provide a misleading result, especially if compared to other physical parameters such as the bolometric luminosity.

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Sheet Models of Protostellar Collapse

Lee Hartmann[1], Nuria Calvet[1,2,3], and Alan Boss [4]

[1] Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, USA
[2] Five College Astronomy Department, Amherst, MA, USA
[3] On leave from Centro de Investigaciones de Astronomia, Mérida, Venezuela [4] DTM, Carnegie Institution of Washington, 5241 Broad Branch Rd., NW, Washington, DC 20015-1305, USA

E-mail contact: lhartmann@cfa.harvard.edu

Recognizing that protostellar clouds are unlikely to be completely spherical, we explore some effects of initial cloud geometry by considering collapse from a sheet initially in hydrostatic equilibrium. A qualitatively different feature of sheet collapse compared with spherical contraction is the development of relatively evacuated cavities in the infalling dusty cloud, which arise because material falls in first along the shortest dimension to the central gravitating mass. Using analytic models of collapse which reproduce the main features of our previous numerical time-dependent simulations, we perform detailed radiative transfer calculations which suggest that these collapse cavities can naturally explain the morphological appearance of many reflection nebulae around young stars on small distance scales without requiring initially diverging outflows. Sheet collapse models can simultaneously explain small-scale reflection nebula morphologies and dust envelope emission properties of many young stellar objects more easily than the standard spherical collapse models. The sheet collapse picture suggests that protostars, i.e. young stellar objects still accreting a large fraction of their mass from infalling envelopes, may be optically visible over a substantial range of system inclinations to the line of sight. These results may be especially relevant to cases where fragmentation and collapse has been triggered by an external impulse, such as a shock wave. We show how many properties of the flat-spectrum T Tauri star HL Tau can be intepreted in terms of flattened protostellar cloud collapse, and draw some distinctions between the flattened toroids resulting in our calculations and the "pseudodisk" of Galli & Shu.

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Giant Molecular Cloud Complexes with Optical HII Regions: ^{12}CO and ^{13}CO Observations and Global Cloud Properties

M.H. Heyer[1], J.M. Carpenter[2], E.F. Ladd[1]

[1] Five College Radio Astronomy Observatory, Lederle Research Building, University of Massachusetts, Amherst, MA 01003, USA
[2] Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, USA

E-mail contact: heyer@fcrao1.phast.umass.edu

Images of ^{12}CO and ^{13}CO J=1-0 emission from the molecular clouds associated with the optical HII regions Sh 155, Sh 235, and Sh 140 are presented to better understand the interstellar gas conditions associated with regions of massive star formation. In the vicinity of the HII regions, there is evidence for the compression of ambient molecular material from shocks associated with the expansion of the ionized gas component and the near complete photoionization or photodissociation of molecular material within the HII region. However, the images also show that most of the molecular mass of the clouds resides within the extended, low column density regions well removed from the localized sites of star formation. Each cloud is characterized by a global line width which is dominated by the relative motions between resolved cloud substructures rather than motions along the line of sight inferred from individual profile line widths. We identify a relationship of the observed profile line widths with molecular gas column density which is consistent with opacity broadening of an intrinsic line width nearly independent with column density. Thus any tendency for neighboring emitting components to be at the same velocity (i.e. spatial coherence to the velocity field) must be weak or absent within CO emitting regions of these clouds. In the context of a clumpy cloud medium, we use the variations of profile line width and antenna temperature with column density to derive the following limits to clump properties: clumps masses less than 0.01 $M_\odot$; clump sizes less than 4×10^{16} cm; and clump volume densities greater than 1×10^{4} cm^{-3}.

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A Cluster of Class 0 Protostars in Serpens: An IRAS HIRES Study

Robert L. Hurt and Mary Barsony

Physics Department, University of California, Riverside, CA 92521 USA

We present new 12, 25, 60, & 100 μm HIRES-processed IRAS images of the nearby Serpens star-forming cloud core at FWHM resolutions of $\sim 30''$–$1'$. We use HIRES-processed point-source models of the IRAS emission to derive new flux values and flux upper limits for all the protostellar candidates in the Serpens core. Our fluxes (and flux upper limits) determine the spectral energy distributions (SED's) necesssary to derive the dust temperature, circumstellar mass, bolometric luminosity, and evolutionary status of each protostellar candidate. Remarkably, we find all five sources studied by Hurt, Barsony, & Wootten (1996): FIRS1, SMM4, S68N, SMM3, and SMM2, to share the defining characteristics of Class 0 protostars, the short-lived (a few $\times$ 10^4 yr) earliest observable protostellar stage (André, Ward-Thompson, & Barsony 1993; Barsony 1994). We can also set an upper limit of 8 $L_\odot$ on the pre-outburst bolometric luminosity of the recently discovered "FU Ori" source in this region (Hodapp 1995).

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Direct imaging of circumstellar disks in the Orion Nebula

Mark J. McCaughrean[1] and C. Robert O'Dell[2]

[1]Max-Planck-Institut für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany
E-mail: mjm@mpia-hd.mpg.de
[2]Department of Space Physics and Astronomy, Rice University, P.O. Box 1892, Houston TX 77251, USA
E-mail: cro@spacsun.rice.edu

Recent surveys of the Orion Nebula with the Hubble Space Telescope have revealed a number of stars surrounded by dark silhouettes seen projected against the bright background H II region. In this paper, we present a detailed analysis of HST and ground-based observations of the six most distinct silhouettes. We find a variety of morphologies, all consistent with thin circumstellar disks spanning a range of diameters (50 to 1000 AU) and inclination angles (0 to >80 degrees). The silhouette intensity profiles cannot be fit by standard disk models in which the surface density follows a radial power law with an exponent in the range −0.75 to −1.5. Rather, the data are best fit by opaque inner disks with exponential edges, and we discuss possible physical origins of this apparent truncation. Masses in the range 6×10^{26}–4×10^{30} g (*i.e.*, up to 0.002 $M_\odot$) are determined for the disks by assuming that the faint light measured from them is background light transmitted through the disk. However, we argue that these are strict lower limits on the true disk masses, as most of this light can be accounted for by PSF blurring and scattering in the HST optical train, and that the present observations are in fact consistent with completely opaque disks. Central stars are seen directly in five of the silhouettes, while the presence of a star is inferred in the sixth, where small reflection nebulae are seen above and below the plane of the near edge-on disk. Optical and near-infrared stellar photometry is consistent with young ($\sim 1\,$Myr) low-mass (0.3–1.5 $M_\odot$) stars, with several showing evidence for excess near-infrared emission from the disk inner edge.

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(A preprint version of this paper may be obtained via anonymous `ftp` or the World Wide Web. For the former, connect to `spitfire.mpia-hd.mpg.de`, login as `ftp`, using your e-mail address as password, `cd preprints`, and `get README` for further instructions. Using WWW, connect to `http://spitfire.mpia-hd.mpg.de/Preprints.html` and follow the relevant links to this paper.)

Kinematic Diagnostics of Disks Around Young Stars: CO Overtone Emission from WL 16 & 1548C27

Joan Najita[1], John S. Carr[2], Alfred E. Glassgold[3], Frank H. Shu[1], & Alan T. Tokunaga[4]

[1] Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, USA
[2] Remote Sensing Division, Naval Research Laboratory, Code 7217, Washington, DC 20375-5351, USA
[3] Physics Department, New York University, 4 Washington Place, New York, NY 10003, USA
[4] Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, USA

E-mail contact: jnajita@cfa.harvard.edu

We report high spectral resolution observations of the CO vibrational overtone emission from the young stellar object 1548C27; our observations include both the CO(2-0) and CO(5-3) bandhead regions. These data and similar observations of the young stellar object WL16, reported in a previous contribution, provide some of the most compelling evidence to date for the existence of inner disks around young stars. We describe the simple procedure that we use to synthesize bandhead emission from disks including the effect of thermal dissociation of CO and non-LTE excitation of the vibrational levels. Using this spectral synthesis procedure to extract the kinematics and physical properties of the emitting gas from the overtone data, we show how these high signal-to-noise data are also powerful probes of the stellar and inner disk properties of these systems. Our modeling is consistent with the identification of WL 16 and 1548C27 as Herbig AeBe stars with stellar masses of approximately 2 and 4 $M_\odot$, respectively. Thus, the kinematic signature of rotating disks in the overtone spectra of these sources provide strong support for the role of accretion disks in the formation of *intermediate mass* stars. For both WL 16 and 1548C27, we interpret our modeling results as indicating that the overtone emission arises from a temperature inversion region in the inner disk atmosphere. We also find evidence for suprathermally broadened lines and are able to place useful constraints on the radial temperature and column density distributions of the CO line-formation region of the disk atmosphere. Given these deduced properties, we discuss the constraints that our observations place on the physical processes responsible for the overtone emission in these sources.

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HH 110: The grazing collision of a Herbig-Haro flow with a molecular cloud core

Bo Reipurth[1], A.C. Raga[2] and Steve Heathcote[3]

[1] European Southern Observatory, Casilla 19001, Santiago 19, Chile
[2] Instituto de Astronomía, UNAM, Apartado postal 70-264, Ciudad Universitaria, 04510 México D.F., México
[3] Cerro Tololo Inter-American Observatory, National Optical Astronomy Observatories, Casilla 603, La Serena, Chile

The HH 110 jet is a major collimated Herbig-Haro flow in Orion. Despite careful searches at optical, infrared and sub-mm wavelengths, attempts to find the driving source along its well defined flow axis have failed. We present deep large-field interference-filter CCD images which reveal the presence of another fainter HH flow, here labelled HH 270, to the north-east of HH 110. This flow is driven by an embedded near-infrared source, which is possibly identical to the 5 $L_\odot$ embedded class I source IRAS 05489+0256. We propose that the source driving HH 270 is also responsible for HH 110, and that the HH 270 flow suffers a grazing collision with the dense molecular cloud core from which HH 110 is seen to emerge. This collision deflects and shocks the flow so that it re-appears as HH 110. This scenario is supported by geometric and kinematic evidence: firstly, the HH 270 flow axis points towards the beginning of HH 110;

secondly, proper motion measurements of the brightest knot in HH 270, knot A, reveal a large tangential motion of 300 km/sec directly towards HH 110 knot A, the apex of this flow; thirdly, HH 110 knot A has a two-component structure consisting of a *head* and a *neck*, the former moving in the direction defined by the HH 270 flow, and the latter in the direction of the HH 110 flow, suggesting that we here see directly the point of impact and deflection. Moreover, there is evidence for weak shocks approximately parallel with the HH 110 flow, which appear to be due to separate collisions with obstructions in the flow.

We assume that the HH 270/110 flow is not far from the plane of the sky, an assumption supported by the high proper motion of HH 270 A and the low radial velocity of HH 110. The observed angle between HH 270 and HH 110 (58°), is then close to the true deflection angle which results from the flow collision. Using the observed velocities and the analytical models of Cantó et al. (1988), we find theoretically that the deflection angle should be about 62°. The similarity of these values supports the idea that HH 110 is the result of a grazing collision of the HH 270 flow with a cloud core.

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VLA Detection of the Exciting Sources of HH 34, HH 114, and HH 199

L.F. Rodríguez[1] and Bo Reipurth[2]

[1] [1] Instituto de Astronomia, UNAM, Apdo. Postal 70-264, 04510 México, D.F., México
[2] European Southern Observatory, Casilla 19001, Santiago 19, Chile

We present sensitive VLA observations at 3.6-cm of four Herbig-Haro fields: HH 34, HH 114, HH 199, and HH 212. In all fields but the last we detect radio sources that are probably associated with the exciting source of the region. In the case of HH 34, our detection of a radio counterpart supports the notion that newborn stars which are actively producing HH flows generally emit in the cm radio continuum at levels that are detectable with a moderately long (a few hours) integration made with the VLA. In the HH 114 field, we detect independent sources associated with both an IRAS source and a millimeter object in the region. Our present observations cannot favor either of the sources as the dominant exciting object in the region. Finally, in HH 199 we detect a source that could be a thermal jet or an unresolved radio binary and that is associated with the IRAS source in the field.

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Angular Momentum Transport in Accretion Disks via Convection

James M. Stone[1] and Steven A. Balbus[2]

[1] Department of Astronomy, University of Maryland, College Park, MD 20742-2421, USA; e-mail: jstone@astro.umd.edu
[2] Virginia Institute of Theoretical Astronomy, Department of Astronomy, University of Virginia, PO Box 3818, Charlottesville, VA 22903, USA

In this paper, we investigate, by three-dimensional hydrodynamical simulations, the role that vertical convective motions play in providing angular momentum transport in a Keplerian disk. We begin by deriving simple and general analytic constraints upon the correlated radial and azimuthal velocity fluctuation tensor, critical to the direction of energy and angular momentum transport. When azimuthal pressure gradients are small, as is often the case for incompressible turbulence in a shearing disk, the constraints are particularly straightforward and striking: they imply there can be no net outward transport in a steady flow. (More precisely, any steady transport which is present must be due to the explicit forcing by azimuthal pressure gradients.) Furthermore, numerical simulations show inward transport even in disks characterized by solid body rotation, which are quite far from axisymmetric. If the kinetic energy of rotational velocity fluctuations increases with time due to coupling with the mean flow (as in an instability), the relationship suggests (and our numerical simulations confirm) that in a Keplerian disk the Reynolds stress is negative, i.e. that the angular momentum and energy transport is inward. The analogous relationship for shearing but non-rotating (Cartesian) flow displays the *opposite* sign for the fluctuation tensor, i.e., an increase in the "streamwise" velocity fluctuations is associated with outward (from higher momentum to smaller momentum) transport. Although Cartesian shear flows are known to be extremely sensitive to disruption by nonlinear secondary instabilities, hydrodynamical calculations presented here demonstrate that Keplerian disk flows show no such inclination. We suggest that the key to understanding this critical difference is the very different nature of the interaction between the mean flow and the transport in each system. We provide a physical interpretation of our findings in terms of the role epicyclic oscillations

play in mediating angular momentum transport.

We base our convection simulations upon a reproducible analytic expression for the vertical profile of an unstable equilibrium state in a stratified disk. The nonlinear evolution of the convective cells is then followed after the initial profile is perturbed. Convection can be sustained only if an *ad hoc* source of heating is added to the disk midplane. The net transport associated with steady convection is small, and on average inward. A comparison between the volume averaged Reynolds stress and the time rate of change of the azimuthal kinetic energy associated with fluctuations in the rotational velocity shows remarkable agreement with our simple analytic predictions.

Taken as a whole, these results offer little hope that convection — or any other form of incompressible hydrodynamic turbulence — is likely to be a significant source of angular momentum transport in nonmagnetic disks. Coherent pressure forcing by, e.g., spiral density waves, remains a viable option.

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Optical, infrared and millimetre-wave properties of Vega-like systems

R.J. Sylvester[1], C.J. Skinner[2], M.J. Barlow[1] and V. Mannings[1]

[1] Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT, UK
[2] Institute of Geophysics & Planetary Physics, L-413, Lawrence Livermore National Laboratory, PO Box 808, Livermore, CA94551-9900, USA

E-mail contact: rjs@star.ucl.ac.uk

Vega-like stars are main-sequence stars that exhibit excess infrared emission due to dust grains which are believed to be distributed in circumstellar discs. To facilitate modelling of the properties of the discs and of their constituent grains, we have assembled a new observational database for a large sample of candidate Vega-like systems, which comprises *UBVRI* optical photometry, *JHKLL′M* near-IR photometry, mid-IR spectra, and mm/submm-wave photometry.

Although our sample of stars are all believed to be main-sequence, it is noteworthy that most have large IR excesses compared with the 'prototype' Vega-like stars, and they may therefore be somewhat younger. The excess fluxes are, in a few cases, greater than can be explained by emission from pure radiation-reprocessing discs, even in the optically thick case, suggesting additional contributions by extended envelopes and/or flux generated by viscous dissipation in a flared accretion disc.

The dereddened optical colours are, for the whole sample, entirely consistent with photospheric emission from main-sequence stars. The near-IR photometry revealed that 9 out of 23 Vega-like sources exhibit excess near-IR emission with colours resembling those of Herbig Ae/Be systems, while the rest show only photospheric emission at near-IR wavelengths.

Our mid-IR spectra reveal that most of the discs show combinations of silicate and unidentified infrared (UIR) emission features, demonstrating the presence of both oxygen- and carbon-rich dust species. Our new mm/submm photometry indicates that most of the sample display small mm-wave spectral indices, implying that they possess grains that are much larger than those found in the interstellar medium, with implications for past or on-going grain growth within the discs.

Fractional excess luminosities, $L_{\rm IR}/L_\star$, were calculated from the optical photometry. For some of our sources, values $\sim 10^{-5} - 10^{-3}$ were found, similar to those of the prototype Vega-like systems. Others gave $L_{\rm IR}/L_\star > 0.25$, the maximum value for a flat passively reprocessing disc. Two sources gave $L_{\rm IR}/L_\star > 0.5$, the maximum for a flared reprocessing disc. These large values are comparable to those of Herbig Ae/Be and T Tauri stars, and suggest that some of the excess IR emission from these sources is due to disc accretion or the presence of circumstellar envelopes.

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The Thermal Radio Jet of Cepheus-A HW2 and the Water Maser Distribution at 0.08″ Scale (60 AU)

José M. Torrelles[1], José F. Gómez[1], Luis F. Rodríguez[2], Salvador Curiel[2], Paul T. P. Ho[3], and Guido Garay[4]

[1]Instituto de Astrofísica de Andalucía, CSIC, Ap. Correos 3004,
C/ Sancho Panza S/N, E-18080 Granada, Spain.
[2]Instituto de Astronomía, UNAM, Ap. Postal 70-264, 04510 México, D.F., México.
[3]Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[4]Departamento de Astronomía, Universidad de Chile, Casilla 36-D, Santiago, Chile

E-mail contact: torrelles@iaa.es

We report observations of the thermal radio jet in Cepheus-A HW2, and the associated water masers, carried out with the highest (0.08 arcsec) angular resolution available to date at the VLA (A-configuration at $\lambda = 1.3$ cm). To calibrate the 1.3 cm continuum emission, we used the strong ($\sim$ 1000 Jy) H_2O maser source as the reference, thus correcting the amplitude and phase instabilities introduced by the atmosphere. This powerful technique, first applied here to a star-forming region, allowed us to achieve a dynamic range of 15,000:1 for the strongest maser feature, a S/N of 70:1 for the radio jet and an accuracy of the order of one *mas* in the relative positions between the radio-continuum jet and the H_2O masers in the region. We resolved the 1.3 cm jet into two maxima, plus a fainter tail to the southwest. The separation between these two maxima (0.14 arcsec), and the total size of the jet (0.39 arcsec) are both consistent with models for a biconical ionized jet. The observed flux density (39 mJy) is, however, higher than expected. We detected 39 H_2O maser spots toward the Cepheus A region, 28 of which are associated with the HW2 object, most of them distributed on either sides of the radio jet. We suggest that these latter maser features might be tracing a circumstellar molecular disk of radius $\sim$ 300 AU, nearly perpendicular to the radio jet. The velocity gradient of 30 $\pm$ 10 km s^{-1} observed in the H_2O spots over 600 AU along the axis perpendicular to the radio jet could be gravitationally bound by a central mass of 70$\pm$40 $M_\odot$.

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Exact Analytic Solutions for Stellar Wind Bow Shocks

Francis P. Wilkin[1]

[1] Astronomy Department, University of California, Berkeley, CA 94720

E-mail contact: fwilkin@astro.berkeley.edu

Stellar wind bow shocks have been seen in association with a wide variety of stellar objects from pulsars to young stars. A new solution method is presented for bow shocks in the thin-shell limit, stressing the importance of the conserved momentum within the shell. This method leads to exact analytic solutions to the classical problem of Baranov, Krasnobaev & Kulikovskii (1971). Simple formulae are given for the shell shape, mass column density and velocity of shocked gas at all points in the shell. These solutions will facilitate detailed comparison between observed sources and bow shock models.

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Dissertation Abstracts

Three-Dimensional Parallel Lattice Boltzmann Hydrodynamic Simulations of Turbulent Flows in Interstellar Dark Clouds

Dirk Muders

Thesis work conducted at: Max-Planck-Institut für Radioastronomie, Bonn

Current address: Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

Electronic mail: DMuders@MPIfR-Bonn.MPG.de

Ph.D dissertation directed by: Johannes Schmid-Burgk, MPIfR

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Exploring the clumpy and filamentary structure of interstellar molecular clouds is one of the key problems of modern astrophysics. So far, we have little knowledge of the physical processes that cause the structure, but turbulence is suspected to be essential. In this thesis I study turbulent flows and how they contribute to the structure of interstellar dark clouds. To this end, three-dimensional numerical hydrodynamic simulations are needed since the detailed turbulent spatial and velocity structure cannot be analytically calculated. I employ the "Lattice Boltzmann Method", a recently developed numerical method which solves the Boltzmann equation in a discretized phase space. Mesoscopic particle packets move with fixed velocities on a Cartesian lattice and at each time step they exchange mass according to given rules. Because of its mainly local operations the method is well suited for application on parallel or clustered computers.

As part of my thesis I have developed a parallelized "Lattice Boltzmann Method" hydrodynamics code. I have improved the numerical stability for Reynolds numbers of up to $10^{4.5}$ and Mach numbers of up to 0.9 and I have extended the method to include a second miscible fluid phase. The code has been used on the three currently most powerful workstations at the "Max-Planck-Institut für Radioastronomie" in Bonn and on the massively parallel mainframe CM-5 at the "Gesellschaft für Mathematik und Datenverarbeitung" in St. Augustin. The simulations consist of collimated shear flows and the motion of molecular clumps through an ambient medium. The dependence of the emerging structure on Reynolds and Mach numbers is studied.

The main results are (1) that distinct clumps and filaments appear only at the transition between laminar and fully turbulent flow at Reynolds numbers between 500 and 5000 and (2) that *subsonic* viscous shear flows are capable of producing the dark cloud velocity structure. The unexpectedly low Reynolds numbers can be explained by the enlargement of the gas viscosity by magnetic fields of the order $10\mu G$ and the strong coupling between ionized and neutral gas. The occurrence of well-defined structure between the highly ordered laminar and the chaotic turbulent flow regimes can be interpreted in the framework of the "Edge of Chaos", i.e. the tendency of complex systems to show self-organization only at the transition between phases. In order to compare the simulations with observed data I have used the 100m radio telescope at Effelsberg to map the ground transition of sulphur monoxide toward the quiescent cold dark cloud L1512. The data show a clumpy structure that I interpret as a turbulent tail behind the dense central cloud.

This thesis is available on the World Wide Web. The PostScript file including 15 full color figures can be obtained at:

http://WWW.MPIfR-Bonn.MPG.de/iram/dmuders/dmuders.html

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HST Key Programs

HST has in recent years produced remarkable results in the field of star formation, and is likely to be an essential facility for our field in the coming years, particularly with new instruments like NICMOS and STIS. Bob Williams of STScI has just issued a request for suggestions and ideas on new and fundamental problems that HST can tackle and which will require large amounts of observing time over the next 3 years. This is a precursor to a Call for Key Programs for Cycles 7 - 9. All suggestions submitted will be discussed in a meeting in March. You can access his letter at http://www.stsci.edu/stsci.html (select Key Programs for Cycles 7-9). A convenient form to submit suggestions is also available at this site. Now is a good time to start thinking about the opportunities that HST will provide us, and a large response from the star formation community would certainly be very desirable.

Corrigenda

Gremlins were at work in the December issue of the Newsletter. The WWW address for the meeting *From Stardust to Planetesimals* should be www-space.arc.nasa.gov/~stardust, and for the *Meteoritical Society Meeting* the e-mail contact is dieter=stoeffler@museum.hu-berlin.de. Steve Skinner kindly provided these corrections.