THE STAR FORMATION NEWSLETTER

An electronic publication dedicated to early stellar evolution and molecular clouds

No. 182 — 22 Dec 2007 Editor: Bo Reipurth (reipurth@ifa.hawaii.edu)

Abstracts of recently accepted papers

A Survey for Massive Giant Planets in Debris Disks with Evacuated Inner Cavities

D. Apai[1,2], M. Janson[3], A. Moro-Martin[4], M. R. Meyer[1,2], E. E. Mamajek[5], E. Masciadri[6], Th. Henning[3], I. Pascucci[1], J. S. Kim[1], L. A. Hillenbrand[7], M. Kasper[8] and B. Biller[1]

[1] Steward Observatory, University of Arizona, AZ 85721, USA
[2] Laplace Team, NASA Astrobiology Institute
[3] Max Planck Institute for Astronomy, Koenigstuhl 17, Heidelberg, Germany
[4] Department of Astrophysical Sciences, Peyton Hall, Ivy Lane, Princeton University, Princeton, NJ 08544, USA
[5] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[6] INAF - Astrophysical Observatory Arcetri, Italy
[7] California Institute of Technology, Pasadena, CA 91125, USA
[8] European Southern Observatory, Garching, D-85748, Germany

E-mail contact: apai *at* as.arizona.edu

The commonality of collisionally replenished debris around main-sequence stars suggests that minor bodies are frequent around Sun-like stars. Whether or not debris disks in general are accompanied by planets is yet unknown, but debris disks with large inner cavities — perhaps dynamically cleared — are considered to be prime candidates for hosting large-separation massive giant planets. We present here a high-contrast VLT/ NACO angular differential imaging survey for eight such cold debris disks. We investigated the presence of massive giant planets in the range of orbital radii where the inner edge of the dust debris is expected. Our observations are sensitive to planets and brown dwarfs with masses $> 3 - 7$ Jupiter mass, depending on the age and distance of the target star. Our observations did not identify any planet candidates. We compare the derived planet mass upper limits to the minimum planet mass required to dynamically clear the inner disks. While we cannot exclude that single giant planets are responsible for clearing out the inner debris disks, our observations constrain the parameter space available for such planets. The nondetection of massive planets in these evacuated debris disks further reinforces the notion that the giant planet population is confined to the inner disk (<15 AU).

Accepted by Astrophysical Journal

http://arxiv.org/abs/0710.0206

Gamma-ray emission from massive young stellar objects

A. T. Araudo[1,2], G. E. Romero[1,2], V. Bosch-Ramon[3], and J. M. Paredes[4]

[1] Instituto Argentino de Radioastronomía, C.C.5, (1894) Villa Elisa, Buenos Aires, Argentina
[2] Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque, 1900 La Plata, Argentina
[3] Max Planck Institut für Kernphysik, Saupfercheckweg 1, Heidelberg 69117, Germany
[4] Departament d'Astronomia i Meteorologia, Universitat de Barcelona, Martí i Franquès 1, 08028, Barcelona, Spain

E-mail contact: aaraudo *at* fcaglp.unlp.edu.ar

Context. Massive stars form in dense and massive molecular cores. The exact formation mechanism is unclear, but it is possible that some massive stars are formed by processes similar to those that produce the low-mass stars, with

accretion/ejection phenomena occurring at some point of the evolution of the protostar. This picture seems to be supported by the detection of a collimated stellar wind emanating from the massive protostar IRAS 16547-4247. A triple radio source is associated with the protostar: a compact core and two radio lobes. The emission of the southern lobe is clearly non-thermal. Such emission is interpreted as synchrotron radiation produced by relativistic electrons locally accelerated at the termination point of a thermal jet. Since the ambient medium is determined by the properties of the molecular cloud in which the whole system is embedded, we can expect high densities of particles and infrared photons. Because of the confirmed presence of relativistic electrons, inverse Compton and relativistic Bremsstrahlung interactions are unavoidable.

Aims. We aim to make quantitative predictions of the spectral energy distribution of the non-thermal spots generated by massive young stellar objects, with emphasis on the particular case of IRAS 16547-4247.

Methods. We study the high-energy emission generated by the relativistic electrons which produce the non-thermal radio source in IRAS 16547-4247. We also study the result of proton acceleration at the terminal shock of the thermal jet and make estimates of the secondary gamma rays and electron-positron pairs produced by pion decay.

Results. We present spectral energy distributions for the southern lobe of IRAS 16547-4247, for a variety of conditions. We show that high-energy emission might be detectable from this object in the gamma-ray domain. The source may also be detectable in X-rays through long exposures with current X-ray instruments.

Conclusions. Gamma-ray telescopes such as GLAST, and even ground-based Cherenkov arrays of new generation can be used to study non-thermal processes occurring during the formation of massive stars.

Published by Astronomy & Astrophysics (Vol. 476, p. 1289)

GS263-02+45: a new HI supershell with evidence of having triggered star formation?

E. M. Arnal[1,2] and M. Corti[2,3]

[1] Instituto Argentino de Radioastronomía (IAR), C.C. No. 5, 1894 Villa Elisa, Argentina
[2] Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina
[3] Instituto de Astrofísica de La Plata (IALP), CONICET, Argentina

E-mail contact: arnal *at* iar.unlp.edu.ar

Aims. We look for galactic neutral hydrogen (HI) supershells likely to be associated with massive star groupings.

Methods. A neutral hydrogen (HI) line survey carried out at the Instituto Argentino de Radioastronomía (IAR) and the Southern Galactic Plane Survey (SGPS) were the main databases used in this investigation.

Results. A new HI supershell (GS263-02+45) was found in the outer part of the Galaxy. This structure is located at a distance of 5.3 $\pm$ 1 kpc from the Sun and has a linear diameter of about 665 $\pm$ 40 pc. The expansion velocity of the supershell is $\sim$14 km s^{-1}. The total amount of atomic gas related to GS263-02+45 is $\sim$2 $\times 10^6 M_\odot$. Based on the analysis of the SGPS HI data it is concluded that the OB-association Bochum 7 is likely to be interacting with GS263-02+45. This fact together with distance and age arguments may indicate that Bochum 7 was born as a consequence of the evolution of GS263-02+45.

Published by Astronomy & Astrophysics (Vol. 476, p. 255)

η Muscae: a young detached binary with two identical components

V. Bakiş[1], H. Bakiş[1], Z. Eker[1] and O. Demircan[1]

[1] Çanakkale Onsekiz Mart University Observatory, Terzioğlu Campus, TR-17040, Çanakkale, Turkey

E-mail contact: bakisv *at* comu.edu.tr

High-resolution (λ/d$\lambda \sim$ 41000) echelle spectra of the multiple system η Muscae were analysed. Precise spectroscopic orbital elements of the close pair η Muscae-A were obtained by means of two techniques; cross-correlation and spectral disentangling. The updated light elements of the close pair were derived using new photometric and spectroscopic data together with Hipparcos ephemerides. According to simultaneous studies of radial velocities with Hipparcos light curve and recent and historic light curves in Strömgren bands, η Mus-A consists of two quasi-identical components:

$M_1 = 3.30\ M_\odot$, $M_2 = 3.29\ M_\odot$, $R_1 = 2.14\ R_\odot$, $R_2 = 2.13\ R_\odot$, $T_1 = 12\,700$ K and $T_2 = 12\,550$ K separated from each other by a = 14.11 $R_\odot$ in an orbit inclined 77°.4 . The membership of η Mus-A to the Lower CentaurusCrux OB association is discussed. The rotational velocity of the primary component was found to be smaller than that of the secondary component. The asynchronous slow rotation of the primary and the synchronous rotation of the secondary imply a recent decrease in the orbital period, either due to orbital angular momentum being transferred to the visual companion η Mus-C or due to relatively frequent stellar encounters in this crowded region. The visual companion η Mus-B is found to be gravitationally unbound to the close pair η Mus-A. The radial velocity measurements of the visual companion η Mus-B, when combined with its positional information, support its membership to the Lower CentaurusCrux OB association, but the evidence for membership of η Mus-A is weaker.

Published by Monthly Notices of the Royal Astronomical Society (Vol. 382, p. 609)

Tides and the Evolution of Planetary Habitability

Rory Barnes[1], Sean N. Raymond[2], Brian Jackson[1] and Richard Greenberg[1]

[1] Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA
[2] Center for Astrophysics and Space Astronomy, University of Colorado, Boulder, CO 80309, USA

E-mail contact: rory *at* lpl.arizona.edu

Tides raised on a planet by its host star's gravity can reduce a planet's orbital semi-major axis and eccentricity. This effect is only relevant for planets orbiting very close to their host stars. The habitable zones of low-mass stars are also close-in and tides can alter the orbits of planets in these locations. We calculate the tidal evolution of hypothetical terrestrial planets around low-mass stars and show that tides can evolve planets past the inner edge of the habitable zone, sometimes in less than 1 billion years. This migration requires large eccentricities (> 0.5) and low-mass stars (< 0.35 solar masses). Such migration may have important implications for the evolution of the atmosphere, internal heating and the Gaia hypothesis. Similarly, a planet detected interior to the habitable zone could have been habitable in the past. We consider the past habitability of the recently-discovered, 5 Earth-mass planet, Gliese 581 c. We find that it could have been habitable for reasonable choices of orbital and physical properties as recently as 2 Gyr ago. However, when we include constraints derived from the additional companions, we see that most parameter choices that predict past habitability require the two inner planets of the system to have crossed their mutual 3:1 mean motion resonance. As this crossing would likely have resulted in resonance capture, which is not observed, we conclude that Gl 581 c was probably never habitable.

Accepted by Astrobiology

On the nature of outflows in intermediate-mass protostars: a case study of IRAS 20050+2720

M. T. Beltrán[1], R. Estalella[1], J. M. Girart[2], P. T. Ho[3,4] and G. Anglada[5]

[1] Departament d'Astronomia i Meteorologia, Universitat de Barcelona, Martí i Franquès 1, 08028 Barcelona, Catalunya, Spain
[2] Institut de Ciències de l'Espai (CSIC-IEEC), Campus UAB, Facultat de Ciències, Torre C-5, 08193, Bellaterra, Catalunya, Spain
[3] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[4] Academia Sinica, Institute of Astronomy and Astrophysics, P.O. Box 23–141, Taipei 106, Taiwan
[5] Instituto de Astrofísica de Andalucía, CSIC, Camino Bajo de Huétor 50, 18008 Granada, Spain

E-mail contact: mbeltran *at* am.ub.es

Context. This is the third of a series of papers devoted to study in detail and with high-angular resolution intermediate-mass molecular outflows and their powering sources.
Aims. The aim of this paper is to study the intermediate-mass YSO IRAS 20050+2720 and its molecular outflow, and put the results of this and the previous studied sources in the context of intermediate-mass star formation.
Methods. We carried out VLA observations of the 7 mm continuum emission, and OVRO observations of the 2.7 mm continuum emission, CO (J=1$\rightarrow$0), $C^{18}O$ (J=1$\rightarrow$0), and HC_3N (J=12$\rightarrow$11) to map the core towards IRAS 20050+2720. The high-angular resolution of the observations allowed us to derive the properties of the dust emission, the molecular outflow, and the dense protostellar envelope. By adding this source to the sample of intermediate-

mass protostars with outflows, we compare their properties and evolution with those of lower mass counterparts.
Results. The 2.7 mm continuum emission has been resolved into three sources, labeled OVRO 1, OVRO 2, and OVRO 3. Two of them, OVRO 1 and OVRO 2, have also been detected at 7 mm. OVRO 3, which is located close to the $C^{18}O$ emission peak, could be associated with IRAS 20050+2720. The mass of the sources, estimated from the dust continuum emission, is 6.5 $M_\odot$ for OVRO 1, 1.8 $M_\odot$ for OVRO 2, and 1.3 $M_\odot$ for OVRO 3. The CO (J=1→0) emission traces two bipolar outflows within the OVRO field of view, a roughly east-west bipolar outflow, labeled A, driven by the intermediate-mass source OVRO 1, and a northeast-southwest bipolar outflow, labeled B, probably powered by a YSO engulfed in the circumstellar envelope surrounding OVRO 1.
Conclusions. The multiplicity of sources observed towards IRAS 20050+2720 appears to be typical of intermediate-mass protostars, which form in dense clustered environments. In some cases, as for example IRAS 20050+2720, intermediate-mass protostars would start forming after a first generation of low-mass stars has completed their main accretion phase. Regarding the properties of intermediate-mass protostars and their outflows, they are not significantly different from those of low-mass stars. Although intermediate-mass outflows are intrinsically more energetic than those driven by low-mass YSOs, when observed with high-angular resolution they do not show intrinsically more complex morphologies. Intermediate-mass protostars do not form a homogeneous group. Some objects are likely in an earlier evolutionary stage as suggested by the infrared emission and the outflow properties.

Accepted by A&A

http://arxiv.org/abs/0712.1757 or http://www.am.ub.es/∼robert/Papers.html♯last

Accretion funnels onto weakly magnetized young stars

N. Bessolaz[1], C. Zanni[1], J. Ferreira[1], R. Keppens[2,3,4] and J. Bouvier[1]

[1] Laboratoire d'Astrophysique de Grenoble, Université Joseph Fourier, CNRS UMR5571, France
[2] Centre for Plasma Astrophysics, K.U.Leuven, Belgium
[3] FOM Institute for Plasma Physics, Rijnhuizen, the Netherlands
[4] Astronomical Institute, Utrecht University, the Netherlands

E-mail contact: Nicolas.Bessolaz *at* obs.ujf-grenoble.fr

Aims. We re-examine the conditions required to steadily deviate an accretion flow from a circumstellar disc into a magnetospheric funnel flow onto a slow rotating young forming star.
Methods. New analytical constraints on the formation of accretion funnels flows due to the presence of a dipolar stellar magnetic field disrupting the disc are derived. The Versatile Advection Code is used to confirm these constraints numerically. Axisymmetric MHD simulations are performed, where a stellar dipole field enters the resistive accretion disc, whose structure is self-consistently computed.
Results. The analytical criterion derived allows to predict a priori the position of the truncation radius from a non perturbative accretion disc model. Accretion funnels are found to be robust features which occur below the co-rotation radius, where the stellar poloidal magnetic pressure becomes both at equipartition with the disc thermal pressure and is comparable to the disc poloidal ram pressure. We confirm the results of Romanova et al. 2002 and find accretion funnels for stellar dipole fields as low as 140 G in the low accretion rate limit of $10^{-9} M_\odot.yr^{-1}$. With our present numerical setup with no disc magnetic field, we found no evidence of winds, neither disc driven nor X-winds, and the star is only spun up by its interaction with the disc.
Conclusions. Weak dipole fields, similar in magnitude to those observed, lead to the development of accretion funnel flows in weakly accreting T Tauri stars. However, the higher accretion observed for most T Tauri stars ($\dot{M} \sim 10^{-8} M_\odot.yr^{-1}$) requires either larger stellar field strength and/or different magnetic topologies to allow for magnetospheric accretion.

Accepted by Astronomy and Astrophysics

Kinematics of a hot massive accretion disk candidate

H. Beuther[1] and A. Walsh[2]

[1] Max Planck Institute for Astronomy, Königstuhl 17, 69117 Heidelberg, Germany
[2] Centre for Astronomy, James Cook University, Townsville, QLD 4811 Australia

E-mail contact: beuther *at* mpia.de

Characterizing rotation, infall and accretion disks around high-mass protostars is an important topic in massive star formation research. With the Australia Telescope Compact Array and the Very Large Array we studied a massive disk candidate at high angular resolution in ammonia (NH_3(4,4) & (5,5)) tracing the warm disk but not the envelope. The observations resolved at $\sim 0.4''$ resolution (corresponding to $\sim$1400 AU) a velocity gradient indicative of rotation perpendicular to the molecular outflow. Assuming a Keplerian accretion disk, the estimated protostar-disk mass would be high, similar to the protostellar mass. Furthermore, the position-velocity diagram exhibits additional deviation from a Keplerian rotation profile which may be caused by infalling gas and/or a self-gravitating disk. Moreover, a large fraction of the rotating gas is at temperatures >100 K, markedly different to typical low-mass accretion disks. In addition, we resolve a central double-lobe cm continuum structure perpendicular to the rotation. We identify this with an ionized, optically thick jet.

Accepted by Astrophysical Journal Letters

http://www.mpia.de/homes/beuther/papers.html

Discovery of an extremely-high velocity, massive and compact molecular outflow in Norma

Leonardo Bronfman[1], Guido Garay[1] Manuel Merello[1], Diego Mardones[1], Jorge May[1], Kate J. Brooks[2], Lars-Åke Nyman[3], and Rolf Güsten[4]

[1] Departamento de Astronomía, Universidad de Chile, Casilla 36-D, Santiago, Chile
[2] Australia Telescope National Facility, P.O. Box 76, Epping NSW 1710, Australia
[3]European Southern Observatory, Casilla 19001, Santiago, Chile
[4]Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany

E-mail contact: guido *at* das.uchile.cl

G331.5−0.1 in the Norma spiral arm is one of the most luminous and extended cores of a GMC, containing at least six massive and dense dust condensations. Here we report the discovery, from observations of several sub-millimeter molecular lines made using the Atacama Submillimeter Telescope (ASTE) and the Atacama Pathfinder Experiment Telescope (APEX), of an unresolved, extremely-high velocity molecular outflow towards the brighter and most massive dust condensation. The outflow is massive and energetic (flow mass $\sim 55 M_\odot$, momentum $\sim 2.4\times10^3$ $M_\odot$ km s^{-1} and kinetic energy $\sim 1.4\times10^{48}$ erg). These values are characteristic of flows driven by young massive stellar objects with $L_{bol}\sim 1\times10^5$ $L_\odot$. We also report the detection, using ATCA, of a compact radio continuum source located at the center of the outflow and therefore likely to be its driving energy source. It has an spectral index between 4.8 and 8.6 GHz of 1.1 ± 0.2, suggesting it might corresponds to a collimated jet.

Accepted by ApJ

Mid-Infrared Photometry and Spectra of Three High Mass Protostellar Candidates at IRAS 18151-1208 and at IRAS 20343+4129

M. F. Campbell[1], T. K. Sridharan[2], H. Beuther[3], J. H. Lacy[4], J. L. Hora[2], Q. Zhu[5], M. Kassis[6], M. Saito[7], J. M. De Buizer[8], S. H. Fung[1] and L. C. Johnson[1]

[1] Department of Physics and Astronomy, Colby College, Waterville, ME 04901, USA
[2] Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[3] Max-Planck-Institut für Astronomie, Königstuhl 17, Heidelberg, Germany D-69117
[4] Department of Astronomy, University of Texas, Austin, TX 78712, USA
[5] Center for Imaging Science, Rochester Institute of Technology, Rochester, NY 14623, USA
[6] W. H. Keck Observatory, 65-1120 Mamalahoa Highway, Kamuela, HI 96743, USA
[7] National Astronomical Observatory of Japan, Osawa 2-21-1, Mitaka, Tokyo 181-8588, Japan
[8] Gemini Observatory, Casilla 603, La Serena, Chile

E-mail contact: mfcampbe *at* colby.edu

We present arcsecond-scale mid-IR photometry (in the 10.5 μm N band and at 24.8 μm), and low resolution spectra in the N band ($R\simeq 100$) of a candidate high mass protostellar object (HMPO) in IRAS 18151-1208 and of two HMPO candidates in IRAS 20343+4129, IRS 1 and IRS 3. In addition we present high resolution mid-IR spectra ($R \simeq 80000$) of the two HMPO candidates in IRAS 20343+4129. These data are fitted with simple models to estimate the masses of gas and dust associated with the mid-IR emitting clumps, the column densities of overlying absorbing dust and gas, the luminosities of the HMPO candidates, and the likely spectral type of the HMPO candidate for which [Ne II] 12.8 μm emission was detected (IRAS 20343+4129 IRS 3). We suggest that IRAS 18151-1208 is a pre-ultracompact HII region HMPO, IRAS 20343+4129 IRS 1 is an embedded young stellar object with the luminosity of a B3 star, and IRAS 20343+4129 IRS 3 is a B2 ZAMS star that has formed an ultracompact HII region and disrupted its natal envelope.

Accepted by Astrophysical Journal, Part I, for 2008 February 10

http://arxiv.org/abs/0710.3754v1

The environs of the H II region Gum 31

C. Cappa[1,2], V. S. Niemela[1,3], R. Amorín[4], and J. Vasquez[1,2]

[1] Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina
[2] Instituto Argentino de Radioastronomía, C.C. 5, 1894 Villa Elisa, Argentina
[3] Instituto de Astrofísica de La Plata, La Plata, Argentina
[4] Instituto de Astrofísica de Canarias, Spain

E-mail contact: ccappa *at* fcaglp.fcaglp.unlp.edu.ar

Aims. We analyze the distribution of the interstellar matter in the environs of the H II region Gum 31, excited by the open cluster NGC 3324, located in the complex Carina region, with the aim of investigating the action of the massive stars on the surrounding neutral material.

Methods. We use neutral hydrogen 21-cm line data, radio continuum images at 0.843, 2.4 and 4.9 GHz, ^{12}CO(1-0) observations, and IRAS and MSX infrared data.

Results. Adopting a distance of 3 kpc for the H II region and the ionizing cluster, we derived an electron density of 33 ± 3 cm^{-3} and an ionized mass of ($3.3 \pm 1.1) \times 10^3$ $M_\odot$ based on the radio continuum data at 4.9 GHz. The H I 21-cm line images revealed an H I shell surrounding the H II region. The H I structure is 10.0 $\pm$ 1.7 pc in radius, has a neutral mass of 1500 $\pm$ 500 $M_\odot$, and is expanding at 11 km s^{-1}. The associated molecular gas amounts to ($1.1 \pm 0.5) \times 10^5$ $M_\odot$, being its volume density of about 350 cm^{-3}. This molecular shell could represent the remains of the cloud where the young open cluster NGC 3324 was born or could have originated by the shock front associated with the H II region. The difference between the ambient density and the electron density of the H II region suggests that the H II region is expanding.

The distributions of the ionized and molecular material, along with that of the emission in the MSX band A, suggest that a photodissociation region has developed at the interface between the ionized and molecular gas. The copious UV photon flux from the early type stars in NGC 3324 keeps the H II region ionized.

The characteristics of a relatively large number of the IRAS, MSX, and 2MASS point sources projected onto the molecular envelope are compatible with protostellar candidates, showing the presence of active star forming regions. Very probably, the expansion of the H II region has triggered stellar formation in the molecular shell.

Published by Astronomy & Astrophysics (Vol. 477, p. 173)

A Multiple System of Radio Sources at the Core of the L723 Multipolar Outflow

Carlos Carrasco-Gonzalez[1], Guillem Anglada[1], Luis F. Rodriguez[2], Jose M. Torrelles[3], Mayra Osorio[1] and Jose M. Girart[4]

[1] Instituto Astrofisica Andalucia, CSIC, Camino Bajo de Huetor 50, E-18008 Granada, Spain
[2] Centro de Radioastronomia y Astrofisica, UNAM, Apartado Postal 3-72 (Xangari), 58089 Morelia, Michoacan, Mexico
[3] Instituto de Ciencias del Espacio (CSIC) and Institut d'Estudis Espacials de Catalunya, Facultad de Fisica, Planta 7a, Universitat de Barcelona, Av. Diagonal 647, E-08028 Barcelona, Spain

[4] Instituto de Ciencias del Espacio (CSIC) and Institut d'Estudis Espacials de Catalunya, Campus UAB, Facultat de Ciencies, Torre C-5 parell, E-08193 Bellaterra, Spain

E-mail contact: charly *at* iaa.es

We present high angular resolution Very Large Array multi-epoch continuum observations at 3.6 cm and 7 mm towards the core of the L723 multipolar outflow revealing a multiple system of four radio sources suspected to be YSOs in a region of only 4 arcsecs (1200 AU) in extent. The 3.6 cm observations show that the previously detected source VLA 2 contains a close (separation 0.29 arcsecs or 90 AU) radio binary, with components (A and B) along a position angle of 150 degrees. The northern component (VLA 2A) of this binary system is also detected in the 7 mm observations, with a positive spectral index between 3.6 cm and 7 mm. In addition, the source VLA 2A is associated with extended emission along a position angle of 115 degrees, that we interpret as outflowing shock-ionized gas that is exciting a system of HH objects with the same position angle. A third, weak 3.6 cm source, VLA 2C, that is detected also at 7 mm, is located 0.7 arcsecs northeast of VLA 2A, and is possibly associated with the water maser emission in the region. The 7 mm observations reveal the presence of an additional source, VLA 2D, located 3.5 arcsecs southeast of VLA 2A, and with a 1.35 mm counterpart. All these radio continuum sources have a positive spectral index, compatible with them being YSOs. We also propose that the high velocity CO emission observed in the region could be the superposition of multiple outflows (at least three independent bipolar outflows) excited by the YSOs located at the core, instead of the previous interpretations in terms of only one or two outflows.

Accepted by The Astrophysical Journal

http://arxiv.org/abs/0712.1454

Curved Herbig-Haro Jets: Simulations and Experiments

A. Ciardi[1], D. J. Ampleford[2], S. V. Lebedev[3] and C. Stehle[1]

[1] Observatoire de Paris, LERMA, 92195, Meudon, France
[2] Sandia National Laboratories, Albuquerque, NM 87123-1106, USA
[3] Blackett Laboratory, Imperial College, London SW7 2BW, United Kingdom

E-mail contact: a.ciardi *at* imperial.ac.uk

Herbig-Haro jets often show some degree of curvature along their path, in many cases produced by the ram pressure of a side-wind. We present simulations of both laboratory and astrophysical curved jets and experimental results from laboratory experiments. We discuss the properties and similarities of the laboratory and astrophysical flow, which show the formation of internal shocks and working surfaces. In particular the results illustrate how the break-up of the bow-shock and clumps in the flow are produced without invoking jet variability; we also discuss how jet rotation reduces the growth of the Rayleigh-Taylor instability in curved jets.

Accepted by The Astrophysical Journal

http://arxiv.org/abs/0712.0959

Testing the Disk Regulation Paradigm with Spitzer Observations. II. A Clear Signature of StarDisk Interaction in NGC 2264 and the Orion Nebula Cluster

Lucas Cieza[1] and Nairn Baliber[2]

[1] Astronomy Department, University of Texas at Austin, 1 University Station C1400, Austin, TX 78712, USA
[2] Las Cumbres Observatory Global Telescope, 6740 Cortona Drive, Suite 102, Goleta, CA 93117; and University of California, Santa Barbara, CA, USA

E-mail contact: lcieza *at* astro.as.utexas.edu

Observations of premainsequence star rotation periods reveal slow rotators in young clusters of various ages, indicating that angular momentum is somehow removed from these rotating masses. The mechanism by which spinup is regulated as young stars contract has been one of the longest standing problems in star formation. Attempts to observationally confirm the prevailing theory that magnetic interaction between the star and its circumstellar disk regulates these rotation periods have produced mixed results. In this paper, we use the unprecedented disk identification capability of the Spitzer Space Telescope to test the stardisk interaction paradigm in two young clusters, NGC 2264 and the Orion

Nebula Cluster (ONC). We show that once mass effects and sensitivity biases are removed, a clear increase in the disk fraction with period can be observed in both clusters across the entire period range populated by cluster members. We also show that the longperiod peak ($P \sim 8$ days) of the bimodal distribution observed for highmass stars in the ONC is dominated by a population of stars possessing a disk, while the shortperiod peak ($P \sim 2$ days) is dominated by a population of stars without a disk. Our results represent the strongest evidence to date that stardisk interaction regulates the angular momentum of these young stars. This study will make possible quantitative comparisons between the observed period distributions of stars with and without a disk and numerical models of the angular momentum evolution of young stars.

Published by The Astrophysical Journal (Vol. 671, p. 605)

The radial structure of protostellar accretion disks: influence of the jets

C. Combet[1] and J. Ferreira[1]

[1] Laboratoire d'Astrophysique de Grenoble, BP 53, 38041 Grenoble Cedex 9, France

E-mail contact: celine.combet *at* astro.le.ac.uk

The radial structure of accretion disks is a fundamental issue regarding star and planet formation. Many theoretical studies, focussing on different aspects such as e.g. disk emissivity or ionization, have been conducted in the context of the standard accretion disk (SAD) model, where no jet is present. We wish to calculate the structure of young stellar object (YSO) accretion disks in an approach that takes into account the presence of the protostellar jets. The radial structure of these jet emitting disks (JED) should then be compared to that of standard accretion disks. The analytical treatment used in this work is similar to that of standard accretion disks but uses the parameter space of magnetised accretion-ejection structures that include the jet torque on the underlying disk. In this framework, the analytical expressions of key quantities are derived, such as midplane temperatures, surface densities or disk aspect ratio. We find that JEDs present a structure very different from the SADs and that can be observationally tested. The implications on planet formation in the inner regions of accretion disks are briefly discussed. We also supply sets of analytical formulae, valid in different opacity regimes, for the disk quantities. These expressions can be readily used for any work where the disk structure is needed as an input for the model.

Accepted by A&A

http://arxiv.org/abs/0712.0913

Complex Organic Materials in the Circumstellar Disk of HR 4796A

John H. Debes[1] and Alycia J. Weinberger[1]

[1] Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015, USA
[2] Steward Observatory, The University of Arizona, Tucson, AZ 8572, USA

E-mail contact: debes *at* dtm.ciw.edu

We combine HST/NICMOS imaging photometry of the HR 4796A disk at previously unobserved wavelengths between 1.71-2.22μm with reprocessed archival observations to produce a measure of the dust's scattering efficiency as a function of wavelength. The spectrum of the dust, synthesized from the seven photometric measures, is characterized by a steep red slope increasing from 0.5 μm to 1.6 μm followed by a flattening of the spectrum at wavelengths > 1.6 μm. We fit the spectrum with a model population of dust grains made of tholins, materials comprised of complex organic materials seen throughout the outer parts of our Solar System. The presence of organic material around a star that may be in the later stages of giant planet formation implies that the basic building blocks for life may be common in planetary systems.

Accepted by ApJL

Proper Motions of OH Masers and Magnetic Fields in Massive Starforming Regions

Vincent L. Fish[1] and Mark J. Reid[2]

[1] Jansky Fellow, National Radio Astronomy Observatory, 1003 Lopezville Road, Socorro, NM 87801, USA

[2] HarvardSmithsonian Center for Astrophysics, 60 Garden Street, MS 42, Cambridge, MA 02138, USA

E-mail contact: vfish *at* nrao.edu

We present data of proper motions of OH masers in the massive starforming regions ON 1, K350, and W51 Main/South. OH maser motions in ON 1 are consistent with expansion at approximately 5 km s^{-1}, likely tracing the expanding ultracompact H II region. Motions in K350 are faster and may be indicating the final stages of OH maser emission in the source, before the OH masers turn off as the H II region transitions from the ultracompact to the compact phase. W51 South shows indications of aspherical expansion, while motions in W51 Main are more difficult to interpret. Nevertheless, it appears that the relative projected separation between W51 Main and W51 South is decreasing, corresponding to an estimate of enclosed mass of at least 1500 $M_\odot$, consistent with estimates derived from millimeterwavelength dust emission. We confirm the $\sim$20 mG magnetic fields previously seen in W51 Main, which may represent the upper end of the density range allowable for 1665 MHz maser emission. Magnetic field strengths and directions, obtained from Zeeman splitting, in each source are consistent with values obtained in the first epoch 49 yr ago.

Published by The Astrophysical Journal (Vol. 670, p. 1159)

MHD simulations of the magnetorotational instability in a shearing box with zero net flux I. The issue of convergence

S. Fromang[1] and J. Papaloizou[1]

[1] Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Centre for Mathematical Sciences, Wilberforce Road, Cambridge, CB3 0WA, UK

E-mail contact: S.Fromang *at* damtp.cam.ac.uk

Aims. We study the properties of MHD turbulence driven by the magnetorotational instability (MRI) in accretion disks. To do this we perform a series of numerical simulations for which the resolution is gradually increased.

Methods. We adopt the local shearing box model and focus on the special case for which the initial magnetic flux threading the disk vanishes. We employ the finite difference code ZEUS to evolve the ideal MHD equations.

Results. Performing a set of numerical simulations in a fixed computational domain with increasing resolution, we demonstrate that turbulent activity decreases as resolution increases. The highest resolution considered is 256 grid cells per scale height. We quantify the turbulent activity by measuring the rate of angular momentum transport through evaluating the standard α parameter. We find $\alpha = 0.004$ when (Nx,Ny,Nz) = (64,100,64), $\alpha = 0.002$ when (Nx,Ny,Nz) = (128,200,128) and $\alpha = 0.001$ when (Nx,Ny,Nz) = (256,400,256). This steady decline is an indication that numerical dissipation, occurring at the grid scale is an important determinant of the saturated form of the MHD turbulence. Analysing the results in Fourier space, we demonstrate that this is due to the MRI forcing significant flow energy all the way down to the grid dissipation scale. We also use our results to study the properties of the numerical dissipation in ZEUS. Its amplitude is characterised by the magnitude of an effective magnetic Reynolds number Re_M which increases from 10^4 to 10^5 as the number of grid points is increased from 64 to 256 per scale height.

Conclusions. The simulations we have carried out do not produce results that are independent of the numerical dissipation scale, even at the highest resolution studied. Thus it is important to use physical dissipation, both viscous and resistive, and to quantify contributions from numerical effects, when performing numerical simulations of MHD turbulence with zero net flux in accretion disks at the resolutions normally considered.

Published by Astronomy & Astrophysics (Vol. 476, p. 1113)

MHD simulations of the magnetorotational instability in a shearing box with zero net flux II. The effect of transport coefficients

S. Fromang[1], J. Papaloizou[1], G. Lesur[2], and T. Heinemann[1]

[1] Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Centre for Mathematical Sciences, Wilberforce Road, Cambridge, CB3 0WA, UK
[2] Laboratoire d'astrophysique, UJF CNRS, BP 53, 38041 Grenoble Cedex 9, France

E-mail contact: S.Fromang *at* damtp.cam.ac.uk

Aims. We study the influence of the choice of transport coefficients (viscosity and resistivity) on MHD turbulence driven by the magnetorotational instability (MRI) in accretion disks.

Methods. We follow the methodology described in Paper I: we adopt an unstratified shearing box model and focus on the case where the net vertical magnetic flux threading the box vanishes. For the most part we use the operator split code ZEUS, including explicit transport coefficients in the calculations. However, we also compare our results with those obtained using other algorithms (NIRVANA, the PENCIL code and a spectral code) to demonstrate both the convergence of our results and their independence of the numerical scheme.

Results. We find that small scale dissipation affects the saturated state of MHD turbulence. In agreement with recent similar numerical simulations done in the presence of a net vertical magnetic flux, we find that turbulent activity (measured by the rate of angular momentum transport) is an increasing function of the magnetic Prandtl number Pm for all values of the Reynolds number Re that we investigated. We also found that turbulence disappears when the Prandtl number falls below a critical value $\mathrm{Pm_c}$ that is apparently a decreasing function of Re. For the limited region of parameter space that can be probed with current computational resources, we always obtained $\mathrm{Pm_c} > 1$.

Conclusions. We conclude that the magnitudes of the transport coefficients are important in determining the properties of MHD turbulence in numerical simulations in the shearing box with zero net flux, at least for Reynolds numbers and magnetic Prandtl numbers that are such that transport is not dominated by numerical effects and thus can be probed using current computational resources.

Published by Astronomy & Astrophysics (Vol. 476, p. 1123)

A survey of SiO 5 → 4 emission towards outflows from massive young stellar objects

A. G. Gibb[1], C. J. Davis[2] and T. J. T. Moore[3]

[1] Department of Physics and Astronomy, University of British Columbia, 6224 Agricultural Road, Vancouver, BC V6T 1Z1, Canada

[2] Joint Astronomy Centre, 660 North A'ohoku Place, University Park, Hilo, HI 96720, USA

[3] Astrophysics Research Institute, Liverpool John Moores University, Twelve Quays House, Egerton Wharf, Birkenhead CH41 1LD, UK

E-mail contact: agg *at* phas.ubc.ca

Results are presented of a survey of SiO 5 → 4 emission observed with the James Clerk Maxwell Telescope towards a sample of outflows from massive young stellar objects. The sample is drawn from a single-distance study by Ridge & Moore and allows the reasons that govern the detectability of SiO to be explored without the bias introduced by observing sources at different distances. This is the first such unbiased survey of SiO emission from massive outflows. In a sample of 12 sources, the 5 → 4 line was detected in five, a detection rate of 42 per cent. This detection rate is higher than that found for a sample of low-luminosity outflow sources, although for sources of comparable luminosity, it is in good agreement with the results of a previous survey of high-luminosity sources. For most of the detected sources, the 5 → 4 emission is compact or slightly extended along the direction of the outflow. NGC 6334I shows a clear bipolar flow in the 5 → 4 line. Additional data were obtained for W3-IRS5, AFGL 5142 and W75N for the 2 → 1 transition of SiO using the BerkeleyIllinoisMaryland Association millimetre interferometer. There is broad agreement between the appearance of the SiO emission in both lines, though there are some minor differences. The 2 → 1 emission in AFGL 5142 is resolved into two outflow lobes which are spatially coincident on the sky, in good agreement with previous observations. In general, the SiO emission is clearly associated with the outflow. Simple analysis and radiative transfer modelling of the detected sources yields similar SiO column densities. The abundance of SiO is $\sim 0.1 - 7.0 \times 10^9$, and the H_2 number density is within a factor of 2 of 10^5 cm^3. However, the temperature is not constrained over the range 50150 K. The primary indicator of SiO 5 → 4 detectability is the outflow velocity, that is, the presence of SiO is an indicator of a high-velocity outflow. This result is consistent with the existence of a critical shock velocity required to disrupt dust grains and subsequent SiO formation in post-shock gas. There is also weak evidence that higher luminosity sources and denser outflows are more likely to be detected.

Published by Monthly Notices of the Royal Astronomical Society (Vol. 382, p. 1213)

A MERLIN Study of 6-GHz excited-state OH and 6.7-GHz methanol masers in ON1

J. A. Green[1], A. M. Richards[1], W.H.T. Vlemmings[1,2], P. Diamond[1] and R. J. Cohen[1]

[1] University of Manchester, Jodrell Bank Observatory, Macclesfield, Cheshire SK11 1DL, UK
[2] Argelander Institute for Astronomy, University of Bonn, Auf dem Hügel 71, 53121 Bonn, Germany

E-mail contact: james.green *at* postgrad.manchester.ac.uk

Multi-Element Radio Linked Interferometer Network (MERLIN) observations of 6.668-GHz methanol and both 6.031- and 6.035-GHz hydroxyl (OH) emission from the massive star formation region ON1 are presented. These are the first methanol observations made in full polarization using five antennas of MERLIN, giving high resolution and sensitivity to extended emission. Maser features are found to lie at the southern edge of the ultracompact H II region, following the known distribution of ground-state OH masers. The masers cover a region ∼1 arcsec in extent, lying perpendicular to the $H^{13}CO^+$ bipolar outflow. Excited-state OH emission demonstrates consistent polarization angles across the strongest linearly polarized features which are parallel to the overall distribution. The linear polarizations vary between 10.0 and 18.5 per cent, with an average polarization angle of $60^\circ \pm 28^\circ$. The strongest 6.668-GHz methanol features provide an upper limit to linear polarization of ∼1 per cent. Zeeman splitting of OH shows magnetic fields between 1.1 and 5.8 mG, and a tentative methanol magnetic field strength of 18 mG is measured.

Published by Monthly Notices of the Royal Astronomical Society (Vol. 382, p. 770)

Million-Degree Plasma Pervading the Extended Orion Nebula

M. Güdel[1,2,3,4], K. R. Briggs[1,5], T. Montmerle[4], M. Audard[6,7], L. Rebull[8], and S. L. Skinner[9]

[1] Paul Scherrer Institut, Würenlingen and Villigen, CH-5232 Villigen PSI, Switzerland;
[2] Max-Planck-Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany;
[3] Leiden Observatory, Leiden University, PO Box 9513, 2300 RA Leiden, The Netherlands;
[4] Laboratoire d'Astrophysique de Grenoble, Université Joseph Fourier - CNRS, BP 53, 38041 Grenoble Cedex, France;
[5] Institute of Astronomy, ETH Zentrum, CH-8092 Zürich, Switzerland;
[6] ISDC, Chemin d'Ecogia 16, 1290 Versoix, Switzerland;
[7] Geneva Observatory, University of Geneva, Ch. des Maillettes 51, 1290 Sauverny, Switzerland;
[8] Spitzer Science Center, California Institute of Technology, Mail Code 220-6, Pasadena, CA 91125;
[9] CASA, UCB 389, University of Colorado, Boulder, CO 80309-0389, USA.

E-mail contact: guedel *at* astro.phys.ethz.ch

Most stars form as members of large associations within dense, very cold (10-100 K) molecular clouds. The nearby giant molecular cloud in Orion hosts several thousand stars of ages less than a few million years, many of which are located in or around the famous Orion Nebula, a prominent gas structure illuminated and ionized by a small group of massive stars (the Trapezium). We present X-ray observations obtained with the X-ray Multi-Mirror satellite XMM-Newton revealing that a hot plasma with a temperature of 1.7-2.1 million K pervades the southwest extension of the nebula. The plasma, originating in the strong stellar winds from the Trapezium, flows into the adjacent interstellar medium. This X-ray outflow phenomenon must be widespread throughout our Galaxy.

Accepted by Science

http://www.sciencemag.org/cgi/content/abstract/1149926 or
http://www.astro.phys.ethz.ch/papers/guedel/papers.html

Discovery of a bipolar X-ray jet from the T Tauri star DG Tau

M. Güdel[1,2,3], S. L. Skinner[4], M. Audard[5,6], K. R. Briggs[1], and S. Cabrit[7]

[1] Paul Scherrer Institut, Würenlingen and Villigen, CH-5232 Villigen PSI, Switzerland;
[2] Max-Planck-Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany;
[3] Leiden Observatory, Leiden University, PO Box 9513, 2300 RA Leiden, The Netherlands;
[4] CASA, UCB 389, University of Colorado, Boulder, CO 80309-0389, USA;
[5] ISDC, Chemin d'Ecogia 16, 1290 Versoix, Switzerland;
[6] Geneva Observatory, University of Geneva, Ch. des Maillettes 51, 1290 Sauverny, Switzerland;

[7] L'Observatoire de Paris, 61, avenue de l'Observatoire, 75014 Paris, France.

E-mail contact: guedel *at* astro.phys.ethz.ch

We have obtained and analyzed Chandra ACIS-S observations of the strongly accreting classical T Tauri star DG Tau. Our principal goals are to map the immediate environment of the star to characterize possible extended X-rays formed in the jet, and to re-visit the anomalous, doubly absorbed X-ray spectrum of DG Tau itself. We combine our new ACIS-S data with a data set previously obtained. The data are superimposed to obtain flux and hardness images. Separate X-ray spectra are extracted for DG Tau and areas outside its point spread function. We detect a prominent X-ray jet at a position angle of PA $\approx$ 225 deg (tentatively suggested by Güdel et al. 2005), coincident with the optical jet axis. We also identify a counter jet at PA = 45 deg. The X-ray jets are detected out to a distance of $\approx$5" from the star, their sources being extended at the ACIS-S resolution. The jet spectra are soft, with a best-fit electron temperature of 3.4 MK. We find evidence for excess absorption of the counter jet. The spectrum of the DG Tau point source shows two components with largely different temperatures and absorption column densities. The similar temperatures and small absorbing gas columns of the jet sources and the soft component of the "stellar" source suggest that these sources are related, produced either by shocks or by magnetic heating in the jets. Cooling estimates suggest that the pressure in the hot gas contributes to jet expansion. The hard "stellar" component, on the other hand, is associated with a stellar corona or magnetosphere. The excessive photoelectric absorption of this component suggests the presence of dust-depleted accretion streams above coronal magnetic fields.

Accepted by A&A

http://www.astro.phys.ethz.ch/papers/guedel/papers.html

Seismology of Pre-Main Sequence Stars in NGC 6530

D. B. Guenther[1], T. Kallinger[2], K. Zwintz[2], W. W. Weiss[2], and J. Tanne[3]

[1] Department of Astronomy and Physics, Saint Mary's University, Halifax, NS B3H 3C3, Canada
[2] Institut für Astronomie, Universität Wien, Türkenschanzstrasse 17, A1180 Wien, Austria
[3] Department of Astronomy and Physics, Saint Mary's University, Halifax, NS B3H 3C3, Canada

Nonradial p-mode oscillation spectra, computed from a dense grid of pre-main sequence models, are fit to observed oscillation spectra of several stars in the young cluster NGC 6530. The five stars we consider, all previously identified as pulsating pre-main sequence stars, each have from two to nine observed oscillation frequencies. For those stars with a more complete set of frequencies we are able to constrain the models using the oscillation spectra alone and confirm that the stars are in their pre-main sequence and not post-main sequence phase of evolution. For the stars with only two observed frequencies we are able to reduce the solution space of possible models. Comparing our model fits to the surface temperatures and luminosities derived from the observed colors and parallaxes, we find that the model fits are consistent with the cluster's distance, i.e., the luminosities agree, but we discover that all of our models are systematically too cool. We attribute some of the discrepancy in the surface temperature to uncertainties in the surface boundary conditions of our models, but argue that most of the difference is a direct consequence of applying a single average color-dependent dereddening correction to all the stars when, in fact, it appears that the stars we selected are embedded in varying degrees of gas and dust. For one of the stars we identify a rotationally split $l = 1$ p-mode from which we derive a rotation period of 18 days.

Published by The Astrophysical Journal (Vol. 671, p. 581)

Shocks in dense clouds: I. Dust dynamics

V. Guillet[1], G. Pineau des Forêts[1], and A. P. Jones[1]

[1] Institut d'Astrophysique Spatiale, Université Paris Sud and CNRS (UMR 8617), 91405 Orsay, France

E-mail contact: vincent.guillet *at* free.fr

Aims. A new multi-fluid approach to the dust dynamics in transverse shocks in dense clouds is presented with the aim of modelling the dust processing in C- and J-type shocks.

Methods. We have augmented an existing steady-state shock code to include the effects of an MRN size distribution of grain cores with icy mantles. The dust charge distribution and its evolution is considered in detail and included

in the ionization balance. The 2-D grain dynamics are determined, including the effects of grain inertia and charge fluctuations, paying particular attention to the gyration of the charged grains around the magnetic field lines and the feedback of the ionization state on grain dynamics.

Results. We find that the critical velocity for C shocks increases with the gas density but that it is only weakly dependent on a high abundance of PAHs and on the photodetachment of electrons by secondary photons induced by cosmic-rays. The detailed dust dynamics in C shocks is shown to comprise two distinct phases: 1) a short gyration phase followed by 2) a long term drift phase. In J shocks only the first gyration phase is present. In C shocks propagating through molecular clouds ($n_{\mathrm{H}} = 10^4$ cm^{-3}), large grains ($\gg$100Å) remain coupled to the magnetic field during the second phase. However, a high abundance of PAHs can lead to a shortage of electrons in the gas and the decoupling of large grains in the shock tail. Large grains are decoupled from the magnetic field all through the C shock in high density clouds ($n_{\mathrm{H}} = 10^6$ cm^{-3}). In all C shocks small grains ($\simeq$100Å) remain strongly coupled to the magnetic field, whereas very small grains ($\ll$100Å) are subject to stochastic dynamics. As long as they are charged very small grains remain strongly coupled to the magnetic field but tend to couple to the neutral gas everytime they become neutral. We have investigated the effects of an electric field along the shock direction in C shocks and find that it does not significantly modify the relative velocities between grains. The derived grain dynamics can be used to study dust processing in C and J shocks in dense clouds through the effects of gas-grain and grain-grain collisions.

Published by Astronomy & Astrophysics (Vol. 476, p. 263)

The *Spitzer* Gould Belt Survey of Large Nearby Interstellar Clouds: Discovery of a Dense Embedded Cluster in the Serpens-Aquila Rift

R. A. Gutermuth[1], T. L. Bourke[1], L. E. Allen[1], P. C. Myers[1], S. T. Megeath[2], B. C. Matthews[3], J. K. Jørgensen[4], J. Di Francesco[3], D. Ward-Thompson[5], T. L. Huard[1], T. Y. Brooke[6], M. M. Dunham[7], L. A. Cieza[7], P. M. Harvey[7], N. L. Chapman[8]

[1] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[2] Ritter Observatory, Department of Physics and Astronomy, University of Toledo, Toledo, OH 43606, USA
[3] Herzberg Institute of Astrophysics, National Research Council of Canada, Victoria, BC V9E 2E7, Canada
[4] Argelander-Institut für Astronomie, University of Bonn, Auf dem Hügel 71, 53121 Bonn, Germany
[5] Department of Physics and Astronomy, University of Cardiff, P.O. Box 913, Cardiff, CF2 3YB, Wales, UK
[6] Spitzer Science Center, MC 220-6, California Institute of Technology, Pasadena, CA 91125, USA
[7] Department of Astronomy, University of Texas, Austin, TX 78712, USA
[8] Department of Astronomy, University of Maryland, College Park, MD 20742, USA

E-mail contact: rgutermuth *at* cfa.harvard.edu

We report the discovery of a nearby, embedded cluster of young stellar objects, associated filamentary infrared dark cloud, and 4.5 μm shock emission knots from outflows detected in *Spitzer*/IRAC mid-infrared imaging of the Serpens-Aquila Rift obtained as part of the *Spitzer* Gould Belt Legacy Survey. We also present radial velocity measurements of the region from molecular line observations obtained with the Submillimeter Array (SMA) that suggest the cluster is co-moving with the Serpens Main embedded cluster 3° to the north. We therefore assign it the same distance, 260 pc. The core of the new cluster, which we call Serpens South, is composed of an unusually large fraction of protostars (77%) at high mean surface density (>430 pc^{-2}) and short median nearest neighbor spacing (3700 AU). We perform basic cluster structure characterization using nearest neighbor surface density mapping of the YSOs and compare our findings to other known clusters with equivalent analyses available in the literature.

Accepted by Astrophys. J. Letters

http://www.cfa.harvard.edu/~rgutermuth/preprints/gutermuth_serps.pdf

Effects of photophoresis on the evolution of transitional circumstellar disks

F. Herrmann and A. V. Krivov

[1] Astrophysikalisches Institut, Friedrich-Schiller-Universität Jena, Schillergäßchen 2-3, 07745 Jena, Germany

E-mail contact: fabian *at* astro.uni-jena.de

Although known for almost a century, the photophoretic force has only recently been considered in astrophysical

context for the first time. In our work, we have examined the effect of photophoresis, acting together with stellar gravity, radiation pressure, and gas drag, on the evolution of solids in transitional circumstellar disks. We have applied our calculations to four different systems: the disks of HR 4796A and HD 141569A, which are several Myr-old AB-type stars, and two hypothetical systems that correspond to the solar nebula after disk dispersal has progressed sufficiently for the disk to become optically thin. Our results suggest that solid objects migrate inward or outward, until they reach a certain size-dependent stability distance from the star. The larger the bodies, the closer to the star they tend to accumulate. Photophoresis increases the stability radii, moving objects to larger distances. What is more, photophoresis may cause formation of a belt of objects, but only in a certain range of sizes and only around low-luminosity stars. The effects of photophoresis are noticeable in the size range from several micrometers to several centimeters (for older transitional disks) or even several meters (for younger, more gaseous, ones). We argue that due to gas damping, rotation does not substantially inhibit photophoresis.

Published by Astronomy & Astrophysics (Vol. 476, p. 829)

Stellar contents and star formation in the young open cluster Stock 8

Jessy Jose[1], A.K. Pandey[2,3,1], D.K. Ojha[3], K. Ogura[4], W.P. Chen[2], B.C. Bhatt[5], S.K. Ghosh[3], H. Mito[6], G. Maheswar[1,7] and Saurabh Sharma[1]

[1] Aryabhatta Research Institute of Observational Sciences (ARIES), Manora Peak, Naini Tal, 263129, India
[2] Institute of Astronomy, National Central University, Chung-Li, 32054, Taiwan
[3] Tata Institute of Fundamental Research, Mumbai (Bombay), 400 005, India
[4] Kokugakuin University, Higashi, Shibuya-ku, Tokyo, 150-8440, Japan
[5] CREST, Indian Institute of Astrophysics, Koramangala, Bangalore, 560 034, India
[6] Kiso Observatory, School of Science, University of Tokyo, Mitake-mura, Kiso-gun, Nagano 397-0101, Japan
[7] Korea Astronomy and Space Science Institute (KASI), 61-1, Hwaam-dong, Daejeon, Republic of Korea 305-348

E-mail contact: jessy *at* aries.ernet.in

We present $UBVI_c$ CCD photometry of the young open cluster Stock 8 with the aim of studying its basic properties such as the amount of interstellar extinction, distance, age, stellar contents and initial mass function (IMF). We also studied the star formation scenario in this region. From optical data, the radius of the cluster is found to be $\sim 6'$ (~ 3.6 pc) and the reddening within the cluster region varies from $E(B-V) = 0.40$ to 0.60 mag. The cluster is located at a distance of 2.05 ± 0.10 kpc. Using Hα slitless spectroscopy and 2MASS NIR data we identified Hα emission and NIR excess young stellar objects (YSOs), respectively. From their locations in the colour-magnitude diagrams, majority of them seem to have ages between 1 to 5 Myr. The spread in their ages indicate a possible non-coeval star formation in the cluster. Massive stars in the cluster region reveal an average age of ≤ 2 Myr. In the cluster region ($r \leq 6'$) the slope of the mass function (MF), Γ, in the mass range $\sim 1.0 \leq M/M_{\odot} < 13.4$ can be represented by a power law having a slope of -1.38 ± 0.12, which agrees well with Salpeter value (-1.35). In the mass range $0.3 \leq M/M_{\odot} < 1.0$, the MF is also found to follow a power law with a shallower slope of $\Gamma = -0.58 \pm 0.23$ indicating a break in the slope of the IMF at $\sim 1M_{\odot}$. The slope of the K-band luminosity function for the cluster ($r \leq 6'$) is found to be 0.31 ± 0.02, which is smaller than the average value (~ 0.4) obtained for embedded star clusters.

A significant number of YSOs are distributed along a Nebulous Stream towards the east side of the cluster. A small cluster is embedded in the Nebulous Stream. The YSOs lying in the Nebulous Stream and in the embedded cluster are found to be younger than the stars in the cluster Stock 8. The radio continuum, MSX, IRAS mid- and far-infrared maps and the ratio of [S II]/Hα intensities indicate that the eastern region of Stock 8 is ionization bounded whereas the western region is density bounded. The morphology seems to indicate that the ionization/ shock front caused by the ionizing sources located in the Stock 8 region and westwards of Stock 8 has not reached the Nebulous Stream. It appears that star formation activity in the Nebulous Stream and embedded cluster may be independent from that of Stock 8.

Accepted by MNRAS

Structure of the inner regions of the circumstellar gas envelopes around young hot stars. II. The new cycle of spectral activity of the Herbig Ae star HD 31648

O. V. Kozlova[1], I. Yu. Alekseev[1] and D. N. Shakhovskoi[1]

[1] Crimean Astrophysical Observatory, Crimea, Ukraine

E-mail contact: oles *at* crao.crimea.ua

The results of the high-resolution long-term spectral monitoring of the Herbig Ae star HD 31648 in the regions of emission Hα line, Na I D resonance lines and OI 7774 lines are presented. We confirmed the conclusion, made in previous papers, that the spectral variability of the star in the region of Hα line have a cyclic character. It is manifested itself as the changing of the equivalent width and intensity of Hα line of the time scale of about 1200d. It is shown, that the stellar wind is non-homogeneous and consists of several components, which are differed each other by their velocities. They are observed as in the H line as in Na I D resonance lines. The component's parameters are changed during the cycle of stellar activity (in the maximum of activity the velocity and density of the wind are taken the largest values and then they are gradually decreased). The investigation of rapid variability of the He I 5876 line on the time scale of a few hours allows find the correlation between the variability of the blue and the red wings of the line. It points at the connection between the accretion and the outflows. Such connection, in particularly, is predicted by the modeling of the wind from young stars made in the frame of the magneto-centrifugal model, the accordance of which for the HD 31648 was shown in the previous papers. In the present work we confirmed this conclusion on the basis of the new data. We found the weak variability of the stellar brightness (about 0.2m), which is agree with the spectral variability (the brightness of the star becomes lower in the maximum of the activity). These changes are well explained by the process of the dust transfer from CS disk by the stellar wind. This process is likely to be more effective in the maximum of activity. An analysis of the variability of other spectral lines shows the agreement between the changing of the Hα line, the Na I D resonance doublet lines and KI 7698 line. The weak connection between the He I 5876 and the Na I D lines is also found. Since the formation regions of He I 5876 and Na I D lines are essentially different, we can conclude that the phenomena, responsible for the observed cyclic variability, take place in a spacious region of the CS envelope. We believe that the most plausible reason of found cyclic variability is the reconstruction of the inner structure of the CS gas envelope, caused by the presence around the star a low mass companion or planet.

Published by Astrophysics (Vol. 50, p. 467)

Detection of an inner gaseous component in a Herbig Be star accretion disk: Near- and mid-infrared spectro-interferometry and radiative transfer modeling of MWC 147

Stefan Kraus[1], Thomas Preibisch[1] and Keiichi Ohnaka[1]

[1] Max-Planck-Institut for Radioastronomy, Auf dem Huegel 69, 53121 Bonn, Germany

E-mail contact: skraus *at* mpifr-bonn.mpg.de

We study the geometry and the physical conditions in the inner (AU-scale) circumstellar region around the young Herbig Be star MWC 147 using long-baseline spectro-interferometry in the near-infrared (NIR K-band, VLTI/AMBER observations and PTI archive data) as well as the mid-infrared (MIR N-band, VLTI/MIDI observations). The emission from MWC 147 is clearly resolved and has a characteristic physical size of $\sim$ 1.3 AU and $\sim$ 9 AU at 2.2 μm and 11 μm respectively (Gaussian diameter). The MIR emission reveals asymmetry consistent with a disk structure seen under intermediate inclination. The spectrally dispersed AMBER and MIDI interferograms both show a strong increase in the characteristic size towards longer wavelengths, much steeper than predicted by analytic disk models assuming power-law radial temperature distributions.

We model the interferometric data and the spectral energy distribution of MWC 147 with 2-D, frequency-dependent radiation transfer simulations. This analysis shows that models of spherical envelopes or passive irradiated Keplerian disks (with vertical or curved puffed-up inner rim) can easily fit the SED, but predict much lower visibilities than observed; the angular size predicted by such models is 2 to 4 times larger than the size derived from the interferometric data, so these models can clearly be ruled out. Models of a Keplerian disk with optically thick gas emission from an active gaseous disk (inside the dust sublimation zone), however, yield a good fit of the SED and simultaneously reproduce the absolute level and the spectral dependence of the NIR and MIR visibilities. We conclude that the NIR continuum emission from MWC 147 is dominated by accretion luminosity emerging from an optically thick inner gaseous disk, while the MIR emission also contains contributions from the outer, irradiated dust disk.

Accepted by Astrophysical Journal

http://www.mpifr-bonn.mpg.de/staff/skraus/papers/kraus.mwc147.pdf

Observational 2D model of H_2 emission from a bow shock in the Orion Molecular Cloud

L. E. Kristensen[1], T. L. Ravkilde[2], G. Pineau des Forêts[1,3], S. Cabrit[1], D. Field[2], M. Gustafsson[4], S. Diana[1], and J.-L. Lemaire[1]

[1] Observatoire de Paris & Université de Cergy-Pontoise, LERMA, UMR 8112 du CNRS, 92195 Meudon Cedex, France
[2] Department of Physics and Astronomy, University of Aarhus, 8000 Aarhus C, Denmark
[3] Institut d'Astrophysique Spatiale, UMR 8617 du CNRS, Université de Paris Sud, 91405 Orsay, France
[4] Max Planck Institut für Astronomie, 69117 Heidelberg, Germany

E-mail contact: lars.kristensen *at* u-cergy.fr

Aims. We present a new method for reproducing high spatial resolution observations of bow shocks by using 1D plane parallel shock models. As an example we analyse one bow shock located in the Orion Molecular Cloud (OMC1).

Methods. We use high spatial resolution near-infrared observations of H_2 rovibrational emission to constrain shock models. These observations have been made at the ESO-VLT using a combination of the NACO adaptive optics system and infrared camera array and the Fabry-Perot interferometer. Three rovibrational H_2 lines have been observed: v= 1-0 S(1) at 2.12 μm, v= 1-0 S(0) at 2.23 μm and v= 2-1 S(1) at 2.25 μm. The spatial resolution is $0.15'' \sim 70$ AU. We analyse a single bow shock located in our field, featuring a very well defined morphology and high brightness.

Results. One dimensional shock models are combined to estimate the physical properties of pre-shock density, shock velocity and transverse magnetic field strength along the bow shock. We find that the pre-shock density is constant at $\sim 5 \times 10^5$ cm^{-3} and shock velocities lie between $\sim$35 km s^{-1} in the wings of the shock and $\sim$50 km s^{-1} at the apex. We also find that the transverse magnetic field is stronger at the apex and weaker further down the wings varying between $\sim$2 and 4 mGauss. Predictions of shock velocity and magnetic field strength agree with previous independent observations.

Published by Astronomy & Astrophysics (Vol. 477, p. 203)

The Nature of the Dense Core Population in the Pipe Nebula: Thermal Cores Under Pressure

Charles J. Lada[1], A.A. Muench[1], J. Rathborne[1], João Alves[2] and M. Lombardi[3]

[1] Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge MA 02138, USA
[2] Calar Alto Observatory, Centro Astronõmico Hispano Alemãn, c/ Jesũs Durbãn Remõn 2-2, 04000 Almeria, Spain
[3] European Southern Observatory, Karl-Scwarschild-Str.-2, 85748 Garching, Germany

E-mail contact: clada *at* cfa.harvard.edu

In this paper we present the results of a systematic investigation of an entire population of dust cores within a single molecular cloud. This population of predominately starless cores was previously identified in an infrared extinction survey of the Pipe Nebula, a nearby molecular cloud with a well-established distance but negligible star forming activity. Analysis of extinction data shows the cores to be dense objects characterized by a narrow range of density with a median value of $n(H_2) = 7 \times 10^3$ cm^{-3}, assuming a normal gas-to-dust ratio. Analysis of $C^{18}O$ and NH_3 molecular-line observations reveals very narrow lines. The non-thermal velocity dispersions measured in both these tracers are found to be subsonic for the large majority of the cores and show no correlation with core mass (or size). The bulk gas motions are thus acoustic in nature and thermally dominated. Thermal pressure is thus the dominate source of internal gas pressure and support for most of the core population. The total internal gas pressures of the cores are found to be roughly independent of core mass over the entire (0.2-20 $M_\odot$) range of the core mass function (CMF) indicating that the cores are in pressure equilibrium with an external source of pressure. This external pressure is most likely provided by the weight of the surrounding Pipe cloud within which the cores are embedded. Most of the cores appear to be pressure confined, gravitationally unbound entities whose nature, structure and future evolution are determined by only a few physical factors which include self-gravity, the fundamental processes of thermal physics (i.e., heating and cooling) and the simple requirement of pressure equilibrium with the surrounding environment. The observed core properties likely constitute the initial conditions for star formation in dense gas. The entire core population is found to be characterized by a single critical Bonnor-Ebert mass of ≈ 2 $M_\odot$. This mass coincides with the characteristic mass of the Pipe CMF indicating that most cores formed in the cloud are near critical stability. This suggests that the mass function of cores (and ultimately the stellar IMF) has its origin in the physical process of thermal fragmentation in a pressurized medium.

Accepted by The Astrophysical Journal

www.cfa.harvard.edu/∼clada/preprints.html

Chemical Evolution in VeLLOs

Jeong-Eun Lee[1]

[1] Department of Astronomy and Space Science, Sejong University, Seoul 143-747, Korea

E-mail contact: jelee *at* sejong.ac.kr

A new type of object called "Very Low Luminosity Objects (VeLLOs)" has been discovered by the Spitzer Space Telescope. VeLLOs might be substellar objects forming by accretion. However, some VeLLOs are associated with strong outflows, indicating the previous existence of massive accretion. The thermal history, which significantly affects the chemistry, between substellar objects with a continuous low accretion rate and objects in a quiescent phase after massive accretion (outburst) must be greatly different. In this study, the chemical evolution has been calculated in an episodic accretion model to show that CO and N2H+ have a relation different from starless cores or Class 0/I objects. Furthermore, the CO_2 ice feature at 15.2 micron will be a good tracer of the thermal process in VeLLOs.

Accepted by JKAS

http://arxiv.org/abs/0712.1866

Formation, fractionation, and excitation of carbon monoxide in diffuse clouds

H. S. Liszt[1]

[1] National Radio Astronomy Observatory, 520 Edgemont Road, Charlottesville, VA, 22903-2475, USA

E-mail contact:hliszt *at* nrao.edu

Context. A wealth of observations of CO in absorption in diffuse clouds has accumulated in the past decade at uv and mm-wavelengths

Aims. Our aims are threefold: a) To compare the uv and mm-wave results; b) to interpret ^{13}CO and ^{12}CO abundances in terms of the physical processes which separately and jointly determine them; c) to interpret observed J = 1-0 rotational excitation and line brightness in terms of ambient gas properties.

Methods. A simple phenomenological model of CO formation as the immediate descendant of quiescently-recombining HCO^+ is used to study the accumulation, fractionation and rotational excitation of CO in more explicit and detailed models of H_2-bearing diffuse/H I clouds

Results. The variation of N(CO) with N(H_2) is explained by quiescent recombination of a steady fraction n(HCO^+)/n(H_2) = 2×10^{-9}. Observed N(^{12}CO)/N(^{13}CO) ratios generally do not require a special chemistry but result from competing processes and do not provide much insight into the local gas properties, especially the temperature. J = 1-0 CO line brightnesses directly represent N(CO), not N(H_2), so the CO-H_2 conversion factor varies widely; it attains typical values at N(^{12}CO) $\lesssim 10^{16}$ cm^{-2}. Models of CO rotational excitation account for the line brightnesses and CO-H_2 conversion factors but readily reproduce the observed excitation temperatures and optical depths of the rotational transitions only if excitation by H-atoms is weak - as seems to be the case for the very most recent calculations of these excitation rates.

Conclusions. Mm-wave and uv results generally agree well but the former show somewhat more enhancement of ^{13}C in ^{13}CO. In any case, fractionation may seriously bias ^{12}C/^{13}C ratios measured in CO and other co-spatial molecules. Complete C → CO conversion must occur over a very narrow range of A_V and N(H_2) just beyond the diffuse regime. For N(H_2) $< 7\times10^{19}$ cm^{-2} the character of the chemistry changes inasmuch as CH is generally undetected while CO suffers no such break.

Published by Astronomy & Astrophysics (Vol. 476, p. 291)

Signatures of Dynamical Star Formation in the Ophiuchus Association of Pre-Main-Sequence Stars

Valeri V. Makarov[1]

[1] Michelson Science Center, California Technology Institute, 770 South Wilson Avenue, MS 10022, Pasadena, CA 91125, USA

E-mail contact: vvm *at* caltech.edu

A sample of 58 probable members of the association of pre-main-sequence stars around the filamentary ρ Ophiuchi cloud is investigated. Using astrometric proper motions from the UCAC2 catalog and the convergent point method, the total heliocentric systemic velocity is estimated at 19 km s^{1}, and the mean distance at 145 pc. A small, statistically insignificant difference between the geometric convergent point and the actual direction of velocity defined by the observed radial velocity implies a small, if any, rate of expansion of the association. The Ophiuchus association appears to have a considerable depth, with half of the members lying within 15 pc of the center. When the moving cluster distances are taken into account, the near-infrared versus H-R diagram reveals an apparent large spread of ages between 14 Myr and younger than 1 Myr. Most of the youngest stars are located along a slightly curved strip just south of the densest cloud, extending in the east-west direction roughly aligned with the central streamer of warm dust. The intersection of this strip with a thin segment of shocked dust visible in the IRAS 12 μm map at is marked with a small cluster of probably very young stars around ROXs 43A. The large extent and depth of the association, the moderate rate of expansion, the spread in ages of about 14 Myr, and the alignment of very young stars with the dusty streamer point at a dynamical mode of star formation in this region, scattered far and wide around the main core.

Published by The Astrophysical Journal (Vol. 670, p. 1225)

Dating the First Stage of Planet Formation

Frederic Moynier[1], **Qingzhu Yin**[1], **and Benjamin Jacobsen**[1]

[1] Department of Geology, University of California Davis, One Shields Avenue, Davis, CA 95616, USA

E-mail contact: moynier *at* geology.ucdavis.edu

The ^{53}Mn^{53}Cr chronometer applied to bulk carbonaceous chondrites constrains the solar nebula volatile element fractionation, chondrule formation, and stage I planetary accretion timescale to within +0.91 to 1.17 Myr at 4568 Myr ago. The difference between the initial ^{53}Cr/ ^{52}Cr ratio of ordinary chondrites, defined by Chainpur (LL3.4) chondrules, and carbonaeous chondrites suggests that the former is coming from an isotopically evolved reservoir.

Published by The Astrophysical Journal Letters (Vol. 671, p. L181)

A spectral line survey of Orion KL in the bands 486-492 and 541-577 GHz with the Odin satellite: I. The observational data

A. O. H. Olofsson[1,2], **C. M. Persson**[1], **N. Koning**[3], **P. Bergman**[1,4], **P. F. Bernath**[5,6,7], **J. H. Black**[1], **U. Frisk**[8], **W. Geppert**[9], **T. I. Hasegawa**[3,10], **Å. Hjalmarson**[1], **S. Kwok**[3,11], **B. Larsson**[12], **A. Lecacheux**[13], **A. Nummelin**[14], **M. Olberg**[1], **Aa. Sandqvist**[12], **and E. S. Wirström**[1]

[1] Onsala Space Observatory (OSO), 43992 Onsala, Sweden
[2] LERMA, Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France
[3] Department of Physics and Astronomy, University of Calgary, Calgary, AB T2N 1N4, Canada
[4] European Southern Observatory, Alonso de Cordova 3107, Vitacura, Casilla 19001, Santiago, Chile
[5] Department of Chemistry, University of Arizona, Tucson, AZ 85721, USA
[6] Department of Chemistry, University of Waterloo, Waterloo, ON N2L 3G1, Canada
[7] Department of Chemistry, University of York, Heslington, York YO10 5DD, UK
[8] Swedish Space Corporation, PO Box 4207, 17104 Solna, Sweden
[9] Molecular Physics Division, Department of Physics, Stockholm University AlbaNova, 10691 Stockholm, Sweden
[10] Institute of Astronomy and Astrophysics, Academia Sinica, PO Box 23-141, Taipei 106, Taiwan, R.O.C.
[11] Department of Physics, University of Hong Kong, Hong Kong, PR China
[12] Stockholm Observatory, AlbaNova University Center, 10691 Stockholm, Sweden

[13] LESIA, Observatoire de Paris, Section de Meudon, 5 place Jules Janssen, 92195 Meudon Cedex, France
[14] Computer science and engineering, Chalmers University of Technology, 41296 Göteborg, Sweden

E-mail contact: henrik *at* oso.chalmers.se

Aims. Spectral line surveys are useful since they allow identification of new molecules and new lines in uniformly calibrated data sets. The subsequent multi-transition analysis will provide improved knowledge of molecular abundances, cloud temperatures and densities, and may also reveal previously unsuspected blends of molecular lines, which otherwise may lead to erroneous conclusions. Nonetheless, large portions of the sub-millimetre spectral regime remain unexplored due to severe absorptions by H_2O and O_2 in the terrestrial atmosphere. The purpose of the measurements presented here is to cover wavelength regions at and around 0.55 mm - regions largely unobservable from the ground.

Methods. Using the Odin astronomy/aeronomy satellite, we performed the first spectral survey of the Orion KL molecular cloud core in the bands 486-492 and 541-576 GHz with rather uniform sensitivity (22-25 mK baseline noise). Odin's 1.1 m size telescope, equipped with four cryo-cooled tuneable mixers connected to broad band spectrometers, was used in a satellite position-switching mode. Two mixers simultaneously observed different 1.1 GHz bands using frequency steps of 0.5 GHz (25 h each). An on-source integration time of 20 h was achieved for most bands. The entire campaign consumed ∼1100 orbits, each containing one hour of serviceable astro-observation.

Results. We identified 280 spectral lines from 38 known interstellar molecules (including isotopologues) having intensities in the range 80 to 0.05 K. An additional 64 weak lines remain unidentified. Apart from the ground state rotational $1_{1,0}$-$1_{0,1}$ transitions of ortho-H_2O, $H_2^{18}O$ and $H_2^{17}O$, the high energy $6_{2,4}$-$7_{1,7}$ line of para-H_2O (E_u=867 K) and the HDO($2_{0,2}$-$1_{1,1}$) line have been observed, as well as the 1_0-0_1 lines from NH_3 and its rare isotopologue $^{15}NH_3$. We suggest assignments for some unidentified features, notably the new interstellar molecules ND and SH^-. Severe blends have been detected in the line wings of the $H_2^{18}O$, $H_2^{17}O$ and ^{13}CO lines changing the true linewidths of the outflow emission.

Published by Astronomy & Astrophysics (Vol. 476, p. 791)

A spectral line survey of Orion KL in the bands 486-492 and 541-577 GHz with the Odin satellite - II. Data analysis

C. M. Persson[1], A. O. H. Olofsson[1,2], N. Koning[3], P. Bergman[1,4], P. Bernath[5,6,7], J. H. Black[1], U. Frisk[8], W. Geppert[9], T. I. Hasegawa[3,10], Å. Hjalmarson[1], S. Kwok[3,11], B. Larsson[12], A. Lecacheux[13], A. Nummelin[14], M. Olberg[1], Aa. Sandqvist[12], and E. S. Wirström[1]

[1] Onsala Space Observatory (OSO), Chalmers University of Technology, 43992 Onsala, Sweden
[2] LERMA, Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France
[3] Department of Physics and Astronomy, University of Calgary, Calgary, AB T2N 1N4, Canada
[4] European Southern Observatory, Alonso de Cordova 3107, Vitacura, Casilla 19001, Santiago, Chile
[5] Department of Chemistry, University of Waterloo, Waterloo, ON N2L 3G1, Canada
[6] Department of Chemistry, University of Arizona, Tucson, AZ 85721, USA
[7] Department of Chemistry, University of York, Heslington, York YO10 5DD, UK
[8] Swedish Space Corporation, PO Box 4207, 17104 Solna, Sweden
[9] Molecular Physics Division, Department of Physics, Stockholm University AlbaNova, 10691 Stockholm, Sweden
[1]0 Institute of Astronomy and Astrophysics, Academia Sinica, PO Box 23-141, Taipei 106, Taiwan, R.O.C.
[1]1 Department of Physics, University of Hong Kong, Hong Kong, PR China
[1]2 Stockholm Observatory, AlbaNova University Center, 10691 Stockholm, Sweden
[1]3 LESIA, Observatoire de Paris, Section de Meudon, 5 place Jules Janssen, 92195 Meudon Cedex, France
[1]4 Computer science and engineering, Chalmers University of Technology, 41296 Göteborg, Sweden

E-mail contact: carina *at* oso.chalmers.se

Aims. We investigate the physical and chemical conditions in a typical star forming region, including an unbiased search for new molecules in a spectral region previously unobserved.

Methods. Due to its proximity, the Orion KL region offers a unique laboratory of molecular astrophysics in a chemically rich, massive star forming region. Several ground-based spectral line surveys have been made, but due to the absorption by water and oxygen, the terrestrial atmosphere is completely opaque at frequencies around 487 and 557 GHz. To cover these frequencies we used the Odin satellite to perform a spectral line survey in the frequency ranges 486-492

GHz and 541-577 GHz, filling the gaps between previous spectral scans. Odin's high main beam efficiency, $\eta_{\mathrm{mb}} = 0.9$, and observations performed outside the atmosphere make our intensity scale very well determined.

Results. We observed 280 spectral lines from 38 molecules including isotopologues, and, in addition, 64 unidentified lines. A few U-lines have interesting frequency coincidences such as ND and the anion SH^-. The beam-averaged emission is dominated by CO, H_2O, SO_2, SO, ^{13}CO and CH_3OH. Species with the largest number of lines are CH_3OH, $(CH_3)_2O$, SO_2, $^{13}CH_3OH$, CH_3CN and NO. Six water lines are detected including the ground state rotational transition $1_{1,0}$-$1_{0,1}$ of o-H_2O, its isotopologues o-$H_2^{18}O$ and o-$H_2^{17}O$, the Hot Core tracing p-H_2O transition $6_{2,4}$-$7_{1,7}$, and the $2_{0,2}$-$1_{1,1}$ transition of HDO. Other lines of special interest are the 1_0-0_σ transition of NH_3 and its isotopologue $^{15}NH_3$. Isotopologue abundance ratios of D/H, $^{12}C/^{13}C$, $^{32}S/^{34}S$, $^{34}S/^{33}S$, and $^{18}O/^{17}O$ are estimated. The temperatures, column densities and abundances in the various subregions are estimated, and we find very high gas-phase abundances of H_2O, NH_3, SO_2, SO, NO, and CH_3OH. A comparison with the ice inventory of ISO sheds new light on the origin of the abundant gas-phase molecules.

Published by Astronomy & Astrophysics (Vol. 476, p. 807)

The inner radius of T Tauri disks estimated from near-infrared interferometry: the importance of scattered light.

Christophe Pinte[1,2], Francois Menard[1], Jean-Philippe Berger[1], Myriam Benisty[1] and Fabien Malbet[1]

[1] Laboratoire d'Astrophysique de Grenoble, CNRS/Université Joseph-Fourier, UMR 5571, B.P. 53, F-38041 Grenoble Cedex 9, France

[2] School of Physics, University of Exeter, Stocker Road, Exeter EX4 4QL, United Kingdom

E-mail contact: pinte *at* astro.ex.ac.uk

For young Herbig AeBe stars, near-infrared interferometric measurements have revealed a correlation between the luminosity of the central object and the position of the disk inner rim. This correlation breaks down for the cooler T Tauri stars, a fact often interpreted in terms of disks with larger inner radii. In most cases, the conversion between the observed interferometric visibility and the calculated disk inner radius was done with a crude disk emission model. Here, we examine how the use of models that neglect scattered light can lead to an overestimation of the disk sizes. To do so, synthetic disk images (and visibilities) are calculated with a full treatment of the radiative transfer. The relative contributions of thermal emission and scattered light are compared. We find that the latter can not be neglected for cool stars. For further comparison, the model visibilities are also converted into inner disk radii using the same simple disk models as found in the literature. We find that reliable inner radii can only be estimated for Herbig Ae/Be stars with these models. However, they lead to a systematic overestimation of the disk size, by a factor of 2 to 3, for T Tauri stars. We suggest that including scattered light in the models is a simple (and sufficient) explanation of the current interferometric measurements of T Tauri stars.

Accepted by ApJ Letters

http://arxiv.org/abs/0712.0012

X-ray properties of protostars in Orion

L. Prisinzano[1], G. Micela[1], E. Flaccomio[1], J. R. Stauffer[2], T. Megeath[3], L. Rebull[2], M. Robberto[4], K. Smith[4], E. D. Feigelson[5], N. Grosso[6] and S. Wolk[7]

[1] INAF - Osservatorio Astronomico di Palermo, Piazza del Parlamento 1, I-90134 Palermo, Italy

[2] Spitzer Science Center, California Institute of Technology, 1200 East California Boulevard, Pasadena, CA 91125, USA

[3] Department of Physics, University of Toledo, 2801 W. Bancroft Ave, Toledo OH 43606, USA

[4] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA

[5] Department of Astronomy and Astrophysics, Penn State University, 525 Davey Lab, University Park, PA 16802, USA

[6] Observatoire astronomique de Strasbourg, Universite' Louis-Pasteur, CNRS, INSU, 11 rue de l'Université, 67000 Strasbourg, France

[7] Harvard Smithsonian Center for Astrophysics, MS 65, 60 Garden Street, Cambridge, MA 02138, USA

E-mail contact: loredana *at* astropa.inaf.it

The origin and evolution of the X-ray emission in very young stellar objects (YSOs) are not yet well understood because it is very hard to observe YSOs in the protostellar phase. We study the X-ray properties of Class 0-I objects in the Orion Nebula Cluster (ONC) and compare them with those of the more evolved Class II and III members. Using Chandra Orion Ultradeep Project (COUP) data, we study the X-ray properties of stars in different evolutionary classes: luminosities, hydrogen column densities N_H, average plasma temperatures and time variability are compared in order to understand if the interaction between the circumstellar material and the central object can influence the X-ray emission. We have assembled the deepest and most complete photometric catalog of objects in the ONC region from the UV to 8 μm using data from the HST Treasury Program, deep and almost simultaneous UBVI and JHK images taken, respectively, with WFI@2.2m ESO and ISPI@4m CTIO telescopes, and *Spitzer* IRAC imaging. We select high probability candidate Class 0-I protostars, distinguishing between those having a spectral energy distribution which rises from K up to 8 μm (Class 0-Ia) from those where the SED rises from K up to 4.5 μm and decreasing afterwards (Class 0-Ib). In addition, we select a sample of "bona fide" Class II stars and a set of Class III stars with IR emission consistent with normal photospheres.

Our principal result is that Class 0-Ia objects are significantly less luminous in X-rays, both in the total and hard bands, than the more evolved Class II stars with mass larger than 0.5 $M_\odot$; these latter show X-ray luminosities similar to those of Class 0-Ib stars. This result supports the hypothesis that the onset of X-ray emission occurs at a very early stage of star formation and is in agreement with the result found in Giardino et al. (2007). Spectral properties of Class 0-I stars are similar to those of the more evolved Class II and III objects, except for a larger absorption likely due to gas in the envelope or disk of the protostellar objects. Our data suggest that the three different classes have similar X-ray temporal variability.

Accepted by ApJ

http://www.astropa.unipa.it/Library/preprint.html

Detection of Strong Activity in the Eclipsing Binary Brown Dwarf 2MASS J05352184-0546085: A Possible Explanation for the Temperature Reversal

A. Reiners[1], A. Seifahrt[1], K. G. Stassun[2], C. Melo[3] and R. D. Mathieu[4]

[1] Institut für Astrophysik, Georg-August-Universität, Friedrich-Hund-Platz 1, D-37077 Göttingen, Germany
[2] Department of Physics and Astronomy, Vanderbilt University, Nashville, TN 37235, USA
[3] European Southern Observatory, Casilla 19001, Santiago 19, Chile
[4] Department of Astronomy, University of Wisconsin, Madison, WI 53706, USA

E-mail contact: ansgar.reiners *at* astro.physik.unigoettingen.de

We show high-resolution spectra of the eclipsing brown dwarf binary 2MASS J05352184-0546085 taken at the two opposite radial velocity maxima. Comparisons of the TiO bands to model and template spectra are fully consistent with the temperatures previously derived for this system. In particular, the reversal of temperatures with mass - in which the higher mass primary is cooler than its companion - is confirmed. We measure the projected rotation velocities of the components; the primary is rotating at least twice as rapidly as the secondary. At the two radial velocity maxima, Hα emission lines of both components stick out to either sides of the Hα central wavelength, which is dominated by nebula emission. This enables us to model the individual Hα lines of the primary and the secondary. We find that the Hα emission from the primary is at least 7 times stronger than the emission from the secondary. We conclude that the temperature reversal is very likely due to strong magnetic fields inhibiting convection on the primary.

Published by The Astrophysical Journal Letters (Vol. 671, p. L149)

EF Chamaeleontis: Warm Dust Orbiting a Nearby 10 Myr Old Star

Joseph H. Rhee[1], Inseok Song[2] and B. Zuckerman[3]

[1] Gemini Observatory, 670 North A'ohoku Place, Hilo, HI 96720; current address, Department of Physics and Astronomy, Box 951547, University of California, Los Angeles, CA 900951562, USA
[2] Gemini Observatory, 670 North A'ohoku Place, Hilo, HI 96720, USA

[3] Department of Physics and Astronomy, Box 951547, University of California, Los Angeles, CA 900951562; NASA Astrobiology Institute, USA

E-mail contact: rhee *at* astro.ucla.edu

Most Vegalike stars have farinfrared excess (60 μm or longward in IRAS, ISO, or Spitzer MIPS bands) and contain cold dust ($\lesssim$150 K) analogous to the Sun's Kuiper Belt region. However, dust in a region more akin to our asteroid belt and thus relevant to the terrestrial planet building process is warm and produces excess emission in midinfrared wavelengths. By crosscorrelating Hipparcos dwarfs with the MSX catalog, we found that EF Cha, a member of the recently identified, $\sim$10 Myr old, "ChaNear" moving group, possesses prominent midinfrared excess. Nband spectroscopy reveals a strong emission feature characterized by a mixture of small, warm, amorphous, and possibly crystalline silicate grains. Survival time of warm dust grains around this A9 star is $\lesssim 10^5$ yr, much less than the age of the star. Thus, grains in this extrasolar terrestrial planetary zone must be of a "second generation" and not a remnant of primordial dust and are suggestive of substantial planet formation activity. Such second generation warm excess occurs around 13% of the earlytype stars in nearby young stellar associations.

Published by The Astrophysical Journal (Vol. 671, p. 616)

The T Tauri star RY Tau as a case study of the inner regions of circumstellar dust disks

A. A. Schegerer[1], S. Wolf[1], Th. Ratzka[2] and Ch. Leinert[1]

[1] Max-Planck-Institut fuer Astronomie, Koenigstuhl 17, 69117 Heidelberg, Germany
[2] Astrophysikalisches Institut Potsdam, An der Sternwarte 16, 14482 Potsdam, Germany

E-mail contact: schegerer *at* mpia.de

We study the inner region ($\sim$1.0 AU up to a few 10 AUs) of the circumstellar disk around the "classical" T Tauri star RY Tau. Our aim is to find a physical description satisfying the available interferometric data, obtained with the mid-infrared interferometric instrument at the Very Large Telescope Interferometer, as well as the spectral energy distribution in the visible to millimeter wavelength range. We also compare the findings with the results of similar studies, including those of intermediate-mass Herbig Ae/Be stars. Our analysis is done within the framework of a passively heated circumstellar disk, which is optionally supplemented by the effects of accretion and an added envelope. To achieve a more consistent and realistic model, we used our continuum transfer code MC3D. In addition, we studied the shape of the 10 μm silicate emission feature in terms of the underlying dust population, both for single-dish and for interferometric measurements. We show that a modestly flaring disk model with accretion can explain both the observed spectral energy distribution and the mid-infrared visibilities obtained with the mid-infrared infrared instrument. We found an interesting ambiguity: a circumstellar active disk model with an added envelope, and a lower accretion rate than in the active disk model without envelope, could represent the observations equally as well. This type of model with the envelope should be considered a viable alternative in future models of other T Tauri stars. The approach of a disk with a puffed-up inner rim wall and the influence of a stellar companion is also discussed. We also investigate the influence of various fit parameters on the outcome of the radiative transfer modeling. From the study of the silicate emission feature we see evidence for dust evolution in a T Tauri star, with a decreasing fraction of small amorphous and an increasing fraction of crystalline particles closer to the star.

Accepted by Astronomy & Astrophysics

Morphological Evolution of Outflows from YSOs

Jonathan P. Seale[1] and Leslie W. Looney[1]

[1] Astronomy Department, University of Illinois, 1002 W. Green Street, Urbana, IL 61801, USA

E-mail contact: seale *at* uiuc.edu

We present Spitzer IRAC images that indicate the presence of cavities cut into the dense outer envelope surrounding very young pre-main sequence stars. These young stellar objects (YSOs) characterized by an outflow represent the earliest stages of star formation. Mid-infrared photons thermally created by the central protostar/disk are scattered by dust particles within the outflow cavity itself into the line of sight. We observed this scattered light from 27 nearby, cavity-resolved YSOs, and quantified the shape of the outflow cavities. Using the grid models of Robitaille et al. (2006), we matched model spectral energy distributions (SEDs) to the observed SEDs of the 27 cataloged YSOs

using photometry from IRAC, MIPS, and IRAS. This allows for the estimation of geometric and physical properties such as inclination angle, cavity density, and accretion rate. By using the relative parameter estimates determined by the models, we are able to deduce an evolutionary picture for outflows. Our work supports the concept that cavities widen with time, beginning as a thin jet-like outflow that widens to reveal the central protostar and disk until the protostellar envelope is completely dispersed by outflow and accretion.

Accepted by The Astrophysical Journal

http://eprintweb.org/S/article/astro-ph/0711.4164

Evidence for Misaligned Disks in the T Tauri Triple System: 10 um Super-Resolution with MMTAO and Markov Chains

Andrew Skemer[1], Laird Close[1], Philip Hinz[1], William Hoffmann[1], Matthew Kenworthy[1] and Douglas Miller[1]

[1] Steward Observatory, University of Arizona

E-mail contact: askemer *at* as.arizona.edu

Although T Tauri is one of the most studied young objects in astronomy, the nature of its circumstellar environment remains elusive due, in part, to the small angular separation of its three components (North-South and South a-b are separated by 0.68" and 0.12" respectively). Taking advantage of incredibly stable, high Strehl, PSFs obtained with Mid-IR adaptive optics at the 6.5 meter MMT, we are able to resolve the system on and off the 10 μm silicate dust feature (8.7μm, 10.55μm, and 11.86μm; 10% bandwidth), and broad N. At these wavelengths, South a-b are separated by only $\sim 0.3\lambda/D$. This paper describes a robust Markov Chain Monte Carlo technique to separate all three components astrometrically and photometrically, for the first time, in the mid-IR. Our results show that the silicate feature previously observed in the unresolved T Tau South binary is dominated by T Tau Sa's absorption, while Sb does not appear to have a significant feature. This suggests that a large circumbinary disk around Sa-Sb is not likely the primary source of cool dust in our line-of-sight, and that T Tau Sa is enshrouded by a nearly edge-on circumstellar disk. Surprisingly, T Tau Sb does not appear to have a similarly oriented disk.

Accepted by ApJ

http://lanl.arxiv.org/abs/0712.1595

Hydrodynamical processes in young binaries as a source of periodic variations of circumstellar extinction

N.Ya. Sotnikova[1] and V.P. Grinin[1,2]

[1] The Sobolev Astronomical Institute, St. Petersburg University, Russia
[2] Pulkovo Astronomical Observatory, 196140, St. Petersburg, Russia

E-mail contact: nsot *at* astro.spbu.ru

Hydrodynamical models of a young binary accreting the matter from remnants of a protostellar cloud are calculated by means of the SPH method. It is shown that under a small inclination of the plane system to the line-of-sight, periodic changes in a column concentration of the matter in the projection onto the main component take place. This may result in the periodic changes in the extinction accompanied with variations in the brightness of the primary. In a general case, three periodic components are possible. The first one has a period equal to the orbital one, and is caused by the streams of the matter penetrating into the inner regions of the binary. The second component has a period of 5 - 8 times greater than the orbital one, and is connected with the density waves generating in the circumbinary (CB) disk. At last, the third, greatest period is caused by the precession of the inner regions of the CB disk. Interrelation between the amplitudes of these cycles depends on the model parameters as well as on the inclination of the system and its orientation in space. It is shown the at the dust to gas ratio 1:100 and the dust opacity = 250 cm$^2 g^{-1}$ the amplitude of the brightness variations in the V band can reach 1^m at the mass accretion rate onto the system components $10^{-8} M_\odot$ per year and the inclination angle of the system plane to the line of sight 10 degrees. We discuss the possible applications of the model to the UX Ori type stars.

Accepted by Astron. Letters (v.33, 667)

The Circumstellar Environment of High-Mass Protostellar Objects. IV. $C^{17}O$ Observations and Depletion

H.S. Thomas[1] and G.A. Fuller[1]

[1] Jodrell Bank Centre for Astrophysics, Alan Turing Building, University of Manchester, Manchester, M13 9PL, UK

E-mail contact: G.Fuller *at* manchester.ac.uk

The presence of depletion (freeze-out) of CO around low-mass protostars is well established. Here we observe 84 candidate young high-mass sources in the rare isotopologues $C^{17}O$ and $C^{18}O$ to investigate whether there is evidence for depletion towards these objects. Observations of the $J = 2 \rightarrow 1$ transitions of $C^{18}O$ and $C^{17}O$ are used to derive the column densities of gas towards the sources and these are compared with those derived from submillimetre continuum observations. The derived fractional abundance suggests that the CO species show a range of degrees of depletion towards the objects. We then use the radiative transfer code RATRAN to model a selection of the sources to confirm that the spread of abundances is not a result of assumptions made when calculating the column densities. We find a range of abundances of $C^{17}O$ that cannot be accounted for by global variations in either the temperature or dust properties and so must reflect source to source variations. The most likely explanation is that different sources show different degrees of depletion of the CO. Comparison of the $C^{17}O$ linewidths of our sources with those of CS presented by other authors reveal a division of the sources into two groups. Sources with a CS linewidth $> 3\,\mathrm{km\,s^{-1}}$ have low abundances of $C^{17}O$ while sources with narrower CS lines have typically higher $C^{17}O$ abundances. We suggest that this represents an evolutionary trend. Depletion towards these objects shows that the gas remains cold and dense for long enough for the trace species to deplete. The range of depletion measured suggests that these objects have lifetimes of $2 - 4 \times 10^5$ years.

Accepted by Astronomy and Astrophysics

http://arxiv.org/abs/0712.1512

The Non-Thermal Radio Jet Toward NGC 2264

Alfonso Trejo and Luis F. Rodríguez

Centro de Radioastronomía y Astrofísica, UNAM. Apdo. Postal 3-72, Morelia, Michoacán, 58089 México

E-mail contact: a.trejo and l.rodriguez *at* astrosmo.unam.mx

We report sensitive VLA 3.6 cm radio observations toward the head of the Cone nebula in NGC 2264, made in 2006. The purpose of these observations was to study a non-thermal radio jet recently discovered, that appears to emanate from the head of the Cone nebula. The jet is highly polarized, with well-defined knots, and one-sided. The comparison of our images with 1995 archive data indicates no evidence of proper motions nor polarization changes. We find reliable flux density variations in only one knot, which we tentatively identify as the core of a quasar or radio galaxy. An extragalactic location seems to be the best explanation for this jet.

Accepted by The Astronomical Journal

VLTI/MIDI 10 m Interferometry of the Forming Massive Star W33A

W. J. de Wit[1], M. G. Hoare[1], R. D. Oudmaijer[1] and J. C. Mottram[1]

[1] School of Physics and Astronomy, University of Leeds, Leeds LS2 9JT, UK

E-mail contact: phywjmdw *at* ast.leeds.ac.uk

We report on resolved interferometric observations with VLTI/MIDI of the massive young stellar object (MYSO) W33A. The MIDI observations deliver spectrally dispersed visibilities with values between 0.03 and 0.06, for a baseline of 45 m over the wavelength range 813 μm. The visibilities indicate that W33A has a FWHM size of approximately 120 AU ($0.030''$) at 8 μm that increases to 240 AU at 13 μm, scales previously unexplored among MYSOs. This observed trend is consistent with the temperature falling off with distance. Onedimensional (1D) dust radiative transfer models are simultaneously fit to the visibility spectrum, the strong silicate feature, and the shape of the midinfrared spectral energy distribution (SED). For any powerlaw density distribution, we find that the sizes (as implied by the visibilities) and the stellar luminosity are incompatible. A reduction to a third of W33A's previously adopted luminosity is

required to match the visibilities; such a reduction is consistent with new highresolution 70 μm data from Spitzer's MIPSGAL survey. We obtain best fits for models with shallow dust density distributions of $r^{-0.5}$ and $r^{-1.0}$ and for increased optical depth in the silicate feature produced by decreasing the interstellar medium (ISM) ratio of graphite to silicates and using optical grain properties of Ossenkopf et al.

Published by The Astrophysical Journal Letters (Vol. 671, p. L169)

X-ray and IR Point Source Identification and Characteristics in the Embedded, Massive Star-Forming Region RCW 108

Scott J. Wolk[1], Bradley D. Spitzbart[1], Tyler L. Bourke[1], Robert A. Gutermuth[1], Miquela Vigil[2] and Fernando Comerón[3]

[1] Harvard–Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

[2] Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, MA 02420, USA

[3] European Southern Observatory, Karl-Schwarzschild Strasse 2, D-85748 Garching bei München, Germany

E-mail contact: swolk *at* cfa.harvard.edu

We report on the results of an approximately 90 ks *Chandra* observation of a complex region that hosts multiple sites of recent and active star formation in ARA OB1a. The field is centered on the embedded cluster RCW 108–IR and includes a large portion of the open cluster NGC 6193. We detect over 420 X–ray sources in the field and combined these data with deep near-IR, *Spitzer/IRAC* and MSX mid–IR data. We find about 360 of the X-ray sources have near–IR counterparts. We divide the region into 5 parts based on the X-ray point source characteristics and extended 8 micron emission. The most clearly defined regions are the central region – identified by embedded sources with high luminosities in the both the near–IR and X-ray as well as high X-ray temperatures ($\sim$ 3 keV) and the eastern region – identified by low extinction and $\sim$ 1 keV X-ray temperatures. Other regions, identified by their directional relationship to RCW 108–IR are less uniform – representing combinations of the first two regions, independent star formation epochs, or both. The cluster members range in X-ray luminosity from 10^{29} to 10^{33} ergs s^{-1}. Over 18% percent of the cluster members with over 100 counts exhibit flares. All sources with over 350 counts are variable. Overall about 10% (16% in RCW 108–IR) appear to have optically thick disks as derived from their position in the (J−H), (H−K) diagram. The disk fraction becomes much higher when IRAC data are employed. The largest fraction of X-ray sources are best described as possessing some disk material via a more detailed extinction fitting. We fit the bulk of the X-ray spectra as absorbed Raymond-Smith type plasmas and find the column to the RCW 108-IR members varies from 10^{21} to 10^{23}cm^{-2}. We find that the field contains 41 candidate O or B stars and estimate that the total number of pre–main sequence stars in the field is about 1600 $\pm$ 200. Approximately 800 are confined to the $3'$ ($\sim$ 1.1 pc) central region.

Accepted by The Astronomical Journal

http://arxiv.org/abs/0712.3005

Particle stirring in turbulent gas disks: Including orbital oscillations

Andrew N. Youdin[1] and Youram Lithwick[1]

[1] C.I.T.A., University of Toronto, 60 St. George St., Toronto, ON M5S 3H8, Canada

We describe the diffusion and random velocities of solid particles due to stochastic forcing by turbulent gas. We include the orbital dynamics of Keplerian disks, both in-plane epicycles and vertical oscillations. We obtain a new result for the diffusion of solids. The Schmidt number (ratio of gas to particle diffusivity) is Sc$\approx 1 + (\Omega t_{stop})^2$, in terms of the particle stopping time t_{stop} and the orbital frequency Ω. The standard result, Sc$=1 + t_{stop}/t_{eddy}$, in terms of the eddy turnover time, t_{eddy}, is shown to be incorrect. The main difference is that Sc rises quadratically, not linearly, with stopping time. Consequently, particles larger than $\sim$ 10 cm in protoplanetary disks will suffer less radial diffusion and will settle closer to the midplane. Such a layer of boulders would be more prone to gravitational collapse. Our predictions of RMS speeds, vertical scale height and diffusion coefficients will help interpret numerical simulations. We confirm previous results for the vertical stirring of particles (scale heights and random velocities), and add a correction for arbitrary ratios of eddy to orbital times. The particle layer becomes thinner for $t_{eddy} > 1/\Omega$ with the strength of turbulent diffusion held fixed. We use two analytic techniquesthe HinzeTchen formalism and the

FokkerPlanck equation with velocity diffusionwith identical results when the regimes of validity overlap. We include simple physical arguments for the scaling of our results.

Published by Icarus (Vol. 192, p. 588)

Massive Star Formation Near Sgr A* and Bimodal Star Formation in the Nuclear Disk

F. Yusef-Zadeh[1] and M. Wardle[2]

[1] Northwestern University, Dept Physics and Astronomy, Evanston, IL. 60208, USA
[2] Department of Physics, Macquarie University, Sydney NSW 2109, Australia

E-mail contact: zadeh *at* northwestern.edu

The history of star formation in the strong gravitational potential of the Galactic center has been of much interest, recently. We propose that the sub-parsec-scale disk of massive stars orbiting the massive black hole at the Galactic center can be interpreted in terms of partial accretion of extended Galactic center clouds, such as the 50 km/s molecular cloud, as these clouds envelop Sgr A* on their passage through the inner Galactic center. The loss of angular momentum of the captured cloud material by self-interaction subsequent to gravitationally focusing by Sgr A* naturally creates a compact gaseous disk of material close to Sgr A* in which star formation takes place. On a larger scale the formation of massive clusters such as the Arches and Quintuplet clusters or on-going massive star formation such as Sgr B2 could also be triggered by cloud-cloud collisions due to gravitational focusing in the deep potential of the central bulge.

Unlike the violent and high-pressure environment of clustered star formation triggered by cloud-cloud collision, there are also isolated pockets of star formation and quiescent dense clouds. These sites suggest an inefficient, slow mode of star formation. We propose enhanced cosmic rays in the nuclear disk may be responsible for inhibiting the process of star formation in this region. In particular, we argue that the enhanced ionization rate due to the impact of cosmic-ray particles is responsible for lowering the efficiency of on-going star formation in the nuclear disk of our Galaxy. The higher ionization fraction and higher thermal energy due to the impact of these electrons may also reduce MHD wave damping which contributes to the persistence of the high velocity dispersion of the molecular gas in the nuclear disk.

Accepted by

http://arxiv.org/abs/0712.1245

Forming an Early O-type Star Through Gas Accretion?

Luis A. Zapata[1], Aina Palau[2], Paul T. P. Ho[3,4], Peter Schilke[1], Robin T. Garrod[1], Luis F. Rodríguez[5], and Karl Menten[1]

[1] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121, Bonn, Germany
[2] Laboratorio de Astrofísica Espacial y Física Fundamental, Apartado 78 E-28691, Villanueva de la Cañada, Madrid, Spain.
[3] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[4] Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan
[5] CRyA, Universidad Nacional Autónoma de México, Apdo. Postal 3-72 (Xangari), 58089 Morelia, Michoacán, México

E-mail contact: lzapata *at* mpifr-bonn.mpg.de

We present high angular resolution ($\sim 3''$) and sensitive 1.3 mm continuum, cyanogen (CN) and vinyl cyanide (C_2H_3CN) line observations made with the Submillimeter Array (SMA) toward one of most highly obscured objects of the W51 IRS2 region, W51 North. We find that the CN line exhibits a pronounced inverse P-Cygni profile indicating that the molecular gas is infalling inwards this object with a mass accretion rate between 4 and 7×10^{-2} $M_\odot$ yr^{-1}. The C_2H_3CN traces an east-west rotating molecular envelope that surrounds either a single obscured (proto)star with a kinematic mass of 40 $M_\odot$ or a small central cluster of B-type stars and that is associated with a compact high velocity bipolar outflow traced by H_2O masers and SiO molecular emission. We thus confirm that the W51 North region is part of the growing list of young massive star forming regions that have been associated with infalling motions and with large mass accretion rates ($\sim 10^{-2}$ – 10^{-4} $M_\odot$ yr^{-1}), strengthening the evidence for massive stars forming with very high accretion rates sufficient to quench the formation of an UCHII region.

Accepted by Astronomy and Astrophysics

Massive Star Formation: The Power of Interferometry

Henrik Beuther[1]

[1] Max Planck Institute for Astronomy

E-mail contact: beuther *at* mpia.de

This article presents recent work to constrain the physical and chemical properties in high-mass star formation based largely on interferometric high-spatial-resolution continuum and spectral line studies at (sub)mm wavelengths. After outlining the concepts, potential observational tests, a proposed evolutionary sequence and different possible definitions for massive protostars, four particular topics are highlighted: (a) What are the physical conditions at the onset of massive star formation? (b) What are the characteristics of potential massive accretion disks and what do they tell us about massive star formation in general? (c) How do massive clumps fragment, and what does it imply to high-mass star formation? (d) What do we learn from imaging spectral line surveys with respect to the chemistry itself as well as for utilizing molecules as tools for astrophysical investigations?

Accepted by the German Astronomical Society, review on the occasion of the Ludwig Biermann prize

http://www.mpia.de/homes/beuther/papers.html

The rotational evolution of young low mass stars

Jerome Bouvier[1]

[1] Laboratoire d'Astrophysique, Observatoire de Grenoble, Université Joseph Fourier, B.P.53, 38041 Grenoble, Cedex 9, France

E-mail contact: jbouvier *at* obs.ujf-grenoble.fr

Star-disk interaction is thought to drive the angular momentum evolution of young stars. In this review, I present the latest results obtained on the rotational properties of low mass and very low mass pre-main sequence stars. I discuss the evidence for extremely efficient angular momentum removal over the first few Myr of pre-main sequence evolution and describe recent results that support an accretion-driven braking mechanism. Angular momentum evolution models are presented and their implication for accretion disk lifetimes discussed.

Accepted by IAU S243

http://arxiv.org/abs/0712.2988

The Sun in Time: Activity and Environment

M. Güdel[1,2]

[1] Paul Scherrer Institut, Würenlingen and Villigen, CH-5232 Villigen PSI, Switzerland;
[2] Max-Planck-Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany.

E-mail contact: guedel *at* astro.phys.ethz.ch

The Sun's magnetic activity has steadily declined during its main-sequence life. While the solar photospheric luminosity was about 30% lower 4.6 Gyr ago when the Sun arrived on the main sequence compared to present-day levels, its faster rotation generated enhanced magnetic activity; magnetic heating processes in the chromosphere, the transition region, and the corona induced ultraviolet, extreme-ultraviolet, and X-ray emission about 10, 100, and 1000 times, respectively, the present-day levels, as inferred from young solar-analog stars. Also, the production rate of accelerated, high-energy particles was orders of magnitude higher than in present-day solar flares, and a much stronger wind escaped from the Sun, permeating the entire solar system. The consequences of the enhanced radiation and particle fluxes from the young Sun were potentially severe for the evolution of solar-system planets and moons. Interactions of high-energy radiation and the solar wind with upper planetary atmospheres may have led to the escape of important amounts of atmospheric constituents. The present dry atmosphere of Venus and the thin atmosphere of Mars may be a product of early irradiation and heating by solar high-energy radiation. High levels of magnetic activity are also inferred for the pre-main sequence Sun. At those stages, interactions of high-energy radiation and particles with the

circumsolar disk in which planets eventually formed were important. Traces left in meteorites by energetic particles and anomalous isotopic abundance ratios in meteoritic inclusions may provide evidence for a highly active pre-main sequence Sun. The present article reviews these various issues related to the magnetic activity of the young Sun and the consequent interactions with its environment. The emphasis is on the phenomenology related to the production of high-energy photons and particles. Apart from the activity on the young Sun, systematic trends applicable to the entire main-sequence life of a solar analog are discussed.

Accepted by The Living Reviews in Solar Physics (http://solarphysics.livingreviews.org/)

http://www.astro.phys.ethz.ch/papers/guedel/papers.html

The Star Formation Newsletter is a vehicle for fast distribution of information of interest for astronomers working on star formation and molecular clouds. You can submit material for the following sections: *Abstracts of recently accepted papers* (only for papers sent to refereed journals), *Abstracts of recently accepted major reviews* (not standard conference contributions), *Dissertation Abstracts* (presenting abstracts of new Ph.D dissertations), *Meetings* (announcing meetings broadly of interest to the star and planet formation and early solar system community), *New Jobs* (advertising jobs specifically aimed towards persons within the areas of the Newsletter), and *Short Announcements* (where you can inform or request information from the community).

Latex macros for submitting abstracts and dissertation abstracts (by e-mail to reipurth@ifa.hawaii.edu) are appended to each issue of the newsletter. You can also submit via the Newsletter web interface at http://www2.ifa.hawaii.edu/star-formation/index.cfm
.

The Star Formation Newsletter is available on the World Wide Web at http://www.ifa.hawaii.edu/users/reipurth or at http://www.eso.org/gen-fac/pubs/starform/ .

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the Newsletter bounces back from an address for three consecutive months, the address is deleted from the mailing list.

Infrared Spectro-Interferometry of Massive Stars: Disks, Winds, Outflows, and Stellar Multiplicity

Stefan Kraus

Max-Planck-Institute for Radioastronomy, Germany

Max-Planck-Institute for Radioastronomy, Auf dem Huegel 69, 53121 Bonn, Germany

Electronic mail: skraus *at* mpifr-bonn.mpg.de

Ph.D dissertation directed by: Gerd Weigelt, Thomas Preibisch

Ph.D degree awarded: June 2007

Interferometry is the ultimate technology for overcoming the limitations which diffraction and the atmosphere-induced seeing impose on the resolution achievable with ground-based telescopes. The latest generation of long-baseline interferometric instruments (in particular VLTI/AMBER and VLTI/MIDI), combines the high spatial resolution (typically a few milliarcseconds) with spectroscopic capabilities, allowing one to characterize the geometry of a continuum-emitting region over a wide spectral range or to spatially resolve the emitting region of Doppler-broadened spectral lines in many velocity channels.

One branch of astrophysics which might particularly benefit from these advances in technology is the study of massive (O–B type) stars. In order to characterize these stars and their companions and to study accretion and outflow processes in their vicinity with unprecedented angular resolution, we have performed interferometric studies on four key objects, representing the still most enigmatic evolutionary phases of massive stars; namely the pre-main-sequence (MWC 147, NGC 7538 IRS1, θ^1Ori C) and the post-main-sequence phase (η Carinae).

MWC 147: As indicated by its strong infrared excess, this young Herbig Be star (B6-type) is still associated with residual material from its formation; maybe arranged in a circumstellar disk. In order to investigate the geometry of the material, we combined, for the first time, long-baseline spectro-interferometric observations at near- (NIR) and mid-infrared (MIR) wavelengths (using VLTI/AMBER, VLTI/MIDI, and archival PTI data). Fitting analytic models to the obtained interferometric data revealed a significant elongation of the continuum-emitting region. For a physical interpretation, we modeled the geometry of the dust distribution using 2-D radiative transfer simulations of Keplerian disks with and without a puffed-up inner rim, simultaneously fitting the wavelength-dependent visibilities and the SED, which we complemented with archival *Spitzer*/IRS spectra. Surprisingly, we found that passive disk models, which can reproduce the SED well, are in strong conflict with the interferometric data. However, when including emission from an optically thick inner gaseous disk, good quantitative agreement was found for all observables, suggesting that MWC 147 harbours a still actively accreting disk.

NGC 7538 IRS1/2: NGC 7538 IRS1 is a high-mass (O7-type) protostar with a CO outflow, an associated ultracompact H II region, and a linear methanol maser structure, which might trace a Keplerian-rotating circumstellar disk. We investigated the NIR morphology of the source with unprecedented resolution using NIR bispectrum speckle interferometry obtained at the BTA 6 m and the MMT 6.5 m telescopes. Our high-dynamic range images show fan-shaped outflow structures, in which we detected 18 stars and several blobs of diffuse emission. Complementary archival *Spitzer*/IRAC images were used to relate the detected structures with the outflow at larger scales. We found a misalignment of various outflow axes and interpreted this in the context of a disk precession model, also using molecular hydrodynamic simulations. As a possible triggering mechanism, we identified non-coplanar tidal interaction of an (yet undiscovered) close companion with the circumbinary disk. Finally, our observations resolved the nearby massive protostar NGC 7538 IRS2 as a close binary with a separation of 195 mas, finding indications for shock interaction between the outflows from IRS1 and IRS2.

θ^1Ori C/D: Located in the Orion Trapezium Cluster, θ^1Ori C is one of the youngest and nearest high-mass (O5–O7) stars. The star is also known to be a close binary system. We traced the orbital motion from 1997.8 to 2004.8 using visual and NIR bispectrum speckle interferometry at the BTA 6 m telescope. In 2005.9, we obtained first IOTA long-baseline interferometry on the θ^1Ori C system, allowing us to derive preliminary solutions for the dynamical orbit and the dynamical mass. Taking the measured flux ratio and the derived location in the HR-diagram into account, we estimated the spectral types and masses of θ^1Ori C1 and C2 to be O5.5 ($M = 34.0\ M_\odot$) and O9.5 ($M = 15.5\ M_\odot$), respectively. Thus, the companion C2 appears to be much more massive than previously thought, suggesting strong

wind-wind interaction during the periastron passage, which we predict for epoch 2007.5 with a small physical separation of only ~ 1.5 AU. From the IOTA data on θ^1Ori C, we reconstructed the first optical aperture synthesis image of a young star. We also obtained IOTA data for θ^1Ori D, which appears resolved, perhaps indicating the presence of a close, faint companion.

η Carinae: Using VLTI/AMBER, we performed the first NIR spectro-interferometry of the Luminous Blue Variable (LBV) η Car, simultaneously obtaining high spatial and spectral resolutions ($\lambda/\Delta\lambda = 1\,500$ and $12\,000$). The measured wavelength-dependent visibilities, differential phases, and closure phases were used to constrain the geometry of the continuum-emitting region, as well as the Brγ 2.166 μm and He I 2.059 μm line-emitting region. We compared the measured visibilities with predictions of the radiative transfer model of Hillier et al. (2001), finding good agreement. For the interpretation of the non-zero differential and closure phases measured within the Brγ line, we present a simple geometric model of an inclined, latitude-dependent wind zone. Thus, our observations support theoretical models of anisotropic winds from fast-rotating, luminous hot stars with enhanced high-velocity mass loss near the polar regions. In the He I 2.059 μm line, we measured non-zero phases as well, indicating asymmetries in the brightness distribution, which we discuss in the context of wind-wind interaction between η Car and its hypothetical hot binary companion. Using simulations, we examined the possibility to directly detect this companion in future observations.

Besides these astrophysical results of my dissertation, I present work related to methodological and technical aspects of infrared interferometry. The principles of a data reduction software developed for IOTA/IONIC3 and a pipeline for VLTI/AMBER are discussed. Furthermore, I summarize comparative studies which aim to evaluate the performance of different image reconstruction algorithms in order to explore the prospects and limitations of optical aperture synthesis imaging.

http://www.mpifr-bonn.mpg.de/staff/skraus/papers/kraus.Diss.pdf

Evolution of the Dust and the Structure of Circumstellar Disks around T Tauri stars - Analysis and Modeling of highly spatial Observations in various wavelength regimes

Alexander Schegerer

Ruprecht-Karls-Universitaet Heidelberg, Germany

Koenigstuhl 17, 69117 Heidelberg, Germany

Electronic mail: schegerer *at* mpia.de

Ph.D dissertation directed by: Sebastian Wolf

Ph.D degree awarded: October 2007

The key issues of this thesis is the investigation of the inner regions of the circumstellar disks around TTauri stars as well as the analysis of the properties of circumstellar dust and ice particles and their influence on the disk structure. Using theoretically calculated spectra for different dust components as reference, the shape of the 10um emission feature in the spectra of young stellar objects provides hints for the evolutionary state of silicate dust. The silicate features of 27 TTauri objects are analysed in order to find possible correlations between the silicate dust composition and stellar properties. Correspondingly, similar informations about the evolutionary status of water ice in circumstellar disks can be derived from the absorption band at 3um. For the first time crystallised water ice was detected in the spectrum of a TTauri object. Our primary tool of the analysis of the density and temperature structure of circumstellar disks is a Monte-Carlo program for radiative transfer simulations. In an extended modeling approach the density structure of the disk is self-consistently determined by the relation of hydrostatical equilibrium. The numerical implementation is tested in a benchmark study. Interferometric observations of 14 TTauri objects in the mid- and near-infrared wavelength range provide informations about the spatial distribution of warm and hot dust. Furthermore, it is found that the evolutionary state of silicate dust depends on its radial location in the circumstellar disks of TTauri stars. For the modeling of all the interferometric measurements and of the spectral energy distributions of the observed objects, simultaneously, the approach of a passive disk and an active disk with or without a circumstellar envelope is used, respectively. By means of the interferometric measurements, the number of models that can reproduce the spectral energy distribution, is strongly reduced.

Post-doctoral Position at ETH Zurich, Switzerland

The Institute of Astronomy of ETH Zurich is envolved in ESA's Herschel Space Observatory to be launched in late 2008, and in particular with the HIFI instrument. A strong infrastructure for Herschel data analysis is being built up. A new postdoctoral research position is available as part of our preparation for the data evaluation. The successful candidate will work with the group of Arnold Benz, Manuel Guedel and international collaborators on observational studies of star formation regions and protoplanetary disks. The candidate is expected to participate in Herschel garanteed and open time proposals and to conduct independent ground-based observations. Experience in high-resolution infrared or radio/sub-mm spectroscopy including line data analysis and/or chemical modeling of young stellar systems is highly desirable. Experience in radiative transfer modeling in the far-IR/submm wavelength range is considered an asset.

Candidates must obtain a Ph.D. in Astronomy or Physics prior to the starting date. The appointment is for two years and will be renewable for two more years pending budgetary approval. Salaries will be approximately CHF 80,000 - 90,000 (about Euro 48,000 - 55,000), depending on experience.

Applicants should send a CV, a list of publications, a brief description of past and proposed research (maximum 3 pages each), and should arrange for two letters of recommendation to be sent to Prof. Dr. Arnold Benz, Institute of Astronomy, ETH, CH-8092 Zurich, Switzerland. Applications may be submitted electronically to benz@astro.phys.ethz.ch. Consideration of completed applications will begin February 1, 2008 and will continue until a suitable candidate is identified.

Postdoctoral Fellowship in star formation and astrochemistry

A 4-yr postdoctoral fellowship is available at Leiden Observatory within the Molecular Astrophysics group, as part of a long-term program to study the physical and chemical evolution of star- and planet-forming regions through a combination of theory and observations at submillimeter and infrared wavelengths. In addition to carrying out a personal research program, the successful candidate is expected to take a significant role in the approved Herschel key program on "Water in Star-Forming Regions". The appointment is initially for two years, with the possibility of renewal for another two years. It can start anytime up to Fall 2008. Candidates with an observational and/or modeling background in astrochemistry, star formation, or circumstellar disks are encouraged to apply. See www.strw.leidenuniv.nl/∼ewine and www.strw.leidenuniv.nl/WISH for more information.

Applicants should send a curriculum vitae, publication list, and a statement of research interests, and arrange for three letters of recommendation to be sent to Professor E.F. van Dishoeck at

LEIDEN OBSERVATORY, P.O. Box 9513, 2300 RA Leiden, The Netherlands
Fax: +31-71-5275819;
e-mail submission: jobs *at* strw.leidenuniv.nl

The closing date for applications and all letters of recommendation has been extended to January 3, 2008.

J. Mayo Greenberg scholarship prize 2008

The purpose of the J. Mayo Greenberg scholarship is to provide an opportunity for a talented graduate student to carry out research at Leiden Observatory for a period up to 9 months in one of the following areas: laboratory astrophysics, dust in the local and distant universe, comet formation, origin of life. Preference will be given to applicants from developing countries.

See http://www.strw.leidenuniv.nl/jobs/miley-green.php?node=-1 for more details. Deadline for application is December 31, 2007

The first international Workshop on

The UX Ori type stars and related topics

Crimean Astrophysical Observatory, Ukraine
Pulkovo Astronomical Observatory, St. Petersburg, Russia
Yalta, 25-29 May 2008

Owing to the specific orientation of circumstellar (CS) disks (almost edge-on) the UX Ori type stars (UXORs) are an excellent laboratory for studies of CS disks, their structure and dynamical state. The goal of this workshop is to summarize the observational properties of UXORs and discuss current models suggested for their explanations

The main topics are:

- Optical photometry and polarimetry of UXORs
- Activity of UXORs in the infrared
- Spectral energy distribution of UXORs and related objects
- The nearest environment of UXORs in the light of interferometric observations
- Circumstellar disks and accretional activity of UXORs
- Related phenomena: R CrB stars, exotic eclipsing systems (KH 15D, H 187, etc.)

SOC: C. Dullemond, C. Eiroa, G. Gahm, K. Grankin, V. Grinin (co-chair), A. Natta (co-chair), R. Oudmaijer, T. Prusti, A. Rostopchina, M. van den Ancker

Contact e-mail: uxors *at* meta.ua

URL: http://www.crao.crimea.ua/conf/uxors

The Cosmic Agitator - Magnetic Fields in the Galaxy
60 years of studies of the interstellar magnetic field

2008 March 26-29 Lexington KY, USA

New: Program schedule now available (please see website link below)

Reminder: Registration deadline - 2008 Jan 25

The magnetic field of the galaxy was discovered in observations made in 1948. Since that time, the galactic magnetic field has challenged (and often annoyed) observers and theorists alike. This meeting will celebrate sixty years of studies of the interstellar magnetic field.

The meeting will take place in Lexington, Kentucky USA, in the heart of the beautiful Bluegrass region. Lexington and its environs are known for picturesque countryside, thoroughbred race horses, and fine bourbon whiskey asleep many years in the wood.

The meeting web site is http://thunder.pa.uky.edu/magnetic - a program schedule is now available at this web site, including an updated list of speakers. Please note that the registration deadline is fast approaching (2008 Jan 25), and meeting dates are 2008 Mar 26-29. Interested participants are urged to register at the web site mentioned above, in order to ensure availability of their preferred slots for contributed talks/posters.

Oral presentations - Oral presentations will occur in the auditorium of the William T. Young Library on the University of Kentucky campus. There will be review talks, approximately 30 minutes long with a 10 minute discussion. There will also be contributed talks, approximately 15 minutes long with a 5 minute discussion.

Poster presentations - The poster session will run concurrently with the oral presentations throughout the conference. The poster session will occur in a gallery adjacent to the conference auditorium. Half hour poster and coffee break periods are scheduled in the middle of each oral session. Coffee and snacks will be served in the poster session gallery, ensuring that posters receive ample attention throughout the conference.

X-Atlas: An Online Archive of Chandra's Stellar High Energy Transmission Gratings Observations

Owen W. Westbrook[1,2], Nancy Remage Evans[1], Scott J. Wolk[1], Vinay L Kashyap[1], Joy S. Nichols[1], Peter J. Mendygral[1,3], Jonathan D. Slavin,[1], Bradley D. Spitzbart[1] and Wayne L. Waldron[4]

[1] Harvard-Smithsonian Center for Astrophysics, 60 Garden St. Cambridge MA, USA

[2] Present Address: Massachusettes Institute of Technology, Cambridge MA, USA

[3] Present Address: University of Minnisota, Twin Cities, MN, USA

[4] Eureka Scientific, Oakland California, USA

E-mail contact: swolk *at* cfa.harvard.edu

The high-resolution X-ray spectroscopy made possible by the 1999 deployment of the Chandra X-ray Observatory has revolutionized our understanding of stellar X-ray emission. Many puzzles remain, though, particularly regarding the mechanisms of X-ray emission from OB stars. Although numerous individual stars have been observed in high-resolution, realizing the full scientific potential of these observations will necessitate studying the high-resolution Chandra dataset as a whole. To facilitate the rapid comparison and characterization of stellar spectra, we have compiled a uniformly processed database of all stars observed with the Chandra High Energy Transmission Grating (HETG). This database, known as X-Atlas, is accessible through a web interface with searching, data retrieval, and interactive plotting capabilities. For each target, X-Atlas also features predictions of the low-resolution ACIS spectra convolved from the HETG data for comparison with stellar sources in archival ACIS images. Preliminary analyses of the hardness ratios, quantiles, and spectral fits derived from the predicted ACIS spectra reveal systematic differences between the high-mass and low-mass stars in the atlas and offer evidence for at least two distinct classes of high-mass stars. A high degree of X-ray variability is also seen in both high and low-mass stars, including Capella, long thought to exhibit minimal variability. X-Atlas contains over 130 observations of approximately 25 high-mass stars and 40 low-mass stars and will be updated as additional stellar HETG observations become public. The atlas has recently expanded to non-stellar point sources, and Low Energy Transmission Grating (LETG) observations are currently being added as well.

Accepted by APJ Supplement Series

http://arxiv.org/abs/0712.0610