COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 131 — February 2007 Editor: Steve Skinner (coolnews@jila.colorado.edu)

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Stellar Abstracts

HV 11423: The Coolest Supergiant in the SMC

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We call attention to the fact that one of the brightest red supergiants in the SMC has recently changed its spectral type from K0-1 I (December 2004) to M4 I (December 2005) and back to K0-1 I (September 2006). An archival spectrum from the Very Large Telescope reveals that the star was even cooler (M4.5-M5 I) in December 2001. By contrast, the star was observed to be an M0 I in both October 1978 and October 1979. The M4-5 I spectral types is by far the latest type seen for an SMC supergiant, and its temperature in that state places it well beyond the Hayashi limit into a region of the H-R diagram where the star should not be in hydrostatic equilibrium. The star is variable by nearly 2 mag in V, but essentially constant in K. Our modeling of its spectral energy distribution shows that the visual extinction has varied during this time, but that the star has remained essentially constant in bolometric luminosity. We suggest that the star is currently undergoing a period of intense instability, with its effective temperature changing from 4300 K to 3300 K on the time-scale of months. It has one of the highest 12μm fluxes of any RSG in the SMC, and we suggest that the variability at V is due primarily to changes in effective temperature, and secondly, due to changes in the local extinction due to creation and dissipation of circumstellar dust. We speculate that the star may be nearing the end of its life.

Accepted by ApJ

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For preprints via ftp or WWW: http://www.lowell.edu/users/massey/hv11423.pdf.gz

Eclipsed X-ray Flares in Binary Stars: Geometrical Constraints on the Flare's Location and Size

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Aims: The observation of eclipses during X-rays flares taking place in active cool stars binaries allows us to calculate the position and size of the flares. This information cannot be derived by analyzing the decay of the flares, a frequently used approach in the literature that requires the assumption of a physical model. We make use of the eclipsing light curve to constrain the set of possible solutions, from the geometrical point of view, in two flares of Algol, and one flare in VW Cep.
Methods: We make use of a technique developed with the system SV Cam ($i \sim 90°$) and generalize it to binary systems with arbitrary inclination. The method simulates all possible geometrical situations that can produce the times of the four contacts of the eclipse. As an approximation we assume that the emitting region has a spherical shape that remains unchanged during the eclipse. We however show that this is a good approximation for the problem.
Results: The solutions observed indicate that in two of the three cases the flare cannot be polar ($|\theta| < 55°$) and in a third one the flare can be placed either near the pole or at other latitudes. The emitting regions must have a small size ($0.002 - 0.5R_*$), but if interpreted as the apex of coronal loops, their length could actually be up to 3.1 R_* for one of the Algol flares. These measurements imply a lower limit to the electron density in the emitting region between $\log n_e\,(\mathrm{cm}^{-3})$ 10.4 and 14.0, and a magnetic field between 70 and 3500 G. Similar results are found if the emitting region is assumed to be loop-shaped.

Accepted by A&A

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For preprints via ftp or WWW: http://laeff.esa.es/users/jsanz/Papers/Eclipses/eclipses.html

A Critical Test of Empirical Mass Loss Formulas Applied to Individual Giants and Supergiants

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To test our new, improved Reimers-type mass-loss relation, given by Schröder & Cuntz (2005), we take a look at a set of well-studied giant and supergiant stars, which are: α Boo (K1.5 III), 32 Cyg (K5 Ib), δ Sge (M2 II), α Sco (M1.5 Iab), α^1 Her (M5 Ib), and α Ori (M2 Iab). These stars, except α Boo, have spatially resolved circumstellar shells and winds — obtained directly or by means of a companion acting as a probing light source — resulting in relatively accurate, empirically determined mass-loss rates. Together with well-known physical parameters, the selected stars provide a powerful and critical observational venue for assessing the validity of parameterized mass-loss relations for cool winds not driven by molecules or dust. Furthermore, they encompass a significant range in luminosity (factor of 400), stellar radius (factor of 30), and stellar mass (factor of 10). The input data, especially the stellar masses, have been constrained using detailed stellar evolution models. In this study, star by star, we compare the relation previously published by Schröder & Cuntz (2005) with the original Reimers relation (1975), the Lamers relation (1981), and the two relations by de Jager and his group (1988, 1990). We find that only the relationship by Schröder & Cuntz agrees, within the error bars, with the observed mass-loss rates for all giants and supergiants.

Accepted by A&A

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Coronal Abundances in Orion Nebula Cluster Stars

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Following the Chandra Orion Ultradeep Project (COUP) observation, we have studied the chemical composition of the hot plasma in a sample of 146 X-ray bright pre-main sequence stars in the Orion Nebula Cluster (ONC). We report measurements of individual element abundances for a subsample of 86 slightly-absorbed and bright X-ray sources, using low resolution X-ray spectra obtained from the Chandra ACIS instrument. The X-ray emission originates from a plasma with temperatures and elemental abundances very similar to those of active coronae in older stars. A clear pattern of abundances vs. First Ionization Potential (FIP) if solar photospheric abundances are assumed as reference. The results are validated by extensive simulations. The observed abundance distributions are compatible with a single pattern of abundances for all stars, although a weak dependence on flare loop size may be present. The abundance of calcium is the only one which appears to vary substantially between stars, but this quantity is affected by relatively large uncertainties.

The ensemble properties of the X-ray bright COUP sources confirm that the iron in the emitting plasma is underabundant with respect to both the solar composition and to the average stellar photospheric values. Comparison of the present plasma abundances with those of the stellar photospheres and those of the gaseous component of the nebula, indicates a good agreement for all the other elements with available measurements, and in particular for the high-FIP elements (Ne, Ar, O, and S) and for the low-FIP element Si. We conclude that there is evidence of a significant chemical fractionation effect only for iron, which appears to be depleted by a factor 1.5–3 with respect to the stellar composition.

Accepted by ApJ

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Editor's Note: The above abstract is being cross-listed with the Star Formation Newsletter.

X-ray Emission from MP Muscae: An Old Classical T Tauri star

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We study the properties of X-ray emitting plasma of MP Mus, an old classical T Tauri star. We check whether an accretion process could produce the observed X-ray emission and we derive the accretion parameters and the characteristics of the shock-heated plasma. We compare the properties of MP Mus with those of younger classical T Tauri stars to test whether age is related to the properties of the X-ray emission plasma. XMM-Newton X-ray spectra allow us to measure plasma temperatures, abundances, and electron density. The density of cool plasma probes whether X-ray emission is produced by plasma heated in the accretion process. X-ray emission from MP Mus originates from high density cool plasma but a hot flaring component is also present, suggesting that both coronal magnetic activity and accretion contribute to the observed X-ray emission. We find a Ne/O ratio similar to that observed in the much younger classical T Tauri star BP Tau. From the soft part of the X-ray emission, mostly produced by plasma heated in the accretion shock, we derive a mass accretion rate of $5 \times 10^{-11}\,M_\odot\,yr^{-1}$.

Accepted by A&A (Letter)

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For preprints via ftp or WWW: http://www.astropa.unipa.it/Library/preprint.html

Editor's Note: The above abstract is being cross-listed with the Star Formation Newsletter.

Solar Cycle Prediction Using Precursors and Flux Transport Models

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We study the origin of the predictive skill of some methods to forecast the strength of solar activity cycles. A simple flux transport model for the azimuthally averaged radial magnetic field at the solar surface is used, which contains a source term describing the emergence of new flux based on observational sunspot data. We consider the magnetic flux diffusing over the equator as a predictor, since this quantity is directly related to the global dipole field from which a Babcock-Leighton dynamo generates the toroidal field for the next activity cycle. If the source is represented schematically by a narrow activity belt drifting with constant speed over a fixed range of latitudes between activity minima, our predictor shows considerable predictive skill with correlation coefficients up to 0.95 for past cycles. However, the predictive skill is completely lost when the actually observed emergence latitudes are used. This result originates from the fact that the precursor amplitude is determined by the sunspot activity a few years before solar minimum. Since stronger cycles tend to rise faster to their maximum activity (known as the Waldmeier effect), the temporal overlapping of cycles leads to a shift of the minimum epochs that depends on the strength of the following cycle. This information is picked up by precursor methods and also by our flux transport model with a schematic source. Therefore, their predictive skill does not require a memory, i.e., a physical connection between the surface manifestations of subsequent activity cycles.

Accepted by ApJ

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For preprints via ftp or WWW: http://arxiv.org/abs/astro-ph/0612693

Acoustic Heating of the Solar Chromosphere: Present Indeed and Locally Dominant

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We investigate the physical reality of acoustic heating in the solar chromosphere. Evidence is provided that contrary to previous claims by Fossum & Carlsson, high-frequency acoustic waves are indeed sufficient to heat the non-magnetic solar chromosphere. This assessment is based on three different lines of evidence, which are (1) a discussion of the inherent problems of the limited sensitivity of TRACE when assessing the 3-D solar chromospheric topology, (2) a study of the acoustic chromospheric wave energy flux, and (3) a new look at the heating and emission of chromospheric basal flux stars such as τ Ceti.

Accepted by ApJ Letters

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Upcoming Meeting

Second Announcement
IAU Symposium No. 243
Star-Disk Interaction in Young Stars

21 - 25 May 2007

Grenoble, France

The registration form and call for abstracts (20-min contributed talks and posters) are now open on http://www.iaus243.org

<u>Dead-lines</u>

Abstracts for contributed talks and posters : March 1, 2007
Financial support request : March 1, 2007
Early Registration (170 euros) : March 26, 2007
Late Registration (200 euros) : April 23, 2007

The attendance is limited to 150 participants. Hotel reservations must be made as soon as possible.

Rationale: Disk accretion and jet outflows are intimately associated with the formation of stars and planets. One central issue raised by recent observational studies is the origin of the physical connection between accretion and wind/jet processes. It has become clear that the physical connection takes place within 1 AU of the central star, in a region where the interaction between the star and the inner disk is still poorly understood. The conference is intended to review the observational constraints available on the physical processes thought to be at work at the star-disk interface, to confront the predictions of the latest numerical and analytical MHD models of star-disk-jet systems with observations, and to explore the consequences of these processes for stellar angular momentum evolution and inner disk structure.

Objectives: The aim of the conference is to gather astronomers from around the world to critically review the MHD processes which are thought to take place within 1 AU of young stellar objects. It will focus on the structure and variability of the inner magnetized disk, the magnetospheric cavity, and the jet launching region. Understanding the structure and evolution of the star-disk interaction region in young stars is critical to our understanding of star and planet formation.

Program schedule : http://www.iaus243.org

Invited speakers : S. Alencar, I. Appenzeller, D. Ardila, G. Basri, C. Bertout, J. Bouvier, S. Cabrit, N. Calvet, J. Carr, S. Edwards, C. Fendt, L. Ferrario, T. Harries, M. Jardine, C. Johns-Krull, F. Malbet, R. Mathieu, S. Mohanty, T. Montmerle, A. Natta, F. Pont, M. Romanova, T. Ray, F. Shu, C. Terquem

Scientific Organizing Committee: Silvia Alencar, Immo Appenzeller, Gibor Basri, Jerome Bouvier (chair), Sylvie Cabrit, Suzan Edwards, Moira Jardine, Rony Keppens, Oded Regev, Bo Reipurth, Kazunari Shibata

Local Organizing Committee: Agnes Blanc-Senet, Francoise Bouillet, Jerome Bouvier (chair), Catherine Dougados, Jonathan Ferreira, Fabien Malbet, Thierry Montmerle, Marie-Helene Sztefek

Upcoming Meeting

Third Announcement

Structure Formation in the Universe: Galaxies, Stars, Planets

27 May - 1 June 2007

Chamonix, France

This is the **3rd annoucement** of the conference *"Structure Formation in the Universe"*, to be held in Chamonix, France from 27 May through 1 June 2007. The aim of the conference is to bring together researchers working in the fields of planet, star and galaxy formation in order to share their expertise and to address common physical and numerical issues in the understanding of structure formation in astrophysics.

The **registration**, with the possibility to submit a **poster presentation**, is **now open**, with the hotel reservation.

Early Registration (320 euros) and Financial support request: **February 28, 2007**

Late Registration (380 euros) : **April 30, 2007**.

See information on the conference website: **http:// chamonix2007.ens-lyon.fr/**

Organizer and contact: **G. Chabrier (ENS-Lyon; chabrier@ens-lyon.fr)**

Abstract Guidelines

Abstracts for *COOLNEWS* are solicited for papers that have been recently accepted by or submitted to refereed journals, and for recent Ph.D. theses. Abstracts for conference proceedings articles are *not* posted in *COOLNEWS*. The subject matter should pertain directly to cool stars (spectral types F,G,K,M or L), substellar objects, or the sun. Both theoretical and observational abstracts are appropriate.

Abstracts dealing with cool pre-main-sequence (PMS) stars will generally not be included in *COOLNEWS*, since they are already covered by the *Star Formation Newsletter*. Exceptions to this rule will be considered if the subject matter is truly cross-disciplinary. If you wish to submit a cross-disciplinary abstract on PMS stars, then first submit it to the *Star Formation Newsletter*. After doing so, submit the abstract to *COOLNEWS* accompanied by a short e-mail stating that it has already been submitted to the *Star Formation Newsletter*, and summarizing why it will be of interest to the cool star/solar community at large.

A monthly call for abstracts will be issued and abstracts received by the last day of the month will usually appear in the following month's newsletter. Announcements of general interest to the cool star and solar communities may also be submitted for posting in the newsletter. These might include (but are not restricted to) the following: (i) *Job Openings* directed toward cool star or solar researchers, (ii) announcements of *Upcoming Meetings*, (iii) announcements of *Upcoming Observing Campaigns* for which participation is solicited from the community at large, (iv) reviews of *New Books*, and (v) *General Announcements* that provide or request research-related information. Please send all correspondence to the editor at coolnews@jila.colorado.edu. Abstract templates and back issues can be obtained from the COOLNEWS Web-page at

`http://casa.colorado.edu/~skinners/coolnews.html .`

*** Please send abstracts in the body of the message and *not* as attachments.***