COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 136 — July 2007 Editor: Steve Skinner (coolnews@jila.colorado.edu)

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Stellar Abstracts

Late-Type Red Supergiants: Too Cool for the Magellanic Clouds?

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We have identified seven red supergiants (RSGs) in the Large Magellanic Cloud (LMC) and four RSGs in the Small Magellanic Cloud (SMC), all of which have spectral types that are considerably later than the average type observed in their parent galaxy. Using moderate-resolution optical spectrophotometry and the MARCS stellar atmosphere models, we determine their physical properties and place them on the H-R diagram for comparison with the predictions of current stellar evolutionary tracks. The radial velocities of these stars suggest that they are likely all members of the Clouds rather than foreground dwarfs or halo giants. Their locations in the H-R diagram also show us that those stars are cooler than the current evolutionary tracks allow, appearing to the right of the Hayashi limit, a region in which stars are no longer in hydrodynamic equilibrium. These stars exhibit considerable variability in their V magnitudes, and three of these stars also show changes in their effective temperatures (and spectral types) on the time-scales of months. One of these stars, [M2002] SMC 055188, was caught in an M4.5 I state, as late as that seen in HV 11423 at its recent extreme: considerable later, and cooler, than any other supergiant in the SMC. In addition, we find evidence of variable extinction due to circumstellar dust and changes in the stars' luminosities, also consistent with our recent findings for HV 11423 - when these stars are hotter they are also dustier and more luminous. We suggest that these stars have unusual properties because they are in an unstable (and short-lived) evolutionary phase.

Accepted by ApJ

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For preprints via ftp or WWW: http://xxx.lanl.gov/abs/0705.3431

Homogenization of Stellar Catalogues Through Data Intercomparison

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The accuracies of selected stellar catalogues of $T_{\rm eff}$ values have been estimated through data intercomparison. The technique of such estimating developed earlier at Tartu Observatory for triples of catalogues has been adapted to a set of catalogues. A homogenized catalogue of $T_{\rm eff}$ values has been produced by weighted data averaging and compared with some available data.

Submitted to A&A

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HST Observations of Chromospheres in Metal Deficient Field Giants

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HST high resolution spectra of metal-deficient field giants more than double the stars in previous studies, span ~ 3 magnitudes on the red giant branch, and sample an abundance range [Fe/H]=-1 to -3. These stars, in spite of their age and low metallicity, possess chromospheric fluxes of Mg II (λ2800) that are within a factor of 4 of Population I stars, and give signs of a dependence on the metal abundance at the lowest metallicities. The Mg II k-line widths depend on luminosity and correlate with metallicity. Line profile asymmetries reveal outflows that occur at lower luminosities ($M_V = -0.8$) than detected in Ca K and H-alpha lines in metal-poor giants, suggesting mass outflow occurs over a larger span of the red giant branch than previously thought, and confirming that the Mg II lines are good wind diagnostics. These results do not support a magnetically dominated chromosphere, but appear more consistent with some sort of hydrodynamic, or acoustic heating of the outer atmospheres.

Accepted by AJ (October 2007 issue)

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X-ray Flares on the UV Ceti-type Star CC Eridani: A "Peculiar" Time-evolution of Spectral Parameters

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Context. Weak flares are supposed to be an important heating agent of the outer layers of stellar atmospheres. However, due to instrumental limitations, only large X-ray flares have been studied in detail until now.
Aims. We used an XMM-Newton observation of the very active BY-Dra type binary star CC Eri in order to investigate the properties of two flares that are weaker than those typically studied in the literature.
Methods. We performed time-resolved spectroscopy of the data taken with the EPIC-PN CCD camera. A multi-temperature model was used to fit the spectra. We inferred the size of the flaring loops using the density-temperature diagram. The loop scaling laws were applied for deriving physical parameters of the flaring plasma. We also estimated the number of loops involved in the observed flares.
Results. A large X-ray variability was found. Spectral analysis showed that all the regions in the light curve, including the flare segments, are well-described by a 3-T model with variable emission measures but, surprisingly, with constant temperatures (values of 3, 10 and 22 MK). The analysed flares lasted ~ 3.4 and 7.1 ks, with flux increases of factors $1.5 - 1.9$. They occurred in arcades made of a few tens of similar coronal loops. The size of the flaring loops is much smaller than the distance between the stellar surfaces in the binary system, and even smaller than the radius of each of the stars. The obtained results are consistent with the following ideas: (i) the whole X-ray light curve of CC Eri could be the result of a superposition of multiple low-energy flares, and (ii) stellar flares can be scaled-up versions of

solar flares.

Accepted by A&A

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For preprints via ftp or WWW: http://fr.arxiv.org/abs/0706.3332

Variable Stars in the Open Cluster NGC 6791 and Its Surrounding Field

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We performed a high–precision variability survey in the field of the old, super metal–rich open cluster NGC 6791. The data sample consists of more than 75,000 high–precision CCD time series measurements in the V band obtained mainly at the Canada–France–Hawaii Telescope, with additional data from S. Pedro Mártir and Loiano observatories, over a time span of ten nights. The field covers an area of 42×28 arcmin^2. We have discovered 260 new variables and re-determined periods and amplitudes of 70 known variable stars. By means of a photometric evaluation of the membership in NGC 6791, and a preliminary membership based on the proper motions, we give a full description of the variable content of the cluster and surrounding field in the range $16 < V < 23.5$. We categorized the entire sample as follows: 6 pulsating, 3 irregular, 3 cataclysmic, 89 rotational variables and 61 eclipsing systems; moreover, we detected 168 candidate variables for which we cannot give a variability class since their periods are much longer than our time baseline. On the basis of photometric considerations, and of the positions of the stars with respect to the center of the cluster, we inferred that 11 new variable stars are likely members of the cluster, for 22 stars the membership is doubtful and 137 are likely non–members.

Accepted by A&A

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For preprints via ftp or WWW: http://arxiv.org/abs/0706.2962

Improved SAAO – 2MASS Photometry Transformations

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Near infrared photometry of 599 stars is used to calculate transformations from the SAAO JHK system to the 2MASS JHK_S system. Both several-term formal regression relations, and simplified transformations are presented. Inverse transformations (i.e. 2MASS to SAAO) are also given. The presence of nonlinearities in some colour terms, and a scale factor in the K-band transformations, are highlighted.

Accepted by MNRAS

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Further Observations of *Hipparcos* Red Stars and Standards for $UBV(RI)_c$ Photometry

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We present homogeneous and standardised $UBV(RI)_CJHK$ photometry for over 100 M stars selected from an earlier paper on the basis of apparent photometric constancy. L photometry has been obtained for stars brighter than about

L =6. Most of the stars have a substantial number of $UBV(RI)_C$ observations and, it is hoped, will prove useful as red supplementary standards. Additionally, we list JHK photometry for nearly 300 *Hipparcos* red stars not selected as standards, as well as L photometry for the brightest stars.

Accepted by MNRAS (subject to minor modification)

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Astrometric Effects of Solar-like Magnetic Activity in Late-type Stars and Their Relevance for the Detection of Extrasolar Planets

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Using a simple model based on the characteristics of sunspots and faculae in solar active regions, the effects of surface brightness inhomogeneities on the position of the photocentre of the disk of a solar-like, magnetically active star, are studied. A general law is introduced, giving the maximum amplitude of the photocentre excursion produced by a distribution of active regions with a given surface filling factor. The consequences for the detection of extrasolar planets by means of the astrometric method are investigated with some applications to forthcoming space missions, such as GAIA and SIM, as well as to ground-based interferometric measurements. Spurious detections of extrasolar planets can indeed be caused by activity-induced photocentre oscillations, requiring a simultaneous monitoring of the optical flux and a determination of the rotation period and of the level of activity of the target stars for an appropriate discrimination.

Accepted by New Astronomy

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For preprints via ftp or WWW: http://arxiv.org/abs/0706.2942

X-ray Flares in Orion Low Mass Stars

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X-ray flares are common phenomena in pre-main sequence stars. Their analysis gives insights into the physics at work in young stellar coronae. The Orion Nebula Cluster offers a unique opportunity to study large samples of young low mass stars. This work is part of the *Chandra* Orion Ultradeep project (COUP), an ~ 10 day long X-ray observation of the Orion Nebula Cluster (ONC).

Our main goal is to statistically characterize the flare-like variability of 165 low mass $(0.1-0.3M_\odot)$ ONC members in order to test and constrain the physical scenario in which flares explain all the observed emission.We adopt a maximum likelihood piece-wise representation of the observed X-ray light curves and detect flares by taking into account both the amplitude and time derivative of the count-rate. We then derive the frequency and energy distribution of the flares.

The high energy tail of the energy distribution of flares is well described by a power-law with index ~ 2.2. We test the hypothesis that light curves are built entirely by overlapping flares with a single power law energy distribution. We constrain the parameters of this simple model for every single light curve. The analysis of synthetic light curves obtained from the model indicates a good agreement with the observed data.

Comparing low mass stars with stars in the mass interval $(0.9-1.2M_\odot)$, we establish that, at ~ 1 Myr, low mass and solar mass stars of similar X-ray luminosity have very similar flare frequencies. Our observational results are consistent with the following model/scenario: the light curves are entirely built by overlapping flares with a power-law intensity distribution; the intense flares are individually detected, while the weak ones merge and form a pseudo-quiescent level, which we indicate as the characteristic level.

Accepted by A&A

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

Solar Abstracts

Angular Momentum Conservation and Torsional Oscillations in the Sun and Solar-like Stars

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The solar torsional oscillations, i.e., the perturbations of the angular velocity of rotation associated with the eleven-year activity cycle, are a manifestation of the interaction among the interior magnetic fields, amplified and modulated by the solar dynamo, and rotation, meridional flow and turbulent thermal transport. Therefore, they can be used, at least in principle, to put constraints on this interaction. Similar phenomena are expected to be observed in solar-like stars and can be modelled to shed light on analogous interactions in different environments. The source of torsional oscillations is investigated by means of a model for the angular momentum transport within the convection zone. A description of the torsional oscillations is introduced, based on an analytical solution of the angular momentum equation in the mean-field approach. It provides information on the intensity and location of the torques producing the redistribution of the angular momentum within the convection zone of the Sun along the activity cycle. The method can be extended to solar-like stars for which some information on the time-dependence of the differential rotation is becoming available. Illustrative applications to the Sun and solar-like stars are presented. Under the hypothesis that the solar torsional oscillations are due to the mean-field Lorentz force, an amplitude of the Maxwell stresses $|B_{\rm r} B_{\phi}| >\sim 8 \times 10^3$ G^2 at a depth of $\sim 0.85\ R_{\odot}$ at low latitude is estimated. Moreover, the phase relationship between $B_{\rm r}$ and B_{ϕ} can be estimated, suggesting that $B_{\rm r} B_{\phi} > 0$ below $\sim 0.85\ R_{\odot}$ and $B_{\rm r} B_{\phi} < 0$ above. Such preliminary results show the capability of the proposed approach to constrain the amplitude, phase and location of the perturbations leading to the observed torsional oscillations.

Accepted by A&A

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or http://arxiv.org/abs/0706.1623

Solar Impulsive EUV and UV Brightenings in Flare Footpoints and Their Connection with X-ray Emission

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Context. The thick-target model of the impulsive phase of solar flares describes propagation of non-thermal electron beams into the chromosphere. The stopping depth of the electron is related to its energy. Thus, the thermal reaction at different levels should be connected to the parameters of the electron spectrum.
*Aims.*We investigate the impulsive thermal reaction produced by non-thermal electron beams at different heights of the solar atmosphere observed in solar flare footpoints.
Methods. We used methods developed for the investigation of the impulsive SXR brightenings (Mrozek & Tomczak 2004). EUV and UV images obtained by TRACE in the 171 Å and 1600 Å filter were used as basic data set for the analysis. For the first time EUV images have been desaturated using the diffraction pattern properties.
Results. It has been found that the thermal impulsive reaction observed in solar flare footpoints is different for UV

and EUV brightenings. Results have been compared to these obtained for the impulsive SXR brightenings. We have found that observed dissimilarities are connected to the properties of the non-thermal electron spectrum and to the depth of their penetration into the chromosphere. Moreover, we have shown that the lower levels of the chromosphere are excited by more energetic electrons.

Accepted by A&A

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Low-Mass and Substellar Abstracts

Spectral Type Dependent Rotational Braking and Strong Magnetic Flux in Three Components of the Late-M Multiple System LHS 1070

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We show individual high resolution spectra of components A, B, and C of the nearby late-M type multiple system LHS 1070. Component A is a mid-M star, B and C are known to have masses at the threshold to brown dwarfs. From our spectra we measure rotation velocities and the mean magnetic field for all three components individually. We find magnetic flux on the order of several kilo-Gauss in all components. The rotation velocities of the two late-M objects B and C are similar ($v \sin i = 16\,\mathrm{km\,s^{-1}}$), the earlier A component is spinning only at about half that rate. This suggests weakening of net rotational braking at late-M spectral type, and that the lack of slowly rotating late-M and L dwarfs is real. Furthermore, we found that magnetic flux in the B component is about twice as strong as in component C at similar rotation rate. This indicates that rotational braking is not proportional to magnetic field strength in fully convective objects, and that a different field topology is the reason for the weak braking in low mass objects.

Accepted by A&A Letters

For preprints via ftp or WWW: http://arxiv.org/abs/0706.2139

Upcoming Meeting

Cool Stars 15

21 - 25 July 2008

St. Andrews, Scotland

MEETING ANNOUNCEMENT

Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun

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Web Site:

http://star-www.st-and.ac.uk/coolstars15/

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http://www.solar-system-school.de

or email to

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Job Opening

Postdoctoral Position

Magnetic Processes in High-Energy Astrophysics

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Postdoctoral Position Solar, Stellar, and Planetary Sciences Smithsonian Astrophysical Observatory Cambridge, MA 02138

Attention: Dr. Nancy S. Brickhouse

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Interested candidates should forward curriculum vitae, bibliography, and names, addresses, telephone numbers and email addresses of three professional references to nbrickhouse@cfa.harvard.edu.

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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

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