COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Stability of Planetary Orbits in Binary Systems

Z. E. Musielak[1,2], M. Cuntz[1,2], E. A. Marshall[1], and T. D. Stuit[3]

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Stability of S-type and P-type planetary orbits in binary systems of different mass and separation ratios is investigated. Criteria for stable, marginally stable and unstable planetary orbits are specified. These criteria are used to determine regions of stability of planetary orbits in different binary systems with Jupiter-type planets. The obtained results show that the regions of stability for S-type orbits depend on the distance ratio between the star and planet, and the stellar companions, in the range of 0.22 and 0.46, depending on the mass ratio. For P-type orbits, the regions of stability also depend on that distance ratio, in the range of 1.75 and 2.45, again depending on the the mass ratio. Applications of these results to three observed binary systems with giant planets, namely, τ Boo, HD 195019 and GJ 86, show that the orbits of the giant planets in those systems can be classified as stable, as expected.

Accepted by A&A

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Localizing Plages on BO Mic – First Steps Towards Chromospheric Doppler Imaging

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We have obtained a densely sampled time series of Ca II H&K line profiles of the ultrafast rotating K-dwarf star BO Mic. Taken at high resolution, the spectra reveal pronounced variations of the emission core profiles. We interpret these variations as signs of concentrated chromospherically active regions, in analogy to solar plages. We further interpret the variations as partly due to the rapid growth and decay of plages, while other variations appear to be caused by plages moved over the visible stellar disk by rotation. The equivalent width of the Ca K core emission changes approximately in anti-phase to the photospheric brightness, suggesting an association of the chromospheric

plage regions with pronounced dark photospheric spots. We believe that further analysis of the presented spectral time series will lead to a chromospheric Doppler image of BO mic.

Accepted by A&A

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For preprints via WWW: http://www.hs.uni-hamburg.de/DE/Ins/PrP/index.html

Doppler Imaging of Speedy Mic Using the VLT – Fast Spot Evolution on a Young K-dwarf Star

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We study the short-term evolution of starspots on the ultrafast-rotating star HD197890 ("Speedy Mic" = BO Mic, K 0-2V, $P_{\rm rot} = 0.380$ d) based on two Doppler images taken about 13 stellar rotations apart. Each image is based on spectra densely sampling a single stellar rotation. The images were reconstructed by our Doppler imaging code CLDI (Clean-like Doppler imaging) from line profiles extracted by spectrum deconvolution. Our Doppler images constructed from two independent wavelength ranges agree well on scales down to 10 degrees on the stellar surface. In conjunction with nearly parallel V-band photometry our observations reveal a significant evolution of the spot pattern during as little as two stellar rotations. We suggest that such a fast spot evolution demands care when constructing Doppler images of highly active stars based on spectral time series extending over several stellar rotations. The fast intrinsic spot evolution on BO Mic impedes the determination of a surface differential rotation; in agreement with earlier results by other authors we determine an upper limit of $|\alpha| < 0.004 \pm 0.002$.

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Chromospherically Active Stars. XXV. HD 144110 = EV Draconis, A Double-Lined Dwarf Binary

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New spectroscopic and photometric observations of HD 144110 have been used to obtain an improved orbital-element solution and determine some basic properties of the system. This chromospherically active, double-lined spectroscopic binary has an orbital period of 1.6714012 days and a circular orbit. We classify the components as G5 V and K0 V and suggest that they are slightly metal rich. The photometric observations indicate that the rotation of HD 144110 is synchronous with the orbital period. Despite the short orbital period, no evidence of eclipses is seen in our photometry.

Accepted by AJ

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A New Detached M Dwarf Eclipsing Binary

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We describe a newly-discovered detached M-dwarf eclipsing binary system, the fifth such system known. This system was first observed by the TrES network during a long term photometry campaign of 54 nights. Analysis of the folded light curve indicates two very similar components orbiting each other with a period of 1.12079 +/- 0.00001 days. Spectroscopic observations with the Hobby-Eberly Telescope show the system to consist of two M3e dwarfs in a near-circular orbit. Double-line radial velocity amplitudes, combined with the orbital inclination derived from light-curve fitting, yield Mass total = 0.983 +/- 0.007 $M_\odot$, with component masses M_1 = 0.493 +/- 0.003 and M_2 = 0.489 +/- 0.003 $M_\odot$. The light-curve fit yields component radii of R_1 = 0.453 +/- 0.060 and R_2 = 0.452 +/- 0.050 $R_\odot$. Though a precise parallax is lacking, broadband VJHK colors and spectral typing suggest component absolute magnitudes of $M_V(1)$ = 11.18 +/- 0.30 and $M_V(2)$ = 11.28 +/- 0.30.

Accepted by ApJ

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http://www.hao.ucar.edu/public/research/stare/stare.html

A Hot Wind from the Classical T Tauri Stars: TW Hydrae and T Tauri

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Spectroscopy of the infrared He I (λ10830) line with KECK/NIRSPEC and IRTF/CSHELL and of the ultraviolet C III (λ 977) and O VI (λ 1032) emission with FUSE reveals that the classical T Tauri star TW Hydrae exhibits P Cygni profiles, line asymmetries, and absorption indicative of a continuous, fast (~400 km/s), hot (~300,000 K) accelerating outflow with a mass loss rate $\sim 10^{-11}$–10^{-12} $M_\odot\ yr^{-1}$ or larger. Spectra of T Tauri N appear consistent with such a wind. The source of the emission and outflow seems restricted to the stars themselves. Although the mass accretion rate is an order of magnitude less for TW Hya than for T Tau, the outflow reaches higher velocities at chromospheric temperatures in TW Hya. Winds from young stellar objects may be substantially hotter and faster than previously thought.

Accepted by ApJ Letters

For preprints via WWW or ftp: astro-ph/0505037; or ftp to cfa-ftp.harvard.edu, cd pub/dupree/

Editor's Note: The above abstract is being cross-listed with the *Star Formation Newsletter* and is included here since it may be of general interest to researchers studying mass loss in cool stars.

Solar Abstracts

Definition and Significance of Average Temperatures in Time-dependent Solar Chromosphere Models

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We assess different types of average temperatures in time-dependent solar chromosphere models. They include the conventional definition of mean and median temperature, and a formal definition related to the model-dependent hydrogen ionization degree, referred to as ionization temperature. It is found that the latter is always higher than the mean and median temperatures except in the photosphere, and that the mean temperatures are always higher than the median temperatures, especially in models with frequency spectra. The most dramatic differences are attained in the topmost portion of one of our models with the ionization temperatures up to a factor 150 higher than the mean and median temperatures. The differences between the mean, median and ionization temperatures are a direct consequence

of nonlinearities ("spikyness") of the temperatures in the models mostly due to strong shocks. The principal results hold for both acoustic and magnetic models despite significant differences in the initial wave energy fluxes, densities, and geometrical settings.

Accepted by A&A

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Electron Density Along a Coronal Loop Observed with CDS/SOHO

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The analysis of a coronal loop observed by CDS and EIT on board SOHO is presented. The loop was situated above the North-East limb at a latitude of $\sim 48^o$, being clearly visible in the hottest lines of the dataset, Fe XVI 360.76 Å, i.e. greater than 2 000 000 K. The cooler lines in the sample (i.e. O V 629.73 Å and He I 584.35Å) showed only a brightening at the footpoints location. Based on the Fe XIV 353.84/334.17 line ratio, the electron density along the loop was determined following three different approaches for the background subtraction. No differences, within the error bars, can be found between the three methods. At the apex, the density is 0.9×10^9 cm^{-3}, while at the footpoint it is 50% greater, i.e. 1.4×10^9 cm^{-3}. The inferred filling factor values along the loop, at the formation temperature of the lines, are in the range 0.2–0.9.
One dimensional hydrodynamic modelling of the loop along a given field line, gravity neglected, was performed. A minimum χ^2 analysis results in a best fit case where the total energy input is directed preferentially to the loop footpoint (the heating rate is three times larger at the base than at the apex). An isochoric solution can not be ruled out completely. The exercise illustrates the necessity of accurate spectral diagnostics in order to derive definite conclusions from theoretical models and suggests the need for simultaneous density and temperature diagnostics.

Accepted by A&A

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Evidence for Explosive Event Activity Originating in the Chromosphere

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We report on a joint SUMER, CDS, TRACE study, concentrating on a region which shows prolonged EUV explosive event (EE) activity in the transition region line N V 1238 Å, yet little evidence of such activity in another transition region line O V 629 Å (formed at a similar temperature) which was observed simultaneously. A possible explanation for the lack of major activity in the O V line in several explosive events could be that they originate in the lower chromosphere. This is consistent with the enhancements in the C I 1249 Å line and with the findings of another study which reported time delays between the chromospheric and transition region lines in some EE's using high cadence observations (10 s exposure time) obtained with the SUMER spectrometer in H I Ly 6 (20 000 K) and S VI (200 000 K). Using the generalized collisional-radiative picture, including the population of metastable levels, we derive the density dependent contribution function for both N V 1238 and O V 629 for three values of the electron density; 10^6 cm^{-3} representing the low density limit, 10^9 cm^{-3} for a typical quiet Sun electron density and 10^{11} cm^{-3} for an active region. These calculations show that with increasing electron density, both lines shift to slightly lower temperatures. However, the major difference is in the relative increase in the line flux with increasing density. For N V, increasing the density to 10^{11} cm^{-3} results in a 60% increase in the line flux, while O V shows a 30% decrease. Increasing the electron density to 10^{12} cm $^{-3}$ results in a factor of two decrease in the O V flux, thus making it difficult to detect explosive event activity in this line if the event is formed in the chromosphere. Other explosive events which show

simultaneous activity in both lines are probably formed in the transition region. In one such event, activity is observed in both N v and O v, yet nothing in C i. In this event we also observe an increase in the TRACE 173 emission, delayed by ≈ 40 s compared in the transition region lines.

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Time Series Study of EUV Spicules Observed by SUMER/SoHO

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Here we study the dynamic properties of EUV spicules seen at the solar limb. The selected data were obtained as time series in polar coronal holes by SUMER/SoHO. The short exposure time and the almost fixed position of the spectrometer's slit allow the analysis of spicule properties such as occurrence, lifetime and Doppler velocity. Our data reveal that spicules occur repeatedly at the same location with a birth rate of around 0.16 min as estimated at 10 arcsec above the limb and a lifetime ranging from 15 down to ≈3 minutes. We are able to see some spicules showing a process of "falling after rising" indicated by the sudden change of the Doppler velocity sign. A periodicity of ≈5 minutes is sometimes discernible in their occurrence. Most spicules have a height between 10 and 20 arcsec above the limb, and some can stretch up to 40 arcsec. These "long macro-spicules" seem to be comprised of a group of high spicules. Some of them have an obvious periodicity in the radiance of ≈5 minutes.

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Blinker/Macro-spicule Activity in an Off-limb Polar Region

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Using measurements of O v 629.73Å from the Coronal Diagnostic Spectrometer (CDS) on board SOHO we report on blinker activity in off-limb regions above the Northern pole of the Sun. The blinkers are found to be occurring above a region showing strong dynamic activity, with evidence for evacuation of plasma. The presence of blinkers is discussed in terms of the heating of spicular material.

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On the Widths and Ratios of Mg x 609.79 and 624.94 Å Lines in Polar Off-limb Regions

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Using measurements of Mg x 609.78 and 624.94 Å lines from the Coronal Diagnostic Spectrometer (CDS) on board SOHO, we seek to examine the variation of line width and line ratio in regions far off-limb at the Northern pole of the Sun. It is found that above ≈1150 arcsec the ratio of the two coronal Mg x resonance lines reduces to values that might be expected for a more radiatively dominant excitation mode. A comparison of the line widths with these ratios indicates that the line widths start to show a decrease in their values at the location where the dominant excitation

changes from being collisionally to radiatively dominant, that is, at $\approx$1150 arcsec. We suggest that the decrease in the line widths above $\approx$1150 arcsec is likely to be due to a reduction in the non-thermal component of the line widths caused by a damping of upwardly propagating Alfvén waves.

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The High Temperature Response of the TRACE 171 Å and 195 Å Channels

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The CHIANTI spectral code is used to estimate line and continuum intensity contributions to the TRACE 171 Å and 195 Å channels, widely used for imaging a variety of solar features and phenomena, including quiet Sun and active region loops and solar flares. It is shown that the 171 Å channel has a high-temperature response, so high-temperature ($\sim$ 10–20 MK) features in flares, prominent in TRACE 195 Å images as well as X-ray images from *Yohkoh* and *RHESSI*, are sometimes visible in images made in the 171 Å channel. Such features consist of hot loop-top emission, either confined spots or 'spine' structures in loop arcades. This is illustrated with TRACE and X-ray flare images.

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Low-Mass and Substellar Abstracts

A Deep Look at the T-Type Brown Dwarf Binary ϵ Indi Bab with *Chandra* and ATCA

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We present deep observations of the nearby T-type brown dwarf binary ϵ Indi Bab in radio with the Australia Telescope Compact Array and in X-rays with the *Chandra* X-ray Observatory. Despite long integration times, the binary (composed of T1 and T6 dwarfs) was not detected in either wavelength regime. We reached 3σ upper limits of 1.23×10^{12} and 1.74×10^{12} erg s^{-1} Hz^{-1} for the radio luminosity at 4.8 GHz and 8.64 GHz, respectively; in the X-rays, the upper limit in the $0.1 - 10$ keV band was 3.16×10^{23} erg s^{-1}. We discuss the above results in the framework of magnetic activity in ultracool, low-mass dwarfs.

Accepted by ApJ Letters

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Hot-Jupiters and Hot-Neptunes: A Common Origin?

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We compare evolutionary models for close-in exoplanets coupling irradiation and evaporation due respectively to the thermal and high energy flux of the parent star with observations of recently discovered new transiting planets. The models provide an overall good agreement with observations, although at the very limit of the quoted error bars of OGLE-TR-10, depending on its age. Using the same general theory, we show that the three recently detected hot-Neptune planets (GJ436, ρ Cancri, μ Ara) may originate from more massive gas giants which have undergone significant evaporation. We thus suggest that hot-Neptunes and hot-Jupiters may share the same origin and evolution history. Our scenario provides testable predictions in terms of the mass-radius relationships of these hot-Neptunes.

Accepted by A&A Letters

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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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