COOLNEWS

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Stellar Abstracts

On a Transition from Solar-like Coronae to Rotation-dominated Jovian-like Magnetospheres in Ultracool Main-sequence Stars

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For main-sequence stars beyond spectral type M5 the characteristics of magnetic activity common to warmer solar-like stars change into the brown-dwarf domain: the surface magnetic field becomes more dipolar and the evolution of the field patterns slows, the photospheric plasma is increasingly neutral and decoupled from the magnetic field, chromospheric and coronal emissions weaken markedly, and the efficiency of rotational braking rapidly decreases. Yet, radio emission persists, and has been argued to be dominated by electron-cyclotron maser emission instead of the gyrosynchrotron emission from warmer stars. These properties may signal a transition in the stellar extended atmosphere. Stars warmer than about M5 have a solar-like corona and wind-sustained heliosphere in which the atmospheric activity is powered by convective motions that move the magnetic field. Stars cooler than early-L, in contrast, may have a jovian-like rotation-dominated magnetosphere powered by the star's rotation in a scaled-up analog of the magnetospheres of Jupiter and Saturn. A dimensional scaling relationship for rotation-dominated magnetospheres by Fan et al. (1982) is consistent with this hypothesis.

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For preprints via WWW: http://www.lmsal.com/ schryver/Public/ms/mstarmagnetospheres.pdf

Observation and Modelling of Main Sequence Star Chromospheres XI. Two-component Model Chromospheres for Nine M1 Dwarfs

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We aim to constrain the H_α, CaII H and CaII K line profiles from quiescent and active regions on nine dM1 stars of near solar metallicity: Gl 2, GJ 1010A, Gl 49, Gl 150.1B, Gl 205, Gl 229, Gl 526, G192-11A and Gl 880.

We propose a new method to build two component model chromospheres for dM1 stars based on simple constraints and on the grid of model atmospheres of Houdebine & Stempels (1997). This method is based on the measurements of the equivalent width of H_α and CaII H & K. Our solutions provide an exact match of these equivalent widths, based on the peculiar inter-relationship between these two equivalent widths for the model atmospheres.

We obtain two component (quiescent and active regions) model chromospheres for our nine target stars. We fit the H_α, CaII H and CaII K profiles for these stars. These models show that seven of these stars lie in the intermediate activity range between H_α maximum absorption and emission. Two stars (Gl 49 and G192-11A) are quite active with H_α emission profiles in plages. As far as the CaII emission is concerned, these two stars are almost as active as dM1e stars. Two stars (GJ 1010A and Gl 526) have lower activity levels with narrower and weaker H_α profiles. The range of activity covered by the stars in this paper is a factor of 13 in the CaII lines, from low activity to activity levels almost as high as those of dM1e stars.

Our method sometimes gives two solutions of the observed H_α equivalent width as a function of the quiescent region H_α equivalent width. For Gl 205 one of the solutions is shown to be impossible for the assumptions we use. For Gl 49 and G192-11A, two solutions are possible; a low solution (low CaII EW) and a high solution (high CaII EW). The difference between these two solutions is mainly in the plage filling factor. The two solutions give almost identical H_α and CaII profiles. We prefer the low solutions because the filling factors are in better agreement with those of other stars. We find plage filling factors typically in the range 20%-40%. We further find that it is the chromospheric pressure that increases with increasing activity rather than the filling factor that increases.

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CNONa and $^{12}C/^{13}C$ in Giant Stars of 10 Open Clusters

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Evolved low-mass stars ($0.8 \leq M/M_\odot \leq 2.5$) with a large range in metallicity bear signatures of a non-standard mixing event in their surface abundances of Li, C, N, and in their $^{12}C/^{13}C$ ratio. A Na overabundance has also been reported in some giants of open clusters but remains debated. Recently, the cause of the extra-mixing has been attributed to thermohaline convection that should take place after the RGB bump for low mass stars and on the early-AGB for more massive objects. In order to track the occurrence of this process over a large mass range, we derive in a homogeneous way the abundances of C, N, O, and Na, as well as the $^{12}C/^{13}C$ ratio in a sample of 31 giants of 10 open clusters with turn-off masses from 1.7 to 3.1 $M_\odot$. The sample includes red giants, clump giants, and early-AGB stars. We study the observational behaviour of the abundances as well as the possible correlations between different elements and between the chemical abundances and stellar mass. A model atmosphere analysis is conducted using high signal to noise, high resolution FEROS and EMMI spectra. We derive atmospheric parameters using FeI and FeII lines. We calculate abundances for Na, C, N, and O, as well as the $^{12}C/^{13}C$ ratio using spectrum synthesis. For the elements Mg, Ca, Si, Sc, Ti, V, Cr, Co, and Ni, abundances are derived using equivalent widths. A group of first ascent red giants with $M/M_\odot \leq 2.5$ exhibits smaller [N/C] ratios than those measured in clump giants of the same mass range, suggesting an additional increase of the [N/C] ratio after the first dredge-up. The sodium abundances corrected from NLTE are found to be about solar. [Na/Fe] shows a slight increase of 0.10 dex as a function of stellar mass in the 1.8

to 3.2 $M_\odot$ range covered by our sample, in agreement with standard first dredge-up predictions. Our results do not support previous claims of sodium overabundances as high as +0.60 dex. An anti-correlation between $^{12}C/^{13}C$ and turn-off mass is obtained and interpreted as due to a post-bump thermohaline mixing. Moreover, we find low $^{12}C/^{13}C$ ratios also in a few intermediate-mass early-AGB stars, confirming that an extra-mixing process also operates in stars that do not go through the RGB bump. In this case, the extra-mixing possibly acts on the early-AGB, in agreement with theoretical expectations for thermohaline mixing.

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Photometric Analysis of the Eclipsing Binary 2MASS 19090585+4911585

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We report on observations of the eclipsing binary 2MASS 19090585+4911585 with the 25 cm auxiliary telescope of the University Observatory Jena. We show that a nearby brighter star (2MASS 19090783+4912085) was previously misclassified as the eclipsing binary and find 2MASS 19090585+4911585 to be the true source of variation. We present photometric analysis of VRI light curves. The system is an overcontact binary of W UMa type with an orbital period of (0.288374 ± 0.000010) d.

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Solar Abstracts

On the Continuum Intensity Distribution of the Solar Photosphere

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For many years, there seemed to be significant differences between the continuum intensity distributions derived from observations and simulations of the solar photosphere. In order to settle the discussion on these apparent discrepancies, we present a detailed comparison between simulations and seeing-free observations that takes into account the crucial influence of instrumental image degradation. We use a set of images of quiet Sun granulation taken in the blue, green and red continuum bands of the Broadband Filter Imager of the Solar Optical Telescope (SOT) onboard Hinode. The images are deconvolved with Point Spread Functions (PSF) that account for non-ideal contributions due to instrumental stray-light and imperfections. In addition, synthetic intensity images are degraded with the corresponding PSFs. The results are compared with respect to spatial power spectra, intensity histograms, and the centre-to-limb variation of the intensity contrast. The intensity distribution of SOT granulation images is broadest for the blue continuum at disc-centre and narrows towards the limb and for longer wavelengths. The distributions are relatively symmetric close to the limb but exhibit a growing asymmetry towards disc-centre. The intensity contrast, which is connected to the width of the distribution, is found to be (12.8 ± 0.5) %, (8.3 ± 0.4) %, and (6.2 ± 0.2) % at disc-centre for blue, green, and red continuum, respectively. Removing the influence of the PSF unveils much broader intensity distributions with a secondary component that is otherwise only visible as an asymmetry between the darker and brighter than average part of the distribution. The contrast values increase to (26.7 ± 1.3) %, (19.4 ± 1.4) %, and (16.6 ± 0.7) % for blue, green, and red continuum, respectively. The power spectral density of the images exhibits a pronounced peak at spatial scales characteristic for the granulation pattern and a steep decrease towards smaller scales. The observational

findings like the absolute values and centre-to- limb variation of the intensity contrast, intensity histograms, and power spectral density are well matched with corresponding synthetic observables from three- dimensional radiation (magneto-)hydrodynamic simulations. We conclude that the intensity contrast of the solar continuum intensity is higher than usually derived from ground-based observations and is well reproduced by modern radiation (magneto-)hydrodynamic models. Properly accounting for image degradation effects is of crucial importance for comparisons between observations and numerical models.

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The YOHKOH Survey of Partially Occulted Flares in Hard X-rays

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Modern solar X-ray imagers did not breakthrough the problem of detailed diagnostics of faint hard X-ray sources in the presence of stronger ones. This is the case of the impulsive phase of solar flares in which footpoint sources are usually stronger than loop-top ones. For this aim, flares being partially occulted by the solar limb, are the best reservoir of our knowledge about hard X-ray loop-top sources. Recently, the survey of partially occulted flares observed by the RHESSI has been published (Krucker & Lin 2008). The extensive YOHKOH database still awaits such activities. This work is an attempt to fill this gap. Among from 1286 flares in the YOHKOH Hard X-ray Telescope Flare Catalogue (Sato et al. 2006), for which the hard X-ray images were presented, we identified 98 events that occurred behind the solar limb. We investigated their hard X-ray spectra and spatial structure. We found that in most cases the hard X-ray spectrum of partially occulted flares consists of two components, non-thermal and thermal, which are co-spatial within 4 arcsec. For rest events the components are separated, with supremacy of the non-thermal component situated higher. The photon energy spectra of the partially occulted flares are systematically steeper than spectra of the non-occulted flares. Such a difference we explain as a consequence of intrinsically dissimilar conditions ruling in coronal parts of flares, in comparison with the footpoints which usually dominate the hard X-ray emission of disk flares. At least two reasons of the difference should be taken into consideration: (1) stronger contamination of hard X-rays with emission of thermal plasma, (2) different mechanism in which non-thermal electrons radiate their energy. For events unbiased with the thermal component the difference, $\Delta\gamma = \bar{\gamma}_{LT} - \bar{\gamma}_{FP}$, is equal to 1.5. We found a lack of correlation between the altitude of flares and the hard X-ray power-law index γ. A schematic picture, in which thin-target mechanism is responsible for hard X-ray emission of loop-top sources and thick-target mechanism - for emission of footpoint sources, is modified by the presence of some coronal thick-target sources. At least a part of them suggests a magnetic trapping. For characteristics of flares conclusive is local magnetic configuration in which they occur.

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For preprints via ftp or WWW: http://fr.arxiv.org/abs/0901.4227

Low-Mass and Substellar Abstracts

New Brown Dwarf Candidates in the Pleiades

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TWe have performed deep, wide-field imaging on a $\sim 0.4\,\mathrm{deg}^2$ field in the Pleiades (Melotte 22). The selected field was not yet a target of a deep search for low mass stars and brown dwarfs. Our limiting magnitudes are $R \sim 22\,\mathrm{mag}$ and $I \sim 20\,\mathrm{mag}$, sufficient to detect brown dwarf candidates down to $40\,M_J$. We found 197 objects, whose location in the $(I,R-I)$ color magnitude diagram is consistent with the age and the distance of the Pleiades. Using CTK R and I as well as JHK photometry from our data and the 2MASS survey we were able to identify 7 new brown dwarf candidates.

We present our data reduction technique, which enables us to resample, calibrate, and co-add many images by just two steps. We estimate the interstellar extinction and the spectral type from our optical and the NIR data using a 2-dimensional χ^2 fitting.

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Announcement (Review Article)

X-Ray Spectroscopy of Stars

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Non-degenerate stars of essentially all spectral classes are soft X-ray sources. Their X-ray spectra have been important in constraining physical processes that heat plasma in stellar environments to temperatures exceeding one million degrees. Low-mass stars on the cooler part of the main sequence and their pre-main sequence predecessors define the dominant stellar population in the galaxy by number. Their X-ray spectra are reminiscent, in the broadest sense, of X-ray spectra from the solar corona. The Sun itself as a typical example of a main-sequence cool star has been a pivotal testbed for physical models to be applied to cool stars. X-ray emission from cool stars is indeed ascribed to magnetically trapped hot gas analogous to the solar coronal plasma, although plasma parameters such as temperature, density, and element abundances vary widely. Coronal structure, its thermal stratification and geometric extent can also be interpreted based on various spectral diagnostics. New features have been identified in pre-main sequence stars; some of these may be related to accretion shocks on the stellar surface, fluorescence on circumstellar disks due to X-ray irradiation, or shock heating in stellar outflows.
Massive, hot stars clearly dominate the interaction with the galactic interstellar medium: they are the main sources of ionizing radiation, mechanical energy and chemical enrichment in galaxies. High-energy emission permits to probe some of the most important processes at work in these stars, and put constraints on their most peculiar feature: the stellar wind. Medium and high-resolution spectroscopy have shed new light on these objects as well. Here, we review recent advances in our understanding of cool and hot stars through the study of X-ray spectra, in particular high-resolution spectra now available from XMM-*Newton* and CHANDRA. We address issues related to coronal structure, flares, the composition of coronal plasma, X-ray production in accretion streams and outflows, X-rays from single OB-type stars, massive binaries, magnetic hot objects and evolved WR stars.

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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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