// COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Confirmation of Errors in *Hipparcos* Parallaxes from HST/FGS Astrometry of the Pleiades

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We present absolute trigonometric parallaxes and relative proper motions for three members of the Pleiades star cluster, obtained with *HST's* Fine Guidance Sensor 1r, a white-light interferometer. We estimate spectral types and luminosity classes of the stars comprising the astrometric reference frame from $R \approx 2,000$ spectra, $VJHK$ photometry, and reduced proper motions. From these we derive estimates of absolute parallaxes and introduce them into our model as observations with error. We constrain the three cluster members to have a 1σ dispersion in distance less than 6.4 pc, and find an average $\pi_{abs} = 7.43 \pm 0.17 \pm 0.20$ milliseconds of arc, where the second error is systematic due to member placement within the cluster. This parallax corresponds to a distance of 134.6 ± 3.1 pc or a distance modulus of $(m - M) = 5.65 \pm 0.05$ for these three Pleiads, presuming a central location. This result agrees with three other independent determinations of the Pleiades distance. Presuming that the cluster depth systematic error can be significantly reduced because of the random placement of these many members within the cluster, these four independent measures yield a best-estimate Pleiades distance of $\pi_{abs} = 7.49 \pm 0.07$ milliseconds of arc, corresponding to a distance of 133.5 ± 1.2 pc or a distance modulus of $(m - M) = 5.63 \pm 0.02$. This resolves the dispute between the main sequence fitting and the *Hipparcos* distance moduli in favor of main sequence fitting.

Accepted by Astronomical Journal

For preprints via ftp or WWW: astro-ph/0412093

A Far Ultraviolet Spectroscopic Survey of Luminous Cool Stars

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FUSE ultraviolet spectra of 8 giant and supergiant stars reveal that high temperature (3×10^5K) atmospheres are common in luminous cool stars and extend across the color-magnitude diagram from α Car (F0 II) to the cool giant α Tau (K5 III). Emission present in these spectra includes chromospheric H-Ly β, Fe II, C I, and transition region lines of C III, O VI, Si III, Si IV. Emission lines of Fe XVIII and Fe XIX signaling temperatures of $\sim10^7$K and coronal material are found in the most active stars, β Cet and 31 Com. A short-term flux variation, perhaps a flare, was detected in β Cet during our observation. Stellar surface fluxes of the emission of C III and O VI are correlated and decrease rapidly towards the cooler stars, reminiscent of the decay of magnetically-heated atmospheres. Profiles of the C III (λ 977) lines suggest that mass outflow is underway at T$\sim$80,000 K, and the winds are warm. Indications of outflow at higher temperatures (3×10^5K) are revealed by O VI asymmetries and the line widths themselves. High temperature species are absent in the M-supergiant α Ori. Narrow fluorescent lines of Fe II appear in the spectra of many giants and supergiants, apparently pumped by H Ly-α, and formed in extended atmospheres. Instrumental characteristics that affect cool star spectra are discussed.

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For preprints via astro-ph or ftp: astro-ph/0412539 or ftp to cfa-ftp.harvard.edu, cd pub/dupree/

Advances of Plasma Diagnostics with High-resolution Spectroscopy of Stellar Coronae

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X-ray emission from cool stars is an important tracer for stellar activity. The X-ray luminosity reflects different levels of activity and covers four orders of magnitude in stars of spectral types M-F. Low spectral resolution provided by X-ray observations of stellar coronae in the past allowed the determination of temperature distributions and elemental abundances making use of atomic databases (listing line emissivities and bremsstrahlung continuum for a given temperature structure). The new missions XMM-Newton and Chandra carry X-ray gratings providing sufficient spectral resolution to measure the fluxes of strategic emission lines. I describe the different approaches applicable to low-resolution and high-resolution spectra, especially focusing on the new grating spectra with X-ray lines. From only a few lines it is possible to determine plasma temperatures and associated densities, to check for any effects from resonant scattering, and to identify particular abundance anomalies. Line-based temperature- and density measurements represent only a fraction of the total plasma, but the pressure environment of different fractions can be probed simply by selection of specific lines. Selected results are presented covering all aspects of line-based analyses.

Accepted by Adv. in Space Research

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For preprints via ftp or WWW:
http://www-thphys.physics.ox.ac.uk/users/Jan-UweNess/Pubs/ cospar35.ps.gz

Coronal Properties of G-type Stars in Different Evolutionary Phases

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We report on the analysis of XMM-*Newton* observations of three G-type stars in very different evolutionary phases: the weak-lined T Tauri star HD 283572, the Zero Age Main Sequence star EK Dra and the Hertzsprung-gap giant star 31 Com. They all have high X-ray luminosity ($\sim 10^{31}\,\mathrm{erg\,s^{-1}}$ for HD 283572 and 31 Com and $\sim 10^{30}\,\mathrm{erg\,s^{-1}}$ for EK Dra). We compare the Emission Measure Distributions (EMDs) of these active coronal sources, derived from high-resolution XMM-*Newton* grating spectra, as well as the pattern of elemental abundances vs. First Ionization Potential (FIP). We also perform time-resolved spectroscopy of a flare detected by XMM from EK Dra. We interpret the observed EMDs as the result of the emission of ensembles of magnetically confined loop-like structures with different apex temperatures. Our analysis indicates that the coronae of HD 283572 and 31 Com are very similar in terms of dominant coronal magnetic structures, in spite of differences in the evolutionary phase, surface gravity and metallicity. In the case of EK Dra the distribution appears to be slightly flatter than in the previous two cases, although the peak temperature is similar.

Accepted by Astronomy & Astrophysics

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Solar Abstracts

The Effect of Metastable Level Populations on the Ionization Fraction of Li-like ions

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Lines from Li-like ions have been known to produce theoretical intensities under-estimated compared to lines of a similar formation temperature. Here we investigate this anomalous behaviour whereby the ionization fractions are calculated using the ADAS code considering the electron density dependence of dielectronic recombination coupled with collisional ionization from metastable levels. For the lines investigated, the line contribution functions show a clear dependence with increasing electron density. For example, C IV 1548 Å shows over a factor of three enhancement for $N_\mathrm{e} = 10^{12}$ cm^{-3}. The increase in the higher temperature lines is lower, but are still in the range of 30 to 60%. Furthermore, all the lines have their peak contribution shifted to lower temperature. Calculating the total radiative power output at an electron density of 10^{11} cm^{-3}, we find that the difference in the transition region is 10–15% while above 10^6 K the difference is around 30% compared to the low density value.

Accepted by A&A

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Simulations of Magneto-convection in the Solar Photosphere: Equations, Methods, and Results of the MURaM Code

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We have developed a 3D magnetohydrodynamics simulation code for applications in the solar convection zone and photosphere. The code includes a non-local and non-grey radiative transfer module and takes into account the effects of partial ionization. Its parallel design is based on domain decomposition, which makes it suited for use on parallel computers with distributed memory archictecture. We give a description of the equations and numerical methods and present the results of the simulation of a solar plage region. Starting with a uniform vertical field of 200 G, the processes of flux expulsion and convective field amplification lead to a dichotomy of strong, mainly vertical fields embedded in the granular downflow network and weak, randomly oriented fields filling the hot granular upflows. The strong fields form a magnetic network with thin, sheet-like structures extending along downflow lanes and micropores with diameters of up to 1000 km which form occasionally at vertices where several downflow lanes merge. At the visible surface around optical depth unity, the strong field concentrations are in pressure balance with their weakly magnetized surroundings and reach field strengths of up to 2 kG, strongly exceeding the values corresponding to equipartition with the kinetic energy density of the convective motions. As a result of the channelling of radiation, small flux concentrations stand out as bright features, while the larger micropores appear dark in brightness maps owing to the suppresion of the convective energy transport. The overall shape of the magnetic network changes slowly on a timescale much larger than the convective turnover time, while the magnetic flux is constantly redistributed within the network leading to continuous formation and dissolution of flux concentrations.

Accepted by A&A

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Magnetic Fields from SOHO/MDI Converted to the Mt. Wilson 150-Foot Solar Tower Scale

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[2] Now at Jet Propulsion Laboratory, Cal Tech, Pasadena, CA In order to permit the construction of long-duration time series dependent on the Sun's magnetic field, this paper presents a detailed cross-correlation between sets of simultaneous magnetograms from the Mt. Wilson Observatory (MWO) and the Michelson Doppler Imager (MDI) aboard the SOHO spacecraft. The MWO 150-foot solar tower telescope magnetogram data are for the FeI $\lambda 525.0\,\mathrm{nm}$ and NiI $\lambda 676.8\,\mathrm{nm}$ lines and the MDI data are level 1.8 magnetograms also for the NiI $\lambda 676.8\,\mathrm{nm}$ spectral line. In these comparisons, we apply a saturation correction factor to the MWO $\lambda 525.0\,\mathrm{nm}$ fields prior to the derivation of the MDI scale factor. Data from March 1997 to August 2002 are used for this work. We have found that the ratio of MWO FeI $\lambda 525.0\,\mathrm{nm}$ magnetograms over MDI magnetograms is about 1.7, and it is a function of the center-to-limb angle. Moreover, there are differences between the west-side and the east-side ratios, and these differences may come from the angle dependence of the Michelson filters in the MDI instrument. The MDI tuning changes, on the other hand, are not associated with significant jumps in the derived scale factor ratio. The average scale factors should be adequate for the construction of MDI images closely comparable to those of the saturation-corrected long-duration MWO $\lambda 525.0\,\mathrm{nm}$ sequence.

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http://www.astro.ucla.edu/ ulrich/papers/MWO_MDI_Xcalib.pdf

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` .

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