COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Europium Abundances in F and G Disk Dwarfs

Andreas Koch[1] & and Bengt Edvardsson[1]

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Europium abundances for 74 F and G dwarf stars of the galactic disk have been determined from the 4129.7 Å Eu II line. The stars were selected from the sample of Edvardsson et al. (1993) and [Eu/Fe] shows a smaller scatter and a slightly weaker trend with [Fe/H] than found by Woolf et al. (1995). The data of the two analyses are homogenized and merged. We also discuss the adopted effective temperature scale.

Accepted by A&A

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For preprints via WWW: http://arXiv.org/abs/astro-ph/0111119

The Initial Mass Function of Stars: Evidence for Uniformity in Variable Systems

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The distribution of stellar masses that form in one star-formation event in a given volume of space is called the initial mass function (IMF). The IMF has been estimated from low-mass brown dwarfs to very massive stars. Combining IMF estimates for different populations in which the stars can be observed individually unveils an extraordinary uniformity of the IMF. This general insight appears to hold for populations including present-day star formation in small molecular clouds, rich and dense massive star-clusters forming in giant clouds, through to ancient and metal-poor exotic stellar populations that may be dominated by dark matter. This apparent universality of the IMF is a challenge for star formation theory because elementary onsiderations suggest that the IMF ought to systematically vary with star-forming conditions.

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High Resolution Optical Observations of EUV-selected Active Late-type Stars

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We present high resolution optical spectra of EUV-selected late-type stars. We have detected seven new spectroscopic binaries, including a pair of F stars and an RS CVn candidate. Many of the stars in our sample show remarkable Hα emission with equivalent widths up to 8 Å. Several sources show strong He I 5876 Å emission. We use cross-correlation techniques to estimate line of sight rotational velocities and find that they range from less than 5 km/s to over 80 km/s. Several of the stars show a strong Li 6707 Å line which we use to determine their Li abundances. The EUV to bolometric luminosity, a measure of the coronal heating efficiency, is as high as 10^{-3}. The present sample extends the EUV-selected late-type stars to lower Rossby numbers and make the coronal saturation boundary better pronounced. Our results indicate that there is a drop in the EUV emission from the corona in late M dwarfs possibly due to a change in the nature of the magnetic dynamo in fully convective stars.

Accepted by AJ

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Spectroscopic Binaries in a sample of ROSAT X-ray Sources South of the Taurus Molecular Clouds

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We report the results of our radial-velocity monitoring of spectroscopic binary systems in a sample of X-ray sources from the ROSAT All Sky Survey south of the Taurus-Auriga star-forming region. The original sample of ∼120 sources by Neuhäuser et al. was selected on the basis of their X-ray properties and the visual magnitude of the nearest optical counterpart, in such a way as to promote the inclusion of young objects. Roughly 20% of those sources have previously been confirmed to be very young. We focus here on the subset of the original sample that shows variable radial velocities (43 objects), a few of which have also been flagged previously as being young. New spectroscopic orbits are presented for 42 of those systems. Two of the binaries, RXJ0528.9+1046 and RXJ0529.3+1210, are indeed weak-lined T Tauri stars likely to be associated with the λ Ori region. Most of the other binaries are active objects of the RS CVn-type, including several W UMa and Algol systems. We detect a strong excess of short-period binaries compared to the field, and an unusually large fraction of double-lined systems. This, along with the overall high frequency of binaries out of the original sample of ∼120 sources, can be understood as a selection effect since all these properties tend to favor the inclusion of the objects in a flux-limited X-ray survey such as this by making them brighter in X-rays. A short description of the physical properties of each binary is provided, and a comparison with evolutionary tracks is made using the stellar density as a distance-independent measure of evolution. We rely for this on our new determinations of the effective temperature and projected rotational velocities of all visible components of the binaries. A number of the systems merit follow-up observations, including at least 4 confirmed or probable eclipsing binaries. One of these, RXJ0239.1−1028, consists of a pair of detached K dwarfs and may provide for a potentially important test of stellar evolution models once the absolute dimensions of the components are determined.

Accepted by AJ

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For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/0112294

UBV(RI)$_C$ Photometry of Hipparcos Red Stars

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We present homogeneous and standardised $UBV(RI)_C$ photometry for nearly 550 M stars selected from the *Hip-*

parcos satellite data base using the following selection criteria: lack of obvious variability (no *Hipparcos* variability flag); $\delta < +10°$; $(V - I) > 1.7$ and V magnitude fainter than about 7.6. Comparisons are made between the current photometry, other ground–based data sets and *Hipparcos* photometry. We use Linear Discriminant Analysis to determine a luminosity segregation criterion for late-type stars, and Principal Component Analysis to study the statistical structure of the colour indices and to calibrate absolute magnitude in terms of $(V - I)$ for the dwarf stars. Various methods are used to determine the mean absolute magnitude of the giant stars. We find ten dwarf stars, apparently previously unrecognised (prior to *Hipparcos*) as being within 25 pc, including five within 20 pc.

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Quiescent and Flaring Structure in RS CVn Stars

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Four of the most active RS CVn stars (V711 Tau, II Peg, σ Gem, and UX Ari) have been observed for a total of 3 Ms with the *Extreme Ultraviolet Explorer* satellite (EUVE) between 1992 and 2000 January. Flaring and quiescent states of extreme ultraviolet spectra ($\lambda\lambda 70-740$) and light curves ($\lambda\lambda 75-175$) have been analyzed to provide emission measure distributions (EMD) for these systems in the range log $\mathrm{T}_e(K) \sim$5.6–7.4 based principally on iron lines. Flux measurements obtained with IUE and ORFEUS complete the EMD in the lower temperature range [log $\mathrm{T}_e(K) \sim$4.0–5.6]. Frequent flaring activity has been found in the systems, including an increase during the rise phase by a factor of $\sim$9 in the flux of σ Gem, the largest flare enhancement observed with EUVE. Analyses of the EUVE emission in the active single star AB Dor, and the low rotation giant star β Cet are also included. The EMDs are remarkably similar among all the stars, showing a narrow enhancement or "bump" around log $\mathrm{T}_e(K) \sim$6.9. These narrow bumps are apparently unrelated to rotation rate, spectral type, binarity, or evolutionary stage. Significant material is found at log $\mathrm{T}_e(K) \geq$7.0 for the most active stars. Modulation of the EUV flux outside of flaring occurs in four of the stars (σ Gem, V711 Tau, UX Ari, AB Dor). The electron density ranges between $N_e \sim 10^{12}\ cm^{-3}$ and $N_e \sim 10^{13}\ cm^{-3}$, measured at log $\mathrm{T}_e(K) \sim 7.0$, and may reach higher values during flares. These densities and EMD values imply small scale sizes for emitting regions.

Accepted by ApJ

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α-Process Elements in the Galaxy: A Possible GAIA Contribution

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The sensitivity of stellar spectra to α/Fe abundance changes is investigated with the aim to be detected photometricly and employed for scientific goals of the GAIA mission. A grid of plane parallel, line blanketed, flux constant, LTE model atmospheres with different [α/Fe] ratios was calculated. As a first step, the modelled stellar energy fluxes for solar-type stars and giants were computed and intercompared. The spectral sensitivity to α/Fe abundance changes is noticeable and has to be taken into account when selecting photometric filters for GAIA. The Ca II H and K lines and Mg I b triplet are the most sensitive direct indicators of α/Fe abundance changes.

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For preprints via WWW: http://arXiv.org/abs/astro-ph/0111119

Fast-rotating Nearby Solar-type Stars I. Spectral Classification, v sin i, Li Abundances and X-ray Luminosities

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We present the results of high-resolution spectroscopic and high-precision photometric observations on a sample of 129 late-F and G-type nearby stars selected on the basis of their large rotational velocity. Using also data from the Hipparcos satellite, CORAVEL and from the ROSAT satellite database, we infer spectral types, compute radial velocities, v sin i, Li abundances and X-ray luminosities and investigate the single or binary nature of the sample stars. Such a careful analysis of our sample shows a large fraction of binaries ($\simeq$62%) and of young single disk stars. In particular, at least 9 stars can be considered bona-fide PMS or ZAMS objects, and 30 stars are identified as SBs for the first time. Information on the presence of Ca II K emission and on optical variability is given for some of the stars of the sample.

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Time-dependent Asymmetries in the Atmosphere of the Mira Variable R Tri through IR Interferometry

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We report high-resolution (< 0.05 mas) angular size measurements of the Mira variable star R Triangulum using the Palomar Testbed Interferometer (PTI). Observations were conducted in the K band (2.0-2.4 μm) between the visual phases of 0.77–0.88, and one period later at phase 0.91. The spatial coverage of the measurements spans 40 degrees in position angle. Three simple geometries were modeled: a uniform ellipse model and a uniform sphere with a brighter "disk" model have lower χ^2_μ than the uniform spherical disk model by factors of 5–10. For the non-spherically symmetric models, the axis of symmetry is clustered between 20 and 35 degrees. The position angles are roughly perpendicular to visual polarization position angles, which supports a non-spherically symmetric source of light scattering. For the elliptical geometry, averaging the semi-major and semi-minor axes throughout the dataset yield an ensemble average angular diameter of 5.22 ± 0.30 mas; the ensemble average axial ratio of $(2a/2b) = 0.75$ is similar to that previously determined for other Mira and semi-regular variable stars.

Accepted by the Astrophysical Journal

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Solar Abstracts

Geometrical Properties of Avalanches in Self-Organized Critical Models of Solar Flares

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We investigate the geometrical properties of avalanches in self-organized-critical models for solar flares. Traditionally, such models differ from the classical sandpile model in their formulation of stability criteria in terms of the curvature of the nodal field, and belong to a distinct universality class. With a view towards comparing these properties to those inferred from spatially and temporally resolved flare observations, we consider the properties of avalanche peak snapshots, time-integrated avalanches in two/three dimensions, and the two-dimensional projections of the latter. The nature of the relationship between the avalanching volume and its projected area is an issue of particular interest in the solar flare context. Using our simulation results we investigate this relationship, and demonstrate that proper accounting of the fractal nature of avalanches can bring into agreement hitherto discrepant results of observational analyses based on simple, non-fractal geometries for the flaring volume.

Accepted by Phys. Rev. E

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Empirical Densities, Kinetic Temperatures, and Outflow Velocities in the Equatorial Streamer Belt at Solar Minimum

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We use combined Ultraviolet Coronagraph Spectrometer (UVCS) and Large Angle Spectroscopic Coronagraph (LASCO) data to determine the O^{5+} outflow velocities as a function of height along the axis of an equatorial streamer at solar minimum and as a function of latitude (at 2.3 R_o from sun center). The results show that outflow increases rather abruptly in the region between 3.6 and 4.1 R_o near the streamer cusp, and gradually increases to $\sim 90\ km\ s^{-1}$ at $\sim 5\ R_o$ in the streamer stalk beyond the cusp. The latitudinal variation at 2.3 R_o shows that there is no outflow (within the measurement uncertainties) in the center of the streamer, called the core, and that a steep increase in outflow occurs just beyond the streamer legs, where the O VI λ1032 intensity relative to H I λ1216 (Lyα) is higher than in the core. Velocity variations in both height and latitude show that the transitions from no measurable outflow to positive outflow are relatively sharp and thus can be used to infer the location of the transition from closed to open field lines in streamer magnetic field topologies. Such information, including the densities and kinetic temperatures derived from the observations, provides hard constraints for realistic theoretical models of streamers and the source regions of the slow solar wind. Accepted by ApJ

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Low-Mass and Substellar Abstracts

Crossing the Brown Dwarf Desert Using Adaptive Optics: A Very Close L-Dwarf Companion to the Nearby Solar Analog HR 7672

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We have found a very faint companion to the active solar analog HR 7672 (HD 190406; GJ 779; 15 Sge). Three epochs of high resolution imaging using adaptive optics (AO) at the Gemini-North and Keck II Telescopes demonstrate that HR 7672B is a common proper motion companion, with a separation of $0''.79$ (14 AU) and a 2.16 μm flux ratio of 8.6 mags. Using follow-up K-band spectroscopy from Keck AO+NIRSPEC, we measure a spectral type of L4.5$\pm$1.5. This is the closest ultracool companion around a main sequence star found to date by direct imaging. We estimate the primary has an age of 1–3 Gyr. Assuming coevality, the companion is most likely substellar, with a mass of 55–78 M_{Jup} based on theoretical models. The primary star shows a long-term radial velocity trend, and we combine the radial velocity data and AO imaging to set a firm (model-independent) lower limit of 48 M_{Jup}. In contrast to the paucity of brown dwarf companions at $\lesssim$4 AU around FGK dwarfs, HR 7672B implies that brown dwarf companions

do exist at separations comparable to those of the giant planets in our own solar system. Its presence is at variance with scenarios where brown dwarfs form as ejected stellar embryos. Moreover, since HR 7672B is likely too massive to have formed in a circumstellar disk as planets are believed to, its discovery suggests that a diversity of physical processes act to populate the outer regions of exoplanetary systems.

Accepted by ApJ

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Abstract Guidelines

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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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