COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 118 — December 2005 Editor: Steve Skinner (coolnews@jila.colorado.edu)

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Stellar Abstracts

Distances and Galactic Kinematics of Two Blue Metal-Poor Stars

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We use an SX Phe period-luminosity relation to derive distance estimates and Galactic kinematic parameters for the short-period pulsating blue metal-poor stars CS 29499-057 and 22966-043. The resulting kinematics are quite distinctive relative to the metal-poor halo field. Even though these two field blue stragglers' binarity is consistent with the idea of formation in a mass transfer system, we thus speculate these stars' origin instead lies in a Galactic merger or interaction with a dwarf galaxy satellite or the merger of a stellar binary system. The former possibility is consistent with CS 22966-043's significant [α/Fe] deficiency. A non-mass transfer origin for both binaries is also consistent with (though not necessarily precluded by) the lack of any signficant s-process enhancement seen in either star, and the long orbital period of CS 29499-057 that may preclude a mass transfer origin. In an effort to determine distances to additional blue metal-poor stars, we have photometrically monitored CS 22890-069, 22872-062, and 22884-065. The light curves of these 3 objects, however, indicate no short-period photometric variability at the few hundredths of a magnitude level.

Accepted by PASP (December 2005)

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For preprints via ftp or WWW: http://www.ces.clemson.edu/ jking2/Research/

Variability and Periodicity of Field M dwarfs Revealed by Multichannel Monitoring

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We present simultaneous, multiband monitoring of 19 field M dwarfs (spectral types M2-M9). Significant variability was found in seven objects in at least one out of the three channels I, R and G. Two objects, LHS370 (M5V) and 2M1707+64 (M9V), show periods of 5.9+-2.0 and 3.65+-0.1 hours respectively. On account of the agreement with the typical values of v*sin(i) published for M dwarfs (Mohanty & Basri 2003), we claim these to be the objects' rotation periods. In the case of 2M1707+64 we furthermore find evidence for the presence of magnetically-induced cool spots as the reason for the observed variability (at a temperature contrast of 4-8 percent, with a projected surface coverage factor of less than 0.075) and can rule out the scenario of dust clouds (as represented by the COND or DUSTY models). Comparing the frequency of occurrence of variability in this and various L dwarf samples published over the past few years, we find that variability is more common in field L dwarfs than in field M dwarfs. This implies a change in the physical nature and/or extent of surface features when moving from M to L dwarfs.

Accepted by A&A

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Unravelling the Nature of HD 81032 - A New RS CVn Binary

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BVR photometric and quasi-simultaneous optical spectroscopic observations of the star HD 81032 have been carried out during the years 2000 - 2004. A photometric period of 18.802 ± 0.07 d has been detected for this star. A large group of spots with a migration period of 7.43 ± 0.07 years is inferred from the first three years of the data. Hα and Ca II H and K emissions from the star indicate high chromospheric activity. The available photometry in the BVRIJHK bands is consistent with spectral type of K0 IV previously found for this star. We have also examined the spectral energy distribution of HD 81032 for the presence of an infrared colour excess using the 2MASS JHK and IRAS photometry, but found no significant excess in any band above the normal values expected for a star with this spectral type. We have also analyzed the X-ray emission properties of this star using data obtained by the ROSAT X-ray observatory during its All-Sky Survey phase. An X-ray flare of about 12 hours duration was detected during the two days of X-ray coverage obtained for this star. Its X-ray spectrum, while only containing 345 counts, is inconsistent with a single-temperature component solar-abundance coronal plasma model, but implies either the presence of two or more plasma components, non-solar abundances, or a combination of both of these properties. All of the above properties of HD 81032 suggest that it is a newly identified, evolved RS CVn binary.

Accepted by JApA

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For preprints via ftp or WWW: http://aries.ernet.in/~jeewan/preprints/hd81032.ps.gz

CNO in Evolved Intermediate Mass Stars

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In order to investigate the possible influence of rotation on the efficiency of the first dredge-up we have determined atmospheric parameters, masses and abundances of carbon, nitrogen and oxygen in a sample of evolved intermediate mass stars. We have used high resolution spectra and conducted a model atmosphere analysis. The abundances were calculated through spectral synthesis and compared to the predictions of rotating and non-rotating evolutionary models. Almost all the objects in our sample where carbon and nitrogen abundances could be determined show signs

of internal mixing. The stars, however, seem to be mixed in different extents. Among the mixed stars we identify in our sample five ones with abundances in agreement with the non-rotating models, four stars that seem to be mixed beyond that and one star which seems to be slightly less mixed than predicted for the first dredge-up. There are also five stars which seem to be slightly more mixed than expected but their abundances are in marginal agreement with both rotating and non-rotating models. Such differences in the extent of the mixing are not predicted by the standard models and certainly imply in the effective action of other mixing mechanisms than solely the convective dredge-up.

Accepted by A&A

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For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/0511329

Photometric Evidence for Two-Temperature Photospheric Inhomogeneities on Magnetically Active K Dwarf Stars

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We derive the properties of spotted regions in late-type active stars from V- and B-band photometric data. Specifically, we compare the amplitudes of spot-induced light and color variations with model amplitudes, which depend on the area, temperature and distribution of spotted regions over the stellar surface. Our analysis is applied to three well-known chromospherically active K dwarf stars: DX Leonis, AB Doradus and LQ Hydrae, and indicates that all three stars show significant variations of the average spot temperature from epoch to epoch. The observed temporal variations of the starspot temperatures are best explained as arising from the contemporary presence on the stellar photosphere of two-component (two-temperature) active regions. These consist of either dark spots and hot faculae and/or dark umbrae and penumbrae and the variations over time arise from change of their areal ratio.

Accepted by A&A

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Collisionless Damping of Fast MHD Waves in Magneto-rotational Winds

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We propose collisionless damping of fast MHD waves as an important mechanism for the heating and acceleration of winds from rotating stars. Stellar rotation causes magnetic field lines anchored at the surface to form a spiral pattern and magneto-rotational winds can be driven. If the structure is a magnetically dominated, fast MHD waves generated at the surface can propagate almost radially outward and cross the field lines. The propagating waves undergo collisionless damping owing to interactions with particles surfing on magnetic mirrors that are formed by the waves themselves. The energy damping rate is especially effective where the angle between the wave propagation and the field lines becomes moderately large (~ 20 to 80°). The angle tends naturally to increase into this range because the field in magneto-rotational winds develops an increasingly large azimuthal component. The dissipation of the wave energy produces heating and acceleration of the outflow. We show using specified wind structures that this damping process can be important in both solar-type stars and massive stars that have moderately large rotation rates. This mechanism can play a role in coronae of young solar-type stars which are rapidly rotating and show X-ray luminosities much larger than the sun. The mechanism could also be important for producing the extended X-ray emitting regions inferred to exist in massive stars of spectral type middle B and later.

Accepted by ApJ

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For preprints via ftp or WWW: http://arxiv.org/abs/astro-ph/0505013

Oscillation Mode Lifetimes in ξ Hydrae: Will Strong Mode Damping Limit Asteroseismology of Red Giant Stars?

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We introduce a new method to measure frequency separations and mode lifetimes of stochastically excited and damped oscillations, so-called solar-like oscillations. Our method shows that velocity data of the red giant star ξ Hya (Frandsen et al. 2002) support a large frequency separation between modes of roughly 7 μHz. We also conclude that the data are consistent with a mode lifetime of 2 days, which is so short relative to its pulsation period that none of the observed frequencies are unambiguous. Hence, we argue that the maximum asteroseismic output that can be obtained from these data is an average large frequency separation, the oscillation amplitude and the average mode lifetime. However, the significant discrepancy between the theoretical calculations of the mode lifetime (Houdek & Gough 2002) and our result based on the observations of ξ Hya, implies that red giant stars can help us better understand the damping and driving mechanisms of solar-like p-modes by convection.

Accepted by A&A

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For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/0511344

Solar Abstracts

Si XII X-ray Satellite Lines in Solar Flare Spectra

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brackets: The temperature dependence of the Si XII $n = 3$ and $n = 4$ dielectronic satellite line features at 5.82 Å and 5.56 Å respectively, near the Si XIII $1s^2 - 1s3p$ and $1s^2 - 1s4p$ lines (5.681 Å and 5.405 Å), is calculated using atomic data presented here. The resulting theoretical spectra are compared with solar flare spectra observed by the RESIK spectrometer on the *CORONAS-F* spacecraft. The satellites, like the more familiar $n = 2$ satellites near the Si XIII $1s^2 - 1s2p$ lines, are formed mostly by dielectronic recombination, but unlike the $n = 2$ satellites are unblended. The implications for similar satellite lines in flare Fe spectra are discussed.

Accepted by ApJ

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Making the Corona and the Fast Solar Wind: A Self-consistent Simulation for the Low-frequency Alfvén Waves from Photosphere to 0.3 AU

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We show that the coronal heating and the fast solar wind acceleration in the coronal holes are natural consequence of the footpoint fluctuations of the magnetic fields at the photosphere, by performing one-dimensional magnetohydrodynamical simulation with radiative cooling and thermal conduction. We initially set up a static open flux tube with temperature 10^4K rooted at the photosphere. We impose transverse photospheric motions corresponding to the granulations with velocity $\langle dv_\perp \rangle = 0.7$km/s and period between 20 seconds and 30 minutes, which generate outgoing

Alfvén waves. We self-consistently treat these waves and the plasma heating. After attenuation in the chromosphere by $\simeq 85\%$ of the initial energy flux, the outgoing Alfvén waves enter the corona and contribute to the heating and acceleration of the plasma mainly by the nonlinear generation of the compressive waves and shocks. Our result clearly shows that the initial cool and static atmosphere is naturally heated up to 10^6K and accelerated to

Accepted by ApJL (vol.632, L49)

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For preprints via ftp or WWW: http://arxiv.org/abs/astro-ph/0506639

The Ne/O Abundance Ratio in the Quiet Sun

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Aims: To determine the neon-to-oxygen abundance in the quiet Sun, a proxy for the photospheric abundance ratio.
Methods: An emission measure method applied to extreme ultraviolet emission lines of Ne IV–VI and O III–V ions observed by the Coronal Diagnostic Spectrometer on the SOHO satellite.
Results: The average Ne/O abundance ratio in supergranule cell centre regions is 0.18 ± 0.05, while in supergranule network regions is 0.16 ± 0.04. A photospheric Ne/O ratio of 0.17 ± 0.05 is suggested, in good agreement with the most recent compilation of solar photospheric abundances, but discrepant with a recent Ne/O ratio derived from stellar X-ray spectra and revised neon abundances suggested from solar interior models.

Accepted by A&A (444, L45)

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Low-Mass and Substellar Abstracts

The Very Low-Mass Population of the Corona Australis and Chamaeleon II Star Forming Regions

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We present the results of a deep optical survey in the Corona Australis and Chamaeleon II star forming regions. Our optical photometry is combined with available near- and mid-infrared photometry to identify very low-mass candidate members in these dark clouds. In our Chamaeleon II field, only one object exhibits clear Hα emission, but the discrepancy between its optical and near-infrared colours suggests that it might be a foreground star. We also identify two objects without Hα emission that could be planetary mass members of Chamaeleon II. In Corona Australis, we find ten stars and three brown dwarf candidates in the Coronet cluster. Five of our new members are identified with ISOCAM sources. Only two of them have a mid-infrared excess, indicating the presence of an accretion disk. On the other hand, one brown dwarf candidate has a faint close companion, seen only in our deepest I-band image. For many of the candidates in both clouds, membership could not be inferred from their Hα emission or near-infrared colours; these objects need spectroscopic confirmation of their status.

Accepted by A&A

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X-ray Emission of Brown Dwarfs: Towards Constraining the Dependence on Age, Luminosity, and Temperature

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We present X-ray observations of brown dwarfs in different evolutionary stages obtained with the *Chandra X-ray Observatory*. The ages of our three targets (HR 7329 B, Gl 569 Bab, and HD 130948 BC) are constrained by them being companions to main-sequence stars of known age. With both known age and effective temperature or bolometric luminosity, the mass can be derived from evolutionary models. Two out of three brown dwarfs are detected with *Chandra*, with variable lightcurves and comparatively soft spectra. Combining the new observations with previous studies of brown dwarfs presented in the literature yields a sample that covers the age range from ~ 1 Myr to ~ 1 Gyr, and reaches well down into the cooling phase of brown dwarfs. We consider a subsample of high-mass brown dwarfs (with $0.05 - 0.07\,M_{\odot}$ according to evolutionary models), thus eliminating mass from the list of free parameters, and find evidence that X-ray luminosity declines with decreasing bolometric luminosity steeper than expected from the canonical relation for late-type stars ($L_{\rm x}/L_{\rm bol} = 10^{-3...-5}$). We identify the effective temperature as a likely parameter responsible for the additional decline of X-ray activity in the more evolved (and therefore cooler) brown dwarfs of the 'high-mass' sample. In another subsample of brown dwarfs characterized by similar effective temperature, the X-ray luminosity scales with the bolometric luminosity without indications for a deviation from the canonical range of $10^{-3...-5}$ observed for late-type stars. This supports the idea that effective temperature plays a critical role for the X-ray activity in brown dwarfs. Our finding underlines an earlier suggestion based on observations of chromospheric Hα emission in ultracool dwarfs that the low ionization fraction in the cool brown dwarf atmospheres may suppress magnetic activity.

Accepted by A&A

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The IAC Online Catalog for M-, L- and T-type Dwarfs

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We present an online catalog for dwarfs with spectral types M, L and T. The catalog currently contains 893 objects listed in order of right ascension. For most of them the spectra can be downloaded from the catalog in ASCII or FITS formats. The web address is http://www.iac.es/galeria/ege/catalogo_spectral/.

Accepted by AN

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NAHUAL: A Near-infrared High-resolution Spectrograph for the GTC Optimized for Studies of Ultracool Dwarfs

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We present the status of an ongoing study for a high-resolution near-infrared echelle spectrograph for the 10.4-m GTC (Gran Telescopio de Canarias) which will soon start operating at the Observatorio del Roque de los Muchachos on the island of La Palma. The main science driver of this instrument, which we have baptized NAHUAL, is to carry out a high precision radial velocity survey of exoplanets around ultracool dwarfs. NAHUAL is being especially designed to achieve the highest possible accuracy for radial velocity measurements. The goal is to reach an accuracy of a few m/s. It is thus required that the instrument is cross-dispersed and that it covers simultaneously a wide wavelength range. Absorption cells will be placed in front of the slit which will allow a simultaneous self-reference similar to an iodine-cell in the optical regime. It is planned to place the instrument at one of the Nasmyth platform of the GTC

behind the Adaptive Optics system. Our current design reaches a maximum spectral resolution of $\lambda/\Delta\lambda$=50,000 with a slit width of 0.175 arcsec, and gives nearly complete spectral coverage from 900 to 2400 nm.

Accepted by AN

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Ph.D. Thesis Abstracts

Brown Dwarf Companions to Young Solar Analogs: An Adaptive Optics Survey Using Palomar and Keck

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Ph.D dissertation directed by: Lynne Hillenbrand

Ph.D degree awarded: Jun 2006 (defended: Aug 2005)

We present results from an adaptive optics survey conducted with the Palomar and Keck telescopes over 3 years, which measured the frequency of stellar and sub-stellar companions to Sun-like stars. The survey sample contains 266 stars in the 3–10000 million year age range at heliocentric distances between 8 and 200 parsecs and with spectral types between F5–K5. A sub-sample of 101 stars, between 3–500 million years old, were observed in deep exposures with a coronagraph to search for faint sub-stellar companions. A total of 288 candidate companions were discovered around the sample stars, which were re-imaged at subsequent epochs to determine physical association with the candidate host stars by checking for common proper motion. Benefiting from a highly accurate astrometric calibration of the observations, we were able to successfully apply the common proper motion test in the majority of the cases, including stars with proper motions as small as 20 milli-arcseconds year^{-1}.

The results from the survey include the discovery of three new brown dwarf companions (HD 49197B, HD 203030B, and ScoPMS 214B), 43 new stellar binaries, and a triple system. The physical association of an additional, a priori-suspected, candidate sub-stellar companion to the star HII 1348 is astrometrically confirmed. The newly-discovered and confirmed young brown dwarf companions span a range of spectral types between M5 and T0.5, and will be of prime significance for constraining evolutionary models of young brown dwarfs and extra-solar planets.

Based on the 3 new detections of sub-stellar companions in the 101 star sub-sample and following a careful estimate of the survey incompleteness, a Bayesian statistical analysis shows that the frequency of 0.012–0.072 solar-mass brown dwarfs in 30–1600 AU orbits around young solar analogs is $6.8^{+8.3}_{-4.9}\%$ (2σ limits). While this is a factor of 3 lower than the frequency of stellar companions to G-dwarfs in the same orbital range, it is significantly higher than the frequency of brown dwarfs in 0–3 AU orbits discovered through precision radial velocity surveys. It is also fully consistent with the observed frequency of 0–3 AU extra-solar planets. Thus, the result demonstrates that the radial-velocity "brown dwarf desert" does not extend to wide separations, contrary to previous belief.

Thesis-related Publications: ApJ, 617, 1330; ApJ, 622, 451

Announcement

Proceedings of Brown Dwarf Workshop (29 Oct. 2005, Hawaii)

Editor: Sandy Leggett[1]

[1] Joint Astronomy Centre, Hilo Hawaii USA

Proceedings of talks and posters presented at a one day brown dwarf workshop are now available at:
http://www.jach.hawaii.edu/~skl/PPV_BD.html

Taking advantage of the Protostars and Planets V (PPV) meeting, held at the Hilton Waikoloa in Hawaii between the 24th and 28th October 2005, Sandy Leggett and Mark Marley hosted an additional one day workshop on Saturday October 29th, at the same location, to discuss new results in studies of late L, T and Y dwarfs. PPV addressed very young brown dwarfs; this, separate, workshop concentrated on brown dwarfs older than 100 Myr. Discussion was limited to spectral types later than L5, or effective temperatures cooler than 1500 K. New results were presented for both theoretical atmospheric models and observations. Recent progress in the models include treatment of the breakup of the condensate clouds in the transition from L to T, and extension of model grids to wider ranges of effective temperature, gravity and metallicity. Progress on the observational front includes high-resolution images of binary dwarfs, new mid-infrared results from the ground and from Spitzer, as well as the search for dwarfs later than T8 in ground- or space-based surveys.

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` .

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