

COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Editor: Steve Skinner (coolnews@jila.colorado.edu)

TABLE OF CONTENTS

| | |
|--|----|
| Stellar Abstracts | 1 |
| Solar Abstracts | 5 |
| Cross-Listed Abstracts | 6 |
| Announcement (Textbook series on Heliospheric Physics) | 7 |
| Upcoming Meeting (Cool Stars 16) | 8 |
| Job Openings | 8 |
| Abstract Guidelines | 10 |

Stellar Abstracts

Scaled Oscillation Frequencies and Échelle Diagrams as a Tool for Comparative Asteroseismology

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We describe a method for comparing the frequency spectra of oscillating stars. We focus on solar-like oscillations, in which mode frequencies generally follow a regular pattern. On the basis that oscillation frequencies of similar stars scale homologously, we show how to display two stars on a single échelle diagram. The result can be used to infer the ratio of their mean densities very precisely, without reference to theoretical models. In addition, data from the star with the better signal-to-noise ratio can be used to confirm weaker modes and reject sidelobes in data from the second star. Finally, we show that scaled échelle diagrams provide a solution to the problem of ridge identification in F-type stars, such as those observed by the CoRoT space mission.

published in *Communications in Asteroseismology*

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For preprints via ftp or WWW: <http://adsabs.harvard.edu/abs/2010CoAst.161....3B>

Fe I and Fe II Abundances of Solar-Type Dwarfs In the Pleiades Open Cluster

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We have derived Fe abundances of 16 solar-type Pleiades dwarfs by means of an equivalent width analysis of Fe I and Fe II lines in high-resolution spectra obtained with the Hobby - Eberly Telescope and High Resolution Spectrograph. Abundances derived from Fe II lines are larger than those derived from Fe I lines (herein referred to as over-ionization) for stars with $T_{\text{eff}} < 5400$ K, and the discrepancy ($\Delta\text{Fe} = [\text{Fe II}/\text{H}] - [\text{Fe I}/\text{H}]$) increases dramatically with decreasing T_{eff} , reaching over 0.8 dex for the coolest stars of our sample. The Pleiades joins the open clusters M34, the Hyades, IC 2602, and IC 2391, and the Ursa Major moving group, demonstrating ostensible over-ionization trends. The Pleiades ΔFe abundances are correlated with Ca II infrared triplet and $\text{H}\alpha$ chromospheric emission indicators and relative differences therein. Oxygen abundances of our Pleiades sample derived from the high-excitation O I triplet have been previously shown to increase with decreasing T_{eff} , and a comparison with the ΔFe abundances suggests that the over-excitation (larger abundances derived from high excitation lines relative to low excitation lines) and over-ionization effects that have been observed in cool open cluster and disk field main sequence (MS) dwarfs share a common origin. Curiously, a correlation between the Pleiades O I abundances and chromospheric emission indicators does not exist. Star-to-star Fe I abundances have low internal scatter (< 0.11 dex), but the abundances of stars with $T_{\text{eff}} < 5400$ K are systematically higher compared to the warmer stars. The cool star [Fe I/H] abundances cannot be connected directly to over-excitation effects, but similarities with the ΔFe and O I triplet trends suggest the abundances are dubious. Using the [Fe I/H] abundances of five stars with $T_{\text{eff}} > 5400$ K, we derive a mean Pleiades cluster metallicity of $[\text{Fe}/\text{H}] = +0.01 \pm 0.02$.

Accepted by PASP (arXiv:1005.3619)

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Photometric and Spectroscopic Observations of Three Rapidly Rotating Late-Type Stars: EY Dra, V374 Peg and GSC 02038-00293

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Here, $BV(RI)_C$ broad band photometry and intermediate resolution spectroscopy in $\text{H}\alpha$ region are presented for two rapidly rotating late-type stars: EY Dra and V374 Peg. For a third rapid rotator, GSC 02038-00293, intermediate resolution $\text{H}\alpha$ spectroscopy and low resolution spectroscopy are used for spectral classification and stellar parameter investigation of this poorly known object. The low resolution spectrum of GSC 02038-00293 clearly indicates that it is a K-type star. Its intermediate resolution spectrum can be best fitted with a model with $T_{\text{eff}}=4750$ K and $v \sin i=90\text{km/s}$, indicating a very rapidly rotating mid-K star. The $\text{H}\alpha$ line strength is variable, indicating changing chromospheric emission on GSC 02038-00293. In the case of EY Dra and V374 Peg, the stellar activity in the photosphere is investigated from the photometric observations, and in the chromosphere from the $\text{H}\alpha$ line. The enhanced chromospheric emission in EY Dra correlates well with the location of the photospheric active regions, indicating that these features are spatially collocated. Hints of this behaviour are also seen in V374 Peg, but it cannot be confirmed from the current data. The photospheric activity patterns in EY Dra are stable during one observing run lasting several nights, whereas in V374 Peg large night-to-night variations are seen. Two large flares, one in the $\text{H}\alpha$ observations and one from the broadband photometry, and twelve smaller ones were detected in V374 Peg during the observations spanning nine nights. The energy of the photometrically detected largest flare is estimated to be $4.25 \times 10^{31} - 4.3 \times 10^{32}$ ergs, depending on the waveband. Comparing the activity patterns in these two stars, which are just below and above the mass limit of full convection, is crucial for understanding dynamo operation in stars with

different internal structures.

Accepted by AN (Astronomical Notes)

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Photospheric Activity, Rotation, and Radial Velocity Variations of the Planet-Hosting Star CoRoT-7

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The CoRoT satellite has recently discovered the transits of a telluric planet across the disc of a late-type magnetically active star dubbed CoRoT-7, while a second planet has been detected after filtering out the radial velocity (hereafter RV) variations due to stellar activity. We investigate the magnetic activity of CoRoT-7 and use the results for a better understanding of the impact of magnetic activity on stellar RV variations. We derive the longitudinal distribution of active regions on CoRoT-7 from a maximum entropy spot model of the CoRoT light curve. Assuming that each active region consists of dark spots and bright faculae in a fixed proportion, we synthesize the expected RV variations. Active regions are mainly located at three active longitudes which appear to migrate at different rates, probably as a consequence of surface differential rotation, for which a lower limit of $\Delta\Omega/\Omega = 0.058 \pm 0.017$ is found. The synthesized activity-induced RV variations reproduce the amplitude of the observed RV curve and are used to study the impact of stellar activity on planetary detection. In spite of the non-simultaneous CoRoT and HARPS observations, our study confirms the validity of the method previously adopted to filter out RV variations induced by stellar activity. We find a false-alarm probability < 0.01 percent that the RV oscillations attributed to CoRoT-7b and CoRoT-7c are spurious effects of noise and activity. Additionally, our model suggests that other periodicities found in the observed RV curve of CoRoT-7 could be explained by active regions whose visibility is modulated by a differential stellar rotation with periods ranging from 23.6 to 27.6 days.

the name of journal, for example: Accepted by A&A

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For preprints via ftp or WWW: arXiv:1005.3602

Lucky Imaging Survey for Southern M Dwarf Binaries

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Context: While M dwarfs are the most abundant stars in the Milky Way, there is still large uncertainty about their basic physical properties (mass, luminosity, radius, etc.) as well as their formation environment. Precise knowledge of multiplicity characteristics and how they change in this transitional mass region, between Sun-like stars on the one side and very low mass stars and brown dwarfs on the other, provide constraints on low mass star and brown dwarf formation.

Aims: In the largest M dwarf binary survey to date, we search for companions to active, and thus preferentially young, M dwarfs in the solar neighbourhood. We study their binary/multiple properties, such as the multiplicity frequency and distributions of mass-ratio and separation, and identify short period visual binaries, for which orbital parameters and hence dynamical mass estimates can be derived in the near future.

Methods: The observations are carried out in the SDSS i' and z' band using the Lucky Imaging camera AstraLux Sur at the ESO 3.5 m New Technology Telescope. Lucky Imaging is a very efficient method of observing a large sample of stars at an angular resolution close to the diffraction limit.

Results: In the first part of the survey, we observed 124 M dwarfs of integrated spectral types M0-M6 and identified 34 new and 17 previously known companions to 44 stars. We derived relative astrometry and component photometry for these binary and multiple systems. More than half of the binaries have separations smaller than 1 arcsec and would have been missed in a simply seeing-limited survey. Correcting our sample for selection effects yields a multiplicity fraction of $32\pm 6\%$ for 108 M dwarfs within 52 pc and with angular separation 0.1-6.0 arcsec, corresponding to projected separation 3-180 A.U. at median distance 30 pc. Compared to early-type M dwarfs ($M > 0.3M_{Sun}$), later-type (and hence lower mass) M dwarf binaries appear to have closer separations, and more similar masses.

Accepted by A&A

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For preprints via ftp or WWW: <http://arxiv.org/abs/1006.2377>

The Magnetically-Active, Low-Mass, Triple System WDS 19312+3607

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Aims. We investigated in detail the system WDS 19312+3607, whose primary is an active M4.5Ve star previously thought to be young ($\tau \sim 300\text{--}500$ Ma) based on high X-ray luminosity.

Methods. We collected intermediate- and low-resolution optical spectra taken with 2 m-class telescopes, photometric data from the B to $8\mu\text{m}$ bands, and eleven astrometric epochs with a time baseline of over 56 years for the two components in the system, G 125-15 and G 125-14.

Results. We derived M4.5V spectral types for both stars, confirmed their common proper motion, estimated the heliocentric distance and projected physical separation, determined the galactocentric space velocities, and deduced a most-probable age older than 600 Ma. We discovered that the primary, G 125-15, is in turn an inflated, double-lined, spectroscopic binary with a short period of photometric variability of $P \sim 1.6$ d, which we associated to orbital synchronisation. The observed X-ray and $H\alpha$ emissions, photometric variability, and abnormal radius and effective temperature of G 125-15 AB indicate strong magnetic activity, possibly due to fast rotation. Besides, the estimated projected physical separation between G 125-15 AB and G 125-14 of about 1200 AU makes WDS 19312+3607 to be one of the widest systems with intermediate M-type primaries.

Conclusions. G 125-15 AB is a nearby ($d \approx 26$ pc), bright ($J \approx 9.6$ mag), active spectroscopic binary with a single proper-motion companion of the same spectral type at a wide separation. They are thus ideal targets for specific follow-ups to investigate wide and close multiplicity or stellar expansion and surface cooling due to reduced convective efficiency.

Accepted by A&A

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For preprints via ftp or WWW: <http://arxiv.org/abs/1006.4116>

A Spectroscopy Study of Nearby Late-Type Stars, Possible Members of Stellar Kinematic Groups

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Nearby late-type stars are excellent targets for seeking young objects in stellar associations and moving groups. The origin of these structures is still misunderstood, and lists of moving group members often change with time and also from author to author. Most members of these groups have been identified by means of kinematic criteria, leading to an important contamination of previous lists by old field stars. We attempt to identify unambiguous moving group members among a sample of nearby-late type stars by studying their kinematics, lithium abundance, chromospheric activity, and other age-related properties. High-resolution echelle spectra ($R \sim 57000$) of a sample of nearby late-type stars are used to derive accurate radial velocities that are combined with the precise Hipparcos parallaxes and proper motions to compute galactic-spatial velocity components. Stars are classified as possible members of the classical moving groups according to their kinematics. The spectra are also used to study several age-related properties for young late-type stars, i.e., the equivalent width of the lithium Li I 6707.8 Å line or the R'_{HK} index. Additional information like X-ray fluxes from the ROSAT All-Sky Survey or the presence of debris discs is also taken into account. The different age estimators are compared and the moving group membership of the kinematically selected candidates are discussed. From a total list of 405 nearby stars, 102 have been classified as moving group candidates according to their kinematics. i.e., only $\sim 25.2\%$ of the sample. The number reduces when age estimates are considered, and only 26 moving group candidates (25.5% of the 102 candidates) have ages in agreement with the star having the same age as an MG member.

Accepted by A&A

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For preprints via ftp or WWW: <http://www.aanda.org/articles/aa/pdf/forth/aa14948-10.pdf>

Solar Abstracts

The Effect Of Activity-related Meridional Flow Modulation On The Strength Of The Solar Polar Magnetic Field

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We studied the effect of the perturbation of the meridional flow in the activity belts detected by local helioseismology on the development and strength of the surface magnetic field at the polar caps. We carried out simulations of synthetic solar cycles with a flux transport model, which follows the cyclic evolution of the surface field determined by flux emergence and advective transport by near-surface flows. In each hemisphere, an axisymmetric band of latitudinal flows converging towards the central latitude of the activity belt was superposed onto the background poleward meridional flow. The overall effect of the flow perturbation is to reduce the latitude separation of the magnetic polarities of a bipolar magnetic region and thus diminish its contribution to the polar field. As a result, the polar field maximum reached around cycle activity minimum is weakened by the presence of the meridional flow perturbation. For a flow perturbation consistent with helioseismic observations, the polar field is reduced by about 18% compared to the case without inflows. If the amplitude of the flow perturbation depends on the cycle strength, its effect on the polar field provides a nonlinearity that could contribute to limiting the amplitude of a Babcock-Leighton type dynamo.

Accepted by ApJ (*continued* →)

Cross-Listed Abstracts (Pre-Main Sequence Stars)

Editor's Note: The abstracts below are being cross-listed with the *Star Formation Newsletter*.

Pre-Main Sequence Stars with Disks in the Eagle Nebula Observed in Scattered Light.

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NGC 6611 and its parental cloud, the Eagle Nebula (M16), are well-studied star-forming regions, thanks to their large content of both OB stars and stars with disks and the observed ongoing star formation. In our previous studies of the Eagle Nebula, we identified 834 disk-bearing stars associated with the cloud, after detecting their excesses in NIR bands from J band to $8.0\mu m$. In this paper, we study in detail the nature of a subsample of disk-bearing stars that show peculiar characteristics. They appear older than the other members in the V vs. $V - I$ diagram, and/or they have one or more IRAC colors at pure photospheric values, despite showing NIR excesses, when optical and infrared colors are compared. We confirm the membership of these stars to M16 by a spectroscopic analysis. The physical properties of these stars with disks are studied by comparing their spectral energy distributions (SEDs) with the SEDs predicted by models of T-Tauri stars with disks and envelopes. We show that the age of these stars estimated from the V vs. $V - I$ diagram is unreliable since their $V - I$ colors are altered by the light scattered by the disk into the line of sight. Only in a few cases their SEDs are compatible with models with excesses in V band caused by optical veiling. Candidate members with disks and photospheric IRAC colors are selected by the used NIR disk diagnostic, which is sensitive to moderate excesses, such as those produced by disks with low masses. In 1/3 of these cases, scattering of stellar flux by the disks can also be invoked. The photospheric light scattered by the disk grains into the line of sight can affect the derivation of physical parameters of Class II stars from photometric optical and NIR data. Besides, the disks diagnostic we defined are useful for selecting stars with disks, even those with moderate excesses or whose optical colors are altered by veiling or photospheric scattered light.

Accepted by A&A

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For preprints via ftp or WWW: http://www.astropa.unipa.it/mguarcel/6611_scatter.ps

Announcement

Textbook Series on Heliophysics

Edited by: Karel Schrijver and George Siscoe

Over the past few centuries, our awareness of the couplings between the Sun's variability and the Earth's environment, and perhaps even its climate, has been advancing at an ever increasing rate. The successful increase in knowledge of the workings of the Sun's magnetic activity, the recognition of the many physical processes that couple the realm of the Sun to our galaxy, and the insights into the interaction of the solar wind and radiation with the Earth's magnetic field, atmosphere and climate system have tended to differentiate and insularize the solar, heliospheric, and extended geo-space sub-disciplines of the physics of the local cosmos. In 2001, the NASA Living With a Star (LWS) program was initiated to reverse that trend. The recognition that there are many connections within the Sun-Earth systems approach led to the development of an integrated strategic mission plan and a comprehensive research program encompassing all branches of solar, heliospheric, space physics, aeronomy, and aspects of climate under the newly coined term of "Heliophysics".

The Heliophysics Summer School (<http://www.vsp.ucar.edu/Heliophysics/>) and the textbooks resulting from the first three years of that project are intended to expand the Sun-Earth systems approach into the early education of scientists. The Heliophysics books aim at the advanced undergraduate and starting graduate-level students, taking the perspective of heliophysics as a single intellectual discipline. The books touch on most branches of heliophysics, with particular emphasis on universal processes and on the multi-disciplinary character of many of its diverse range of specialties.

The three books are subtitled 'Plasma physics of the local cosmos', 'Space storms and radiation: causes and effects', and 'Evolving solar activity and the climates of space and Earth'. Chapter titles and (increasingly) online supporting materials can be accessed at <http://www.vsp.ucar.edu/Heliophysics/science-resources-textbooks.shtml>.

The first two volumes of the series are now available via Cambridge University Press. The third and final textbook volume will be available in early October 2010. The Summer School project continues and is currently developing both problem sets and an undergraduate equivalent of the first three textbooks which are written for graduate level studies and for scientists active in any of the fields of heliophysics.

The CUP URLs for the Heliophysics volumes are:

<http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780521110617>

<http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780521760515>

<http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780521112949>

Submitted by: C.J. Schrijver (schryver@lmsal.com)

Upcoming Meeting

The 16th Cambridge Workshop on Cool Stars, Stellar Systems and the Sun

29 August - 2 September 2010

Seattle, WA

APPROACHING DEADLINE:

The early registration deadline for Cool Stars 16 is 15 July 2010. To register, go to:

<http://www.confcon.com/coolstars16>

Job Opening

Postdoctoral Positions

Universidade do Porto (Portugal)

The Centro de Astrofísica da Universidade do Porto (<http://www.astro.up.pt>) has released the call for pre-applications for Postdoc Grants (3 years, with the possibility of extension for more 3 years). Candidates with a PhD and expertise in any of the topics of activity of CAUP are invited to submit a pre-application.

For details and on how to apply, please visit the following url:

<http://www.astro.up.pt/caup/index.php?WID=141&Lang=uk>

Any additional information can be requested by email to Mario Monteiro (mario.monteiro@astro.up.pt).

Job Opening

Ph.D. Student Fellowships (Solar System Physics)

International Max Planck Research School on Physical Processes in the Solar System and Beyond

The *International Max Planck Research School on Physical Processes in the Solar System and Beyond* at the Max Planck Institute for Solar System Research in Katlenburg-Lindau, and the Universities of Braunschweig and Goettingen, Germany, offers excellent research possibilities for students to obtain a PhD degree in a 3-years graduate program.

The program covers the full range of physics inherent in the field of solar system science from geophysics and planetary physics to solar physics as well as the underlying fundamental physics. The science program is complemented by training in computational physics, space technology and project management.

High-profile space missions, outstanding projects for ground- based instruments and data analysis, as well as theoretical and extensive numerical modeling provide a wide range of research possibilities for PhD students.

Applications for the program are open to highly-qualified and well-motivated students from all countries. A prerequisite is a diploma or master of science degree in physics or a related field, including a corresponding thesis. Proficiency in English is required.

The next PhD program will start in January 2011, review of application begins on 1 August 2010. Successful applicants will receive adequate financial support.

The application documents should include a CV, the filled application form (see web page), copies of university certificates and two letters of recommendation. The application can be send either by mail or by email (preferentially one attachment in pdf format).

For details on the IMPRS program and the application procedure, please visit:

<http://www.solar-system-school.de>

or email to info@solar-system-school.de.

Address applications to:

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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

<http://casa.colorado.edu/~skidders/coolnews.html> .

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