COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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R. Martínez-Arnáiz, J. López-Santiago, I. Crespo-Chacón and D. Montes

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We present a homogeneous study of chromospheric and coronal flux–flux relationships using a sample of 298 late-type dwarf active stars with spectral types F to M. The chromospheric lines were observed simultaneously in each star to avoid spread due to long term variability. Unlike other works, we subtract the basal chromospheric contribution in all the spectral lines studied. For the first time, we quantify the departure of dMe stars from the general relations. We also that dK and dKe stars also deviate from the general trend. Studying the flux–colour diagrams we demonstrate that the stars deviating from the general relations are those with saturated X-ray emission and that those stars also present saturation in the Hα line. Using several age spectral indicators, we show that they are younger stars than those following the general relationships. The non-universality of flux–flux relationships found in this work should be taken into account when converting between fluxes in different chromospheric activity indicators.

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The Basal Chromospheric Mg II $h+k$ Flux of Evolved Stars: Probing the Energy Dissipation of Giant Chromospheres

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Of a total of 177 cool G, K, and M giants and supergiants, we measured the Mg II $h+k$ line emission of extended chromospheres in high-resolution (LWR) IUE spectra by using the IUE final data archive at STScI, and derived the respective stellar surface fluxes. They represent the chromospheric radiative energy losses presumably related to basal heating by the dissipation of acoustic waves, plus a highly variable contribution due to magnetic activity. Thanks to the large sample size, we find a very well-defined lower limit, the basal chromospheric Mg II $h+k$ line flux of cool giant chromospheres, as a function of $T_{\rm eff}$. A total of 16 giants were observed several times, over a period of up to 20 years. Their respective minimal Mg II $h+k$ line fluxes confirm the basal flux limit very well because none of their emissions dip beneath the empirically deduced basal flux line representative for the overall sample. Based on a total of 15 to 22 objects with very low Mg II $h+k$ emission, we find as limit: $\log F_{\rm Mg} = 7.33 \log T_{\rm eff} - 21.75$ (cgs units; based on the $B-V$ relation). Within its uncertainties, this is almost the same relation as has been found in the past for the geometrically much thinner chromospheres of main sequence stars. But any residual dependence of the basal flux on the surface gravity is difficult to determine, since especially among the G-type giants there is a large spread of the individual chromospheric Mg II fluxes, apparently due to revived magnetic activity. However, it can be stated that over a gravity range of more than four orders of magnitude (main-sequence stars to supergiants), the basal flux does not appear to vary by more than a factor of 2. These findings are in good agreement with the predictions by previous hydrodynamic models of acoustic wave propagation and energy dissipation, as well as with earlier empirical determinations. Finally, we also discuss the idea that the ample energy flux of the chromospheric acoustic waves in a cool giant may yield, as a by-product, the energy flux required by its cool wind (i.e., non-dust-driven, "Reimers-type" mass-loss), provided a dissipation mechanism of a sufficiently long range is operating.

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Investigating the Surface Inhomogeneities of the Contact Binary SW Lac. I. Doppler imaging

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Aims. We aim to reconstruct the first detailed surface maps of the W UMa-type contact binary system, SW Lac. These maps will reveal the distributions of dark, magnetically active spot regions on the component stars and enable us to compare these with the results of similar studies of other active stars.

Methods. We used the noise reduction technique Least-Squares Deconvolution (LSD) in order to obtain high S/N ratio spectra of SW Lac, enabling individual starspot features to be observed in the highly rotationally broadened profiles of such a rapid rotator. We performed the Doppler mapping of the system using the Doppler imaging code DoTS, of which we also test the robustness in the case of missing phase coverage.

Results. We obtained surface maps of the system. The secondary (more massive) component is found to have a lower effective temperature and a slightly higher spot coverage than the primary. These may indicate thawt the secondary is more spotted than the primary component. Our results support theoretical assumptions as well as the photometric studies of W-type W UMa contact binary systems, indicating that the secondary component is more active.

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Spring-Fall Asymmetry of Substorm Strength, Geomagnetic Activity and Solar Wind: Implications for Semiannual Variation and Solar Hemispheric Asymmetry

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We study the seasonal variation of substorms, geomagnetic activity and their solar wind drivers in 1993 - 2008. The number of substorms and substorm mean duration depict an annual variation with maxima in Winter and Summer, respectively, reflecting the annual change of the local ionosphere. In contradiction, substorm mean amplitude, substorm total efficiency and global geomagnetic activity show a dominant annual variation, with equinoctial maxima alternating between Spring in solar cycle 22 and Fall in cycle 23. The largest annual variations were found in 1994 and 2003, in the declining phase of the two cycles when high-speed streams dominate the solar wind. A similar, large annual variation is found in the solar wind driver of substorms and geomagnetic activity, which implies that the annual variation of substorm strength, substorm efficiency and geomagnetic activity is not due to ionospheric conditions but to a hemispherically asymmetric distribution of solar wind which varies from one cycle to another. Our results imply that the overall semiannual variation in global geomagnetic activity has been seriously overestimated, and is largely an artifact of the dominant annual variation with maxima alternating between Spring and Fall. The results also suggest an intimate connection between the asymmetry of solar magnetic fields and some of the largest geomagnetic disturbances, offering interesting new pathways for forecasting disturbances with a longer lead time to the future.

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Time Distributions of Large and Small Sunspot Groups Over Four Solar Cycles

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Here we analyze solar activity by focusing on time variations of the number of sunspot groups (SGs) as a function of their modified Zurich class. We analyzed data for solar cycles 2023 by using Rome (cycles 20 and 21) and Learmonth Solar Observatory (cycles 22 and 23) SG numbers. All SGs recorded during these time intervals were separated into two groups. The first group includes small SGs (A, B, C, H, and J classes by Zurich classification), and the second group consists of large SGs (D, E, F, and G classes).We then calculated small and large SG numbers from their daily mean numbers as observed on the solar disk during a given month.We report that the time variations of small and large SG numbers are asymmetric except for solar cycle 22. In general, large SG numbers appear to reach their maximum in the middle of the solar cycle (phases 0.450.5), while the international sunspot numbers and the small SG numbers generally peak much earlier (solar cycle phases 0.290.35). Moreover, the 10.7 cm solar radio flux, the facular area, and the maximum coronal mass ejection speed show better agreement with the large SG numbers than they do with the small SG numbers. Our results suggest that the large SG numbers are more likely to shed light on solar activity and its geophysical implications. Our findings may also influence our understanding of long-term variations of the total solar irradiance, which is thought to be an important factor in the SunEarth climate relationship.

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CFBDSIR J1458+1013B: A Very Cold (>T10) Brown Dwarf in a Binary System

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We have identified CFBDSIR J1458+1013 as a 0.11″ (2.6 AU) physical binary using Keck laser guide star adaptive optics imaging and have measured a distance of 23.1 ± 2.4 pc to the system based on near-IR parallax data from CFHT. The integrated-light near-IR spectrum indicates a spectral type of T9.5, and model atmospheres suggest a slightly higher temperature and surface gravity than the T10 dwarf UGPS J0722−05. Thus, CFBDSIR J1458+1013AB is the coolest brown dwarf binary found to date. Its secondary component has an absolute H-band magnitude that is 1.9±0.3 mag fainter than UGPS J0722−05, giving an inferred spectral type of >T10. The secondary's bolometric luminosity of $\sim 2 \times 10^{-7}$ $L_{\odot}$ makes it the least luminous known brown dwarf by a factor of 4–5. By comparing to evolutionary models and T9–T10 objects, we estimate a temperature of 370±40 K and a mass of 6–15 $M_{\rm Jup}$ for CFBDSIR J1458+1013B. At such extremes, atmospheric models predict the onset of novel photospheric processes, namely the appearance of water clouds and the removal of strong alkali lines, but their impact on the emergent spectrum is highly uncertain. Our photometry shows that strong CH_4 absorption persists at H-band; the $J-K$ color is bluer than the latest known T dwarfs but not as blue as predicted by current models; and the $J-H$ color delineates a possible inflection in the blueward trend for the latest T dwarfs. Given its low luminosity, atypical colors and cold temperature, CFBDSIR J1458+1013B is a promising candidate for the hypothesized Y spectral class. However, regardless of its ultimate classification,
CFBDSIR J1458+1013AB

provides a new benchmark for measuring the properties of brown dwarfs and gas-giant planets, testing substellar models, and constraining the low-mass limit for star formation.

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For preprints via ftp or WWW: http://arxiv.org/abs/1103.0014

A Cross-Match of 2MASS and SDSS. II. Peculiar L Dwarfs, Unresolved Binaries, and the Space Density of T Dwarf Secondaries

the number which corresponds to the institute of each author. **Kerstin Geißler[1], Stanimir Metchev[1], J. Davy Kirkpatrick[2], G. Bruce Berriman[2] and Dagny Looper[3]**

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We present the completion of a program to cross-correlate the SDSS Data Release 1 and 2MASS Point Source Catalog in search for extremely red L and T dwarfs. The program was initiated by Metchev and collaborators, who presented the findings on all newly identified T dwarfs in SDSS DR1, and estimated the space density of isolated T0–T8 dwarfs in the solar neighborhood. In the current work we present most of the L dwarf discoveries. Our red-sensitive ($z - J \geq 2.75$ mag) cross-match proves to be efficient in detecting peculiarly red L dwarfs, adding two new ones, including one of the reddest known L dwarfs. Our search also nets a new peculiarly blue L7 dwarf and, surprisingly, two M8 dwarfs. We further broaden our analysis to detect unresolved binary L or T dwarfs through spectral template fitting to all L and T dwarfs presented here and in the earlier work by Metchev and collaborators. We identify nine probable binaries, six of which are new and eight harbor likely T dwarf secondaries. We combine this result with current knowledge of the mass ratio distribution and frequency of substellar companions to estimate an overall space density of 0.005–0.05 pc^{-3} for individual T0–T8 dwarfs.

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Molecular Data Abstracts

Variationally Computed Line List for Hot NH_3

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We present 'BYTe', a comprehensive 'hot' line list for the ro-vibrational transitions of ammonia, 14NH3, in its ground electronic state. This line list has been computed variationally using the program suite TROVE, a new spectroscopically-determined potential energy surface and an ab initio dipole moment surface. BYTe, is designed to be used at all temperatures up to 1500K. It comprises 1137650964 transitions in the frequency range from 0 to 12000 cm-1, constructed from 1366519 energy levels below 18000 cm-1 having J values below 36. Comparisons with laboratory data confirm the accuracy of the line list which is suitable for modelling a variety of astrophysical problems including the atmospheres of extrasolar planets and brown dwarfs.

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For preprints via ftp or WWW: http://arxiv.org/abs/1011.1569

Upcoming Meeting

Fourth SONG Workshop

15 - 20 September 2011

College of Charleston

Charleston, South Carolina

Dear Colleagues:

We invite you to participate in the Fourth SONG (Stellar Oscillations Network Group) Workshop,scheduled to take place from September 15 - 20, 2011 at the College of Charleston inCharleston, South Carolina. For further information, please refer to the workshop website at:

go.cofc.edu/SONG4

SONG is an international initiative to design, build, and utilize a global network of eight 1-meter class telescopes to be operated as a whole-Earth telescope. SONG's primary goals are to studystellar interiorsby measuring surface sound and gravity-wave oscillations, and tosearch for and place limits on the number of extrasolar planets. Secondary goals include daytime observations of the Sun, analysis of stellar surface structure, observation ofgamma-ray burstafterglows,and connection with other large data-rate temporal studies (e.g. Kepler, LSST) via astrostatistics and astroinformatics.

The Danish prototype node (each node is a complete telescope/ observatory/ instrument system)is under construction, with first light expected this summer (2011). Funding has also been secured inChina for a Chinese node: design and construction have started, with beginning of operations expected in 2013.The U.S. community continues to seek funding and plan for the developmentof SONG nodes in Hawaii and in the Arizona/New Mexico region.

The fourth SONG workshop seeks to(1) continue discussions concerningestablishment of the prototype SONG Network, (2) discuss science that can be done with SONG, (3) seek U.S. partners, (4) secure U.S. funding for operations of the U.S. telescope, and (5) plan for the future whenadditional telescopes will be added to the network. Planned sessions include aSONG status report, a discussion of science that can be done with a three-node SONG network, interactions between SONG and other instruments, theMini-SONG telescopes proposed by the Chinese, and future SONG nodes.The SONG Steering Committee will meet in a separate session.

Thefirst two SONG workshops wereheld in Aarhus, Denmark in 2006 and 2009.Asearch forinternational funding outside of Denmark began in late 2009, and a U.S. consortium was established to seek SONG funding.A small international exploratorydiscussion was held in Beijing in December 2009, at which SONG organizational structure wasestablished and a steering committee was formed. The Chinese government expressed interest in supporting a SONG node, and China held the third SONG workshop in Beijing in late March 2010. The SONG steering committee held its last meeting inJune 2010 to coincide with the Kepler asteroseismology workshop at Aarhus University.

We look forward to your ideas and participation. Please forward this message to anyone in your area you think might be interested.

Sincerely yours,

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Upcoming Meeting

Magnetic Fields in Stars and Exoplanets

22 - 25 August 2011

Potsdam, Germany

FIRST ANNOUNCEMENT

Dear colleagues:

We would like to inform you about the 7th Potsdam Thinkshop on *Magnetic Fields in Stars and Exoplanets: Future Directions in Observational and Theoretical Studies*. The meeting will take place in Potsdam, Germany, on 22 - 25 August 2011.

The conference is focused on stellar magnetic fields, stellar activity cycles and their interactions with exoplanets. The direct comparison of numerical simulations and observational results has special emphasis in this meeting. The program will be very open to discussions and vivid interactions between the scientists. It is planned to give fairly short talks to be able to hear as many news from the field as possible.

Registration is open on the web site:

http://www.aip.de/thinkshop7

The list of invited speakers includes:

Axel Brandenburg (Stockholm), Matthew Browning (Toronto), Thorsten Carroll (Potsdam), Scott Gregory (Pasadena), Jean-Mathias Griessmeier (Dwingeloo), Huib Henrichs (Amsterdam), Swetlana Hubrig (Potsdam), Gaitee Hussain (Garching), Petri Kapyla (Helsinki), Leonid Kitchatinov (Irkutsk), Renada Konstantinova-Antova (Sofia), Norbert Langer (Bonn), Gautier Mathys (Garching), Ansgar Reiners (Goettingen), Markus Schoeller (Garching)

The conference fee will be 220 EUR if paid before July 1, 2011. A special rate of 180 EUR will apply to students as well as PhD students if paid before July 1, 2011.

We are looking forward to your exciting news and a lively Thinkshop!

Sincerely, Rainer Arlt, Swetlana Hubrig, and Klaus G. Strassmeier

Upcoming Meeting

Water in the Gas Phase

13 - 14 June 2011

Kavli Royal Society International Centre (U.K.)

A Royal Society Discussion meeting on *Water in the Gas Phase* will be held on 13 - 14 June 2011 at the Kavli Centre, UK. Speakers include Dr. France Allard and Dr. Giovanna Tinetti, among others. For more detailed information see:

http://royalsociety.org/events/water-gas-phase/

Job Opening

Postdoctoral Positions

Molecular Lines

University College (London)

Applications are invited for **two** postdoctoral positions to work with Prof. Jonathan Tennyson as part of a major new project aimed at calculating extensive line list as input for spectroscopic models of the atmospheres of extrasolar planets (and other hot bodies). The openings are for:

1. A 3-year position for some one to work on high accuracy electronic structure calculations of key molecular species; and

2. A 2-year (possibly extendable) position to work on nuclear motion calculations and line lists of polyatomic molecules.

Note: there are two PhD studentships also available with this project.

See:

http://www.ucl.ac.uk/phys/amopp/studentships/tennyson

Informal enquiries can be made to Prof. Jonathan Tennyson
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for further information and the application procedure, see:

https://atsv7.wcn.co.uk/search_engine/jobs.cgi?owner=5041391&ownertype=fair&jcode=1176998&vt_template=965&adminview=1

Closing date for applications: Friday 25 March 2011.

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.***