COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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TABLE OF CONTENTS

Coolnews on the Web

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Stellar Abstracts

Hydrogen Balmer Line Broadening in Solar and Stellar Flares

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The broadening of the hydrogen lines during flares is thought to result from increased charge (electron, proton) density in the flare chromosphere. However, disagreements between theory and modeling prescriptions have precluded an accurate diagnostic of the degree of ionization and compression resulting from flare heating in the chromosphere. To resolve this issue, we have incorporated the unified theory of electric pressure broadening of the hydrogen lines into the non-LTE radiative transfer code RH. This broadening prescription produces a much more realistic spectrum of the quiescent, A0 star Vega compared to the analytic approximations used as a damping parameter in the Voigt profiles. We test recent radiative-hydrodynamic (RHD) simulations of the atmospheric response to high nonthermal electron beam fluxes with the new broadening prescription and find that the Balmer lines are overbroadened at the densest times in the simulations. Adding many simultaneously heated and cooling model loops as a "multithread" model improves the agreement with the observations. We revisit the three-component phenomenological flare model of the YZ CMi Megaflare using recent and new RHD models. The evolution of the broadening, line flux ratios, and continuum flux ratios are well-reproduced by a multithread model with high-flux nonthermal electron beam heating, an extended decay phase model, and a "hot spot" atmosphere heated by an ultrarelativistic electron beam with reasonable filling factors: $\sim 0.1\%$, 1%, and 0.1% of the visible stellar hemisphere, respectively. The new modeling motivates future work to understand the origin of the extended gradual phase emission.

Accepted by ApJ

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For preprints via WWW: arXiv:1702.03321

Rotation of Late-Type Stars in Praesepe with K2

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We have Fourier analyzed 941 K2 light curves of likely members of Praesepe, measuring periods for 86% and increasing the number of rotation periods (P) by nearly a factor of four. The distribution of P vs. $(V - K_s)$, a mass proxy, has three different regimes: $(V - K_s)$ <1.3, where the rotation rate rapidly slows as mass decreases; 1.3< $(V - K_s)$ <4.5, where the rotation rate slows more gradually as mass decreases; and $(V - K_s)$ >4.5, where the rotation rate rapidly increases as mass decreases. In this last regime, there is a bimodal distribution of periods, with few between $\sim$2 and $\sim$10 days. We interpret this to mean that once M stars start to slow down, they do so rapidly. The K2 period-color distribution in Praesepe ($\sim$790 Myr) is much different than in the Pleiades ($\sim$125 Myr) for late F, G, K, and early-M stars; the overall distribution moves to longer periods, and is better described by 2 line segments. For mid-M stars, the relationship has similarly broad scatter, and is steeper in Praesepe. The diversity of lightcurves and of periodogram types is similar in the two clusters; about a quarter of the periodic stars in both clusters have multiple significant periods. Multi-periodic stars dominate among the higher masses, starting at a bluer color in Praesepe ($(V - K_s) \sim 1.5$) than in the Pleiades ($(V - K_s) \sim 2.6$). In Praesepe, there are relatively more light curves that have two widely separated periods, ΔP >6 days. Some of these could be examples of M star binaries where one star has spun down but the other has not.

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For preprints via WWW: arXiv:1703.07031

Estimates of Active Region Area Coverage Through Simultaneous Measurements of the He I λ5876 and λ10830 Lines

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Simultaneous, high-quality measurements of the neutral helium triplet features at 587.6 nm and 1083.0 nm, respectively, in a sample of solar-type stars are presented. The observations were made with ESO telescopes at the La Silla Paranal Observatory under program ID 088.D-0028(A) and MPG Utility Run for FEROS 088.A-9029(A). The equivalent widths of these features combined with chromospheric models are utilized to infer the fractional area coverage, or filling factor, of magnetic regions outside of spots. We find that the majority of the sample is characterized by filling factors less than unity. However, discrepancies occur among the coolest K-type and warmest and most rapidly rotating F-type dwarf stars. We discuss these apparently anomalous results and find that in the case of K-type stars they are an artifact of the application of chromospheric models best suited to the Sun than to stars with significantly lower effective temperatures. The case of the F-type rapid rotators can be explained with the measurement uncertainties of the equivalent widths, but they may also be due to a non-magnetic heating component in their atmospheres. With the exceptions noted above, preliminary results suggest that the average heating rates in the active regions are the same from one star to the other, differing in the spatially integrated, observed level of activity due to the area coverage. Hence, differences in activity in this sample are mainly due to the filling factor of active regions.

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For preprints via WWW: http://arxiv.org/abs/1703.10060

Solar Abstracts

Centennial Evolution of Monthly Solar Wind Speeds: Fastest Monthly Solar Wind Speeds From Long-Duration Coronal Holes

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High speed solar wind streams (HSSs) are very efficient drivers of geomagnetic activity at high latitudes. In this paper we use a recently developed ΔH parameter of geomagnetic activity, calculated from the night-side hourly magnetic field measurements of the Sodankylä observatory, as a proxy for solar wind (SW) speed at monthly time resolution in 1914-2014 (solar cycles 15-24). The seasonal variation in the relation between monthly ΔH and solar wind speed is taken into account by calculating separate regressions between ΔH and SW speed for each month. Thereby, we obtain a homogeneous series of proxy values for monthly solar wind speed for the last 100 years. We find that the strongest HSS-active months of each solar cycle occur in the declining phase, in years 1919, 1930, 1941, 1952, 1959, 1973, 1982, 1994 and 2003. Practically all these years are the same or adjacent to the years of annual maximum solar wind speeds. This implies that the most persistent coronal holes, lasting for several solar rotations and leading to the highest annual SW speeds, are also the sources of the highest monthly SW speeds. Accordingly, during the last 100 years, there were no coronal holes of short duration (of about one solar rotation) that would produce faster monthly (or solar rotation) averaged solar wind than the most long-living coronal holes in each solar cycle produce.

Accepted by JGR

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For preprints via WWW: arxiv.org/abs/1702.03924

A History of Solar Activity Over Millennia

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Presented here is a review of present knowledge of the long-term behavior of solar activity on a multi-millennial timescale, as reconstructed using the indirect proxy method. The concept of solar activity is discussed along with an overview of the special indices used to quantify different aspects of variable solar activity, with special emphasis upon sunspot number. Over long timescales, quantitative information about past solar activity can only be obtained using a method based upon indirect proxies, such as the cosmogenic isotopes ^{14}C and ^{10}Be in natural stratified archives (e.g., tree rings or ice cores). We give an historical overview of the development of the proxy-based method for past solar-activity reconstruction over millennia, as well as a description of the modern state. Special attention is paid to the verification and cross-calibration of reconstructions. It is argued that this method of cosmogenic isotopes makes a solid basis for studies of solar variability in the past on a long timescale (centuries to millennia) during the Holocene. A separate section is devoted to reconstructions of strong solar energetic-particle (SEP) events in the past, that suggest that the present-day average SEP flux is broadly consistent with estimates on longer timescales, and that the occurrence of extra-strong events is unlikely. Finally, the main features of the long-term evolution of solar magnetic activity, including the statistics of grand minima and maxima occurrence, are summarized and their possible implications, especially for solar/stellar dynamo theory, are discussed.

Accepted by: Living Reviews in Solar Physics

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For preprints via WWW: http://link.springer.com/article/10.1007/s41116-017-0006-9

Low-Mass and Substellar Abstracts

Predicting Radio Emission from the Newborn Hot Jupiter V830 Tau b and Its Host Star

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Magnetised exoplanets are expected to emit at radio frequencies analogously to the radio auroral emission of Earth and Jupiter. Here, we predict the radio emission from V830 Tau b, the youngest (2 Myr) detected exoplanet to date. We model the wind of its host star using three-dimensional magnetohydrodynamics simulations that take into account the reconstructed stellar surface magnetic field. Our simulations allow us to constrain the local conditions of the environment surrounding V830 Tau b that we use to then compute its radio emission. We estimate average radio flux densities of 6 to 24 mJy, depending on the assumption of the radius of the planet (one or two Jupiter radii). These radio fluxes are not constant along one planetary orbit, and present peaks that are up to twice the average values. We show here that these fluxes are weakly dependent (a factor of 1.8) on the assumed polar planetary magnetic field (10 to 100 G), opposed to the maximum frequency of the emission, which ranges from 18 to 240 MHz. We also estimate the thermal radio emission from the stellar wind. By comparing our results with the Karl G. Jansky Very Large Array and the Very Long Baseline Array observations of the system, we constrain the stellar mass-loss rate to be $< 3 \times 10^{-9}$ $M_\odot$ yr^{-1}, with likely values between $\sim 10^{-12}$ and 10^{-10} $M_\odot$ yr^{-1}. With these values, we estimate that the frequency-dependent extension of the radio-emitting wind is around ~ 3 to 30 stellar radii ($R_\star$) for frequencies in the range of 275 to 50 MHz, implying that V830 Tau b, at an orbital distance of 6.1 $R_\star$, could be embedded in the regions of the host star's wind that are optically thick to radio wavelengths, but not deeply so. We also note that planetary emission can only propagate in the stellar wind plasma if the frequency of the cyclotron emission exceeds the stellar wind plasma frequency. In other words, we find that for planetary radio emission to propagate through the host star wind, planetary magnetic field strengths larger than ~ 1.3 to 13 G are required. Since our radio emission computations are based on analogies with solar system planets, we caution that our computations should be considered as estimates. Nevertheless, the V830 Tau system is a very interesting system for conducting radio observations from both the perspective of radio emission from the planet as well as from the host star's wind.

Accepted by A&A, in press (DOI: 10.1051/0004-6361/201629700)

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For preprints via WWW: https://arxiv.org/abs/1703.03622

Cross-Listed Abstracts (Pre-Main Sequence Stars)

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

X-Shooter Spectroscopy of Young Stellar Objects in Lupus. Atmospheric Parameters, Membership and Activity Diagnostics

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A homogeneous determination of basic stellar parameters of young stellar object (YSO) candidates is needed to confirm their pre-main sequence evolutionary stage, membership to star forming regions (SFRs), and to get reliable values of the quantities related to chromospheric activity and accretion. We used the code ROTFIT and synthetic BT-Settl spectra for the determination of the atmospheric parameters ($T_{\rm eff}$ and $\log g$), the veiling (r), the radial (RV) and projected rotational velocity ($v \sin i$), from X-Shooter spectra of 102 YSO candidates (95 of infrared Class II and seven Class III) in the Lupus SFR. The spectral subtraction of inactive templates, rotationally broadened to match the $v \sin i$ of the targets, enabled us to measure the line fluxes for several diagnostics of both chromospheric activity and accretion, such as Hα, Hβ, Ca II and Na I lines. We have shown that 13 candidates can be rejected as Lupus members based on their discrepant RV with respect to Lupus and/or the very low $\log g$ values. At least 11 of them are background giants, two of which turned out to be lithium-rich giants. Regarding the members, we found that all Class III sources have Hα fluxes compatible with a pure chromospheric activity, while objects with disks lie mostly above the boundary between chromospheres and accretion. YSOs with transitional disks displays both high and low Hα fluxes. We found that the line fluxes per unit surface are tightly correlated with the accretion luminosity ($L_{\rm acc}$) derived from the Balmer continuum excess. This rules out that the relationships between $L_{\rm acc}$ and line luminosities found in previous works are simply due to calibration effects. We also found that the Ca II-IRT flux ratio, $F_{\rm CaII8542}/F_{\rm CaII8498}$, is always small, indicating an optically thick emission source. The latter can be identified with the accretion shock near the stellar photosphere. The Balmer decrement reaches instead, for several accretors, high values typical of optically thin emission, suggesting that the Balmer emission originates in different parts of the accretion funnels with a smaller optical depth.

Accepted by A&A

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For preprints via WWW: https://arxiv.org/abs/1703.01251

Upcoming Meeting

The Third Workshop on Extremely Precise Radial Velocities (EPRV III)

14 - 17 August 2017

The Pennsylvania State University, University Park, PA, USA

The Penn State Center for Exoplanets and Habitable Worlds is proud to announce the Third Workshop on Extremely Precise Radial Velocities to be held in State College, Pennsylvania, USA, Aug 14-17, 2017. Following the tradition of previous workshops, participants will dig into the "nuts and bolts" of exoplanetary discovery and orbit characterization via Doppler velocimetry, and be a forum for practitioners to discuss challenges, lessons learned, and the details of their work, "warts and all".

This edition of the workshop will focus on: - specific hardware challenges - lessons learned from the newest generation of EPRV instruments - statistical methods for signal extraction and analysis - physical models and diagnostics of stellar granulation, activity, and other sources of jitter - machine learning methods for Doppler extraction and jitter diagnostics

As with previous workshops, there will be a mix of plenary talks, breakout sessions, and posters.

We anticipate there will be travel support for some participants, especially junior participants, and we encourage strong international participation from all of the teams working on the EPRV problem. Overseas participants may wish to extend their stay in the US to experience the total solar eclipse the following Monday. The path of totality is not near the conference, but many scenic sites in the US will be, including the Carolina coast, the Smokey Mountains of Tennessee, and the Grand Tetons of Wyoming.

Pre-registration is available now at the conference website:

http://bit.ly/EPRVIII

There will be a limited number of spaces for on-site childcare for children under 6, which we hope to subsidize. Advance notice will be required, so interested participants should contact Jason Wright (astrowright@gmail.com) ASAP for more information.

Job Opening

Postdoctoral and Ph.D. Student Positions

Astronomy and/or Space Physics

Uppsala University (Sweden)

Call for Applications: Postdoctoral position and PhD student position

Deadline: May 2, 2017

Web site: http://www.physics.uu.se/research/astronomy-and-space-physics/vacancies/

We now have openings for one Postdoctoral position and one PhD student position in astronomy and/or space physics at the Department of Physics and Astronomy, Uppsala University.

The Division for Astronomy and Space Physics hosts about 30 scientists. We study the physics of stars and their environments, the evolution of the Milky Way Galaxy, fundamental processes, exoplanets, galaxies, and the early Universe. In collaboration with the Swedish Institute of Space Physics (IRF) we also study plasma around the Earth and in the solar wind as well as bodies in the Solar System. Development of instrumentation for large telescopes and space probes is also an important activity.

More information on our research and contact information can be found under

http://www.physics.uu.se/research/astronomy-and-space-physics/
and
http://www.irfu.se/

For further information about the positions and how to apply, see:

http://www.uu.se/en/about-uu/join-us/details/?positionId=140638

and

http://www.uu.se/en/about-uu/join-us/details/?positionId=144691

Submitted by: Ulrike Heiter (ulrike.heiter@physics.uu.se)

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 bimonthly call for abstracts will be issued. 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.***