# COOLNEWS

**A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN**

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## *Coolnews on the Web*

The current and previous issues of *Coolnews* are available on the following web page in pdf, postscript, and Latex format: **http://casa.colorado.edu/∼skinners/coolnews.html**

## *Stellar Abstracts*

### Could a Change in Magnetic Field Geometry Cause the Break in the Wind-Activity Relation?

**A. A. Vidotto[1], J.-F. Donati[2,3], M. Jardine[4], V. See[4], P. Petit[2,3], I. Boisse[5], S. Boro Saikia[6], E. Hébrard[2,3], S. V. Jeffers[6], S. C. Marsden[7], J. Morin[8]**

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Wood et al suggested that mass-loss rate is a function of X-ray flux ($\dot{M} \propto F_x^{1.34}$) for dwarf stars with $F_x < F_{x,6} \equiv 10^6$ erg cm$^{-2}$ s$^{-1}$. However, more active stars do not obey this relation. These authors suggested that the break at $F_{x,6}$ could be caused by significant changes in magnetic field topology that would inhibit stellar wind generation. Here, we investigate this hypothesis by analysing the stars in Wood et al's sample that had their surface magnetic fields reconstructed through Zeeman-Doppler Imaging (ZDI). Although the solar-like outliers in the $\dot{M} - F_x$ relation have

higher fractional toroidal magnetic energy, we do not find evidence of a sharp transition in magnetic topology at $F_{x,6}$. To confirm this, further wind measurements and ZDI observations at both sides of the break are required. As active stars can jump between states with highly toroidal to highly poloidal fields, we expect significant scatter in magnetic field topology to exist for stars with $F_x > F_{x,6}$. This strengthens the importance of multi-epoch ZDI observations. Finally, we show that there is a correlation between $F_x$ and magnetic energy, which implies that $\dot{M}$ − magnetic energy relation has the same qualitative behaviour as the original $\dot{M} - F_x$ relation. No break is seen in any of the $F_x$ − magnetic energy relations.

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*For preprints via ftp or WWW*: http://arxiv.org/abs/1509.08751

## Investigating Magnetic Activity in Very Stable Stellar Magnetic Fields: Long-term Photometric and Spectroscopic Study of the Fully Convective M4 Dwarf V374 Peg

**K. Vida[1], L. Kriskovics[1], K. Oláh[1], M. Leitzinger[2], P. Odert[3,2], Zs. Kővári[1], H. Korhonen[4,5], R. Greimel[2], R. Robb[6], B. Csák[7], J. Kovács[7]**

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The ultrafast-rotating ($P_{rot} \approx 0.44\,d$) fully convective single M4 dwarf V374 Peg is a well-known laboratory for studying intense stellar activity in a stable magnetic topology. As an observable proxy for the stellar magnetic field, we study the stability of the light curve, and thus the spot configuration. We also measure the occurrence rate of flares and coronal mass ejections (CMEs). We analyse spectroscopic observations, $BV(RI)_C$ photometry covering 5 years, and additional $R_C$ photometry that expands the temporal base over 16 years. The light curve suggests an almost rigid-body rotation, and a spot configuration that is stable over about 16 years, confirming the previous indications of a very stable magnetic field. We observed small changes on a nightly timescale, and frequent flaring, including a possible sympathetic flare. The strongest flares seem to be more concentrated around the phase where the light curve indicates a smaller active region. Spectral data suggest a complex CME with falling-back and re-ejected material, with a maximal projected velocity of $\approx 675$ km/s. We observed a CME rate much lower than expected from extrapolations of the solar flare–CME relation to active stars.

Accepted by A&A

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*For preprints via WWW*: http://arxiv.org/abs/1603.00867

## Broad-band Linear Polarization in Late-type Active Dwarfs

**Manoj K. Patel[1], Jeewan C. Pandey[2], Subhajeet Karmakar[2], D. C. Srivastava[1], and Igor S. Savanov[3]**

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We present recent polarimetric results of magnetically active late-type dwarfs. The polarization in these stars is found to be wavelength dependent, decreasing towards the longer wavelength. The average values of degree of polarization in these active dwarfs are found to be $0.16 \pm 0.01$, $0.080 \pm 0.006$, $0.056 \pm 0.004$ and $0.042 \pm 0.003$ per cent in $B$, $V$, $R$, and $I$ bands, respectively. Present results indicate that polarization in the majority of active dwarfs are primarily due to sum of the polarization by magnetic intensification and scattering. However, supplementary sources of the polarization are also found to be present in some active stars. The correlations between the degree of polarization and

various activity parameters like Rossby number, chromospheric activity indicator and coronal activity indicator are found to be stronger in $B$ band and weaker in $I$ band.

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*For preprints via WWW*: http://mnras.oxfordjournals.org/content/457/3/3178.full.pdf or
http://arxiv.org/pdf/1602.01936v1.pdf

# *Solar Abstracts*

## Are Solar Brightness Variations Faculae- or Spot-dominated?

**A.I. Shapiro[1], S.K. Solanki[1,2], N.A. Krivova[1], K.L. Yeo[1] and W.K. Schmutz[3]**

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*Context.* Regular spaceborne measurements have revealed that solar brightness varies on multiple timescales, variations on timescales greater than a day being attributed to surface magnetic field. Independently, ground-based and spaceborne measurements suggest that Sun-like stars show a similar, but significantly broader pattern of photometric variability.

*Aims.* To understand whether the broader pattern of stellar variations is consistent with the solar paradigm we assess relative contributions of faculae and spots to solar magnetically-driven brightness variability. We investigate how the solar brightness variability as well as its facular and spot contributions depend on the wavelength, timescale of variability, and position of the observer relative to the ecliptic plane.

*Methods.* We perform calculations with the SATIRE model, which returns solar brightness with daily cadence from solar disc area coverages of various magnetic features. We take coverages as seen by an Earth-based observer from full-disc SoHO/MDI and SDO/HMI data and project them to mimic out-of-ecliptic viewing by an appropriate transformation.

*Results.* Moving the observer away from the ecliptic plane increases the amplitude of 11-year variability as it would be seen in Strömgren $(b + y)/2$ photometry, but decreases the amplitude of the rotational brightness variations as it would appear in Kepler and CoRoT passbands. The spot and facular contributions to the 11-year solar variability in the Strömgren $(b + y)/2$ photometry almost fully compensate each other so that the Sun appears anomalously quiet with respect to its stellar cohort. Such a compensation does not occur on the rotational timescale.

*Conclusions.* The rotational solar brightness variability as it would appear in Kepler and CoRoT passband from the ecliptic plane is spot-dominated but the relative contribution of faculae increases for out-of-ecliptic viewing so that the apparent brightness variations are faculae-dominated for inclinations less than about $i = 45°$. Over the course of the 11-year activity cycle, the solar brightness variability is faculae-dominated shortward of 1.2 $\mu$m independently of the inclination.

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*For preprints via WWW*: http://adsabs.harvard.edu/abs/2016arXiv160204447S

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

## Multi-dimensional Structure of Accreting Young Stars

**C. Geroux[1], I. Baraffe[1,3,2], M. Viallet[2], T. Goffrey[1], J. Pratt[1], T. Constantino[1], D. Folini[3], M. Popov[3] and R. Walder[3]**

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This work is the first attempt to describe the multi-dimensional structure of accreting young stars based on fully compressible time implicit multi-dimensional hydrodynamics simulations. One major motivation is to analyse the validity of accretion treatment used in previous 1D stellar evolution studies. We analyse the effect of accretion on the structure of a realistic stellar model of the young Sun. Our work is inspired by the numerical work of Kley & Lin (1996, ApJ, 461, 933) devoted to the structure of the boundary layer in accretion disks, which provides the outer boundary conditions for our simulations. We analyse the redistribution of accreted material with a range of values of specific entropy relative to the bulk specific entropy of the material in the accreting object's convective envelope. Low specific entropy accreted material characterises the so-called cold accretion process, whereas high specific entropy is relevant to hot accretion. A primary goal is to understand whether and how accreted energy deposited onto a stellar surface is redistributed in the interior. This study focusses on the high accretion rates characteristic of FU Ori systems. We find that the highest entropy cases produce a distinctive behaviour in the mass redistribution, rms velocities, and enthalpy flux in the convective envelope. This change in behaviour is characterised by the formation of a hot layer on the surface of the accreting object, which tends to suppress convection in the envelope. We analyse the long-term effect of such a hot buffer zone on the structure and evolution of the accreting object with 1D stellar evolution calculations. We study the relevance of the assumption of redistribution of accreted energy into the stellar interior used in the literature. We compare results obtained with the latter treatment and those obtained with a more physical accretion boundary condition based on the formation of a hot surface layer suggested by present multi-dimensional simulations. One conclusion is that, for a given amount of accreted energy transferred to the accreting object, a treatment assuming accretion energy redistribution throughout the stellar interior could significantly overestimate the effects on the stellar structure and, in particular, on the resulting expansion.

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*For preprints via WWW*: http://arxiv.org/pdf/1602.03325.pdf

*Upcoming Meeting*

# Variability of Solar/Stellar Magnetic Activity

## Splinter Session at Cool Stars 19

## 7 and 9 June 2016

## Uppsala, Sweden

Dear Colleagues:

On 7 June and 9 June 2016, the splinter session *Variability of Solar/Stellar Magnetic Activity* will take place as part of the Cool Stars 19 meeting in Uppsala, Sweden (6-10 June 2016). Conference web site: http://www.coolstars19.com/

What can we learn about the Sun (and its evolution) as a variable star with magnetic cycles when comparing it to other stars having similar parameters and, conversely, what can the close view of the Sun teach us about the general characteristics of magnetically-induced changes in the atmospheres of cool stars? What do we know about magnetically-driven variability and activity in FGK-type stars of different evolutionary stages?

The session is aimed at offering a synthetic view of the recent progresses in the domain of variability of solar and stellar magnetism from different perspectives. We invite solar and stellar astrophysicists to present their latest results on this topic, in particular in relation to the solar-stellar connection and the peculiarities and common features between magnetic activity and variability of our Sun and cool stars.

The session provides a timely opportunity to bring together the stellar and solar communities for a fruitful exchange of ideas and methods. In particular, the setting within CS19 will be an ideal venue to present to a wide expert audience new and expected observational results from current and planned solar missions (e.g., HINODE, SDO, the SUNRISE flights, SORCE, TSIS and Solar Orbiter) and large-scale stellar surveys (COROT, Kepler, K2 , GAIA and the forthcoming TESS and PLATO missions), as well as to discuss the significant progress in radiative transfer and MHD treatment in the field of solar and stellar atmospheres and spectral synthesis, which now allows creating models going far beyond what was available up until only recently.

This splinter session will be split over two afternoons, Tuesday 7 June and Thursday 9 June.

In Session 1 (Tuesday 7 June), we will address the nature of solar/stellar magnetic variability based on observations of the Sun and other cool stars. We will focus on solar/stellar brightness variations on different time scales as well as at the properties of solar/stellar magnetic fields.

Session 1: Magnetic variability as a key to explore the solar/stellar connection Sp 1.1: Solar/stellar variability: observational properties and theory Sp 1.2: Stellar magnetic fields and their impact on the surrounding environment

In session 2 (Thursday 9 June), we will address the origin and evolution of stellar magnetic activity in the light of the latest results from stellar surveys and dynamo theory.

Session 2: Magnetic activity and variability throughout evolution Sp 2.1 : Rotation/Activity relation from stellar survey and theory Sp 2.2 : Constraining Solar/Stellar dynamo theory

Deadline for poster abstracts: Friday April 29th, 2016 (please note these are to be sent through the CS19 webpage during compulsory plenary session registration)

**Deadline for contributed talks abstracts: Friday April 29th, 2016** through splinter session website at:

http://coolstars19.com/splinters/stellar-var/index.html .

*Job Opening*

# Postdoctoral Position

## Theoretical/Computational Theory of Stellar Accretion and Winds

## University of Exeter (U.K.)

The astrophysics group at the University of Exeter invites applications for a postdoctoral research position, to work primarily with Dr. Sean Matt on theoretical studies of low-mass stars. The position is funded by a European Research Council grant (AWESoMeStars) and is initially for 3 years, with the possibility of extension, depending on progress and funding considerations.

A broad goal of the project is to understand the rotation and magnetic activity of sun-like and low-mass stars. To further this goal, the successful applicant will use multi-dimensional MHD simulations of young stars interacting with accretion disks. We are thus particularly interested in applicants with a strong background in computational and/or theoretical (magneto)hydrodynamics; prior work on star formation, accretion, outflows, or stellar rotation would be an additional asset. We will also consider exceptional candidates for other aspects of the project, in particular those with expertise suitable for (a) including coronal physics in global simulations of magnetic stellar winds, or (b) stellar evolution calculations that include rotation and comparing synthetic populations with large observational datasets.

Applicants must possess (or be near completion of) a relevant PhD. The position is available from July 2016, but start dates later in the year are acceptable. The starting salary will range from £25,769 on Grade E to £33,574 on Grade F, depending on qualifications and experience. Extensive supercomputing resources and substantial funding for computing equipment and travel will be available.

Please apply using the University's online application system (search for job reference P51891 in the "keywords" field):

https://jobs.exeter.ac.uk

Applications should include a CV and a brief research statement (2 pages max) describing past work and future interest. In addition, please have 3 letters of recommendation sent to: s.matt@exeter.ac.uk, with the applicants name in the subject, before the **deadline of 1 April 2016**.

## New volume in the "Heliophysics" series

A fourth volume in the "Heliophysics" series will be released by Cambridge University Press (CUP) on March 17, 2016, entitled **Heliophysics: Active stars, their astrospheres, and impacts on planetary environments**. This volume, edited by C. Schrijver, F. Bagenal, and J. Sojka, expands the topics related to the Sun-Earth connections presented in the preceding three volumes to other bodies in the solar system and to extrasolar planetary systems.

CUP (cambridge.org) offers a 20% discount on pre-orders, and throughout 2016 after the book becomes available, with discount code "heliophy":

www.cambridge.org/9781107090477.

The same discount (with the same code) applies to the hardcover and paperback editions of the preceding three "Heliophysics" volumes, 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".

A provisional 5th volume on "Space Weather and Society" can be freely downloaded from:

http://www.vsp.ucar.edu/Heliophysics/science-resources-textbooks.shtml

The Heliophysics books aim at the advanced undergraduate and at 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 list of topics includes the formation of planetary systems, astrophysical dynamos, heliospheric perturbations, particle acceleration, cosmic-ray modulation, interactions of the solar wind with planetary magnetospheres, impulstive and explosive events, irradiance and the tropospheric climate system, ionospheric processes, and impacts of space weather on satellites and for manned space flight, among many more.

The Heliophysics book series has its origins in the Summer School series of the same name. Many of the recorded lectures, problem sets, lab manuals, and other online supporting materials can be accessed at the School's site at http://www.vsp.ucar.edu/Heliophysics/.

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

# *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.***