COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

The HADES RV Programme with HARPS-N@TNG. III. Flux-Flux and Activity-Rotation Relationships of Early-M Dwarfs.

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Context. Understanding stellar activity in M dwarfs is crucial for the physics of stellar atmospheres and for ongoing radial velocity exoplanet programmes. Despite the increasing interest in M dwarfs, our knowledge of the chromospheres of these stars is far from being complete.
Aims. We test whether the relations between activity, rotation, and stellar parameters and flux-flux relationships

previously investigated for main-sequence FGK stars and for pre-main-sequence M stars also hold for early-M dwarfs on the main-sequence. Although several attempts have been made so far, here we analyse a large sample of stars undergoing relatively low activity.
Methods. We analyse in a homogeneous and coherent way a well-defined sample of 71 late-K/early-M dwarfs that are currently being observed in the framework of the HArps-n red Dwarf Exoplanet Survey (HADES). Rotational velocities are derived using the cross-correlation technique, while emission flux excesses in the Ca II H & K and Balmer lines from Hα up to Hϵ are obtained by using the spectral subtraction technique. The relationships between the emission excesses and the stellar parameters (projected rotational velocity, effective temperature, kinematics, and age) are studied. Relations between pairs of fluxes of different chromospheric lines (flux-flux relationships) are also studied and compared with the literature results for other samples of stars.
Results. We find that the strength of the chromospheric emission in the Ca II H & K and Balmer lines is roughly constant for stars in the M0-M3 spectral range. Although our sample is likely to be biased towards inactive stars, our data suggest that a moderate but significant correlation between activity and rotation might be present, as well as a hint of kinematically selected young stars showing higher levels of emission in the calcium line and in most of the Balmer lines. We find our sample of M dwarfs to be complementary in terms of chromospheric and X-ray fluxes with those of the literature, extending the analysis of the flux-flux relationships to the very low flux domain.
Conclusions. Our results agree with previous works suggesting that the activity-rotation-age relationship known to hold for solar-type stars also applies to early-M dwarfs. We also confirm previous findings that the field stars which deviate from the bulk of the empirical flux-flux relationships show evidence of youth.

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For preprints via WWW: https://arxiv.org/abs/1610.05906

The HADES RV Programme with HARPS-N at TNG IV. Time Resolved Analysis of the Ca II H&K and Hα Chromospheric Emission of Low-activity Early-type M Dwarfs

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M dwarfs are prime targets for current and future planet search programs, part icularly those focused on the detection and characterization of rocky planets in the habitable zone. In this context, understanding their magnetic activity is important for two main reasons: it affects our ability to detect small planets and it plays a key role in the characterization of the stellar environment.
We analyze observations of the Ca II H&K and Hα lines as diagnostics of chromospheric activity for low-activity early-type M dwarfs. We analyze the time series of spectra of 71 early-type M dwarfs collected in the framework of the HADES project for planet search purposes. The HARPS-N spectra simultaneously provide the Ca II H&K doublet and the Hα lin e. We develop a reduction scheme able to correct the HARPS-N spectra for instrumental and atmospheric effects, and also to provide flux-calibrated spectra in units of flux at the stellar surface. The Ca II H&K and Hα fluxes are then compared with each other, and their time variability is analyzed.

We find that the Ca II H and K flux excesses are strongly correlated with each other, while the Hα flux excess is generally less correlated with the Ca II H&K doublet. We also find that Hα emission does not increase monotonically with the Ca II H&K line flux, showing some absorption before being filled in by chromospheric emission when Ca II H&K activity increases. Analyzing the time variability of the emission fluxes, we derive a tentative estimate of the rotation period (on the order of a few tens of days) for some of the program stars, and the typical lifetime of chromospheric active regions (on the order of a few stellar rotations).
Our results are in good agreement with similar previous studies. In particular, we find evidence that the chromospheres of early-type M dwarfs could be characterized by different filament coverage, affecting the formation mechanism of the Hα line. We also show that chromospheric structure is likely related to spectral type.

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Optical Spectra of Ultracool Dwarfs with the Southern African Large Telescope

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New spectra of 81 ultracool dwarfs (spectral types M7 and later) are discussed. Spectral classifications of 49 objects are available in the literature, while 32 objects are newly classified. The known spectral types were used to test an automated classification scheme, which relies primarily on template fitting, supplemented by matching of spectral indices calibrated against the template spectra. An attempt was made to quantify the uncertainty in the spectral types, which is generally better than two subclasses. Objects for which spectral types differ by more than one subclass from the literature classifications are discussed individually. Discrepancies between automated classifications based on respectively template fitting and spectral index matching, may be useful for flagging objects with unusual spectra. Aside from the 32 first-time classifications, alternative classifications are presented for 32 previously classified dwarfs. Very large (equivalent width greater than 130 Å) Hα flares are reported for the known ultracool dwarf binary 2MASS J15200224-4422419; curiously, the object does not appear to have quiescent emission lines. Non-zero equivalent width measurements are listed for a further 29 objects.

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The Energy Budget of Stellar Magnetic Fields: Comparing Non-potential Simulations and Observations

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The magnetic geometry of the surface magnetic fields of more than 55 cool stars have now been mapped using spectropolarimetry. In order to better understand these observations, we compare the magnetic field topology at different surface scale sizes of observed and simulated cool stars. For ease of comparison between the high-resolution non-potential magnetofrictional simulations and the relatively low-resolution observations, we filter out the small-scale field in the simulations using a spherical harmonics decomposition. We show that the large-scale field topologies of

the solar-based simulations produce values of poloidal/toroidal fields and fractions of energy in axisymmetric modes that are similar to the observations. These global non-potential evolution model simulations capture key magnetic features of the observed solar-like stars through the processes of surface flux transport and magnetic flux emergence. They do not, however, reproduce the magnetic field of M-dwarfs or stars with dominantly toroidal field. Furthermore, we analyse the magnetic field topologies of individual spherical harmonics for the simulations and discover that the dipole is predominately poloidal, while the quadrupole shows the highest fraction of toroidal fields. Magnetic field structures smaller than a quadrupole display a fixed ratio between the poloidal and toroidal magnetic energies.

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Solar Abstracts

A New Calibrated Sunspot Group Series Since 1749: Statistics of Active Day Fractions

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Although the sunspot-number series have existed since the mid-19th century, they are still the subject of intense debate, with the largest uncertainty being related to the "calibration" of the visual acuity of individual observers in the past. Usually a daisy-chain regression method is applied to inter-calibrate the observers which may lead to significant bias and error accumulation. Here we present a novel method to calibrate the visual acuity of the key observers to the reference data set of Royal Greenwich Observatory sunspot groups for the period 1900 – 1976, using the statistics of the active-day fraction. For each observer we independently evaluate their observational thresholds [S_S] defined such that the observer is assumed to miss all of the groups with an area smaller than S_S and report all the groups larger than S_S. Next, using a Monte-Carlo method we construct, from the reference data set, a correction matrix for each observer. The correction matrices are significantly non-linear and cannot be approximated by a linear regression or proportionality. We emphasize that corrections based on a linear proportionality between annually averaged data lead to serious biases and distortions of the data. The correction matrices are applied to the original sunspot group records reported by the observers for each day, and finally the composite corrected series is produced for the period since 1748. The corrected series is provided as supplementary material in electronic form and displays secular minima around 1800 (Dalton minimum) and 1900 (Gleissberg minimum), as well as the Modern grand maximum of activity in the second half of the 20th century. The uniqueness of the grand maximum is confirmed for the last 250 years. It is shown that the adoption of a linear relationship between the data of Wolf and Wolfer results in grossly inflated group numbers in the 18th and 19th centuries in some reconstructions.

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Seasonal Solar Wind Speeds for the Last 100 Years: Unique Coronal Hole Structures During the Peak and Demise of the Grand Modern Maximum

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Solar coronal holes are sources of high-speed solar wind streams, which cause persistent geomagnetic activity especially at high latitudes. Here we estimate seasonal solar wind speeds at 1 AU for the last 100 years using high-latitude geomagnetic measurements and show that they give information on the long-term evolution of important structures of the solar large-scale magnetic field, such as persistent coronal holes. We find that the centennial evolution of solar wind speed at 1 AU is different for equinoxes and solstices, reflecting differences in the evolution of polar coronal hole extensions and isolated low-latitude coronal holes. Equinoctial solar wind speeds had their centennial maximum in 1952, during the declining phase of solar cycle 18, verifying that polar coronal holes had exceptionally persistent extensions just before the peak of the Grand Modern Maximum of solar activity. On the other hand, solstice speeds had their centennial maximum during the declining phase of solar cycle 23 due to large low-latitude coronal holes. A similar configuration of seasonal speeds as in cycle 23 was not found earlier, not even during the less active cycles of early 20th century. Therefore the exceptional occurrence of persistent, isolated low-latitude coronal holes in cycle 23 is not related to the absolute level of sunspot activity but, most likely, to the demise of the Grand Modern Maximum.

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Stellar Magnetism: Challenges, Connections, and Prospects (14th Potsdam Thinkshop)

12 - 16 June 2017

Telegrafenberg, Potsdam, Germany

Web page: https://thinkshop.aip.de/14/

Scientific Program: The scientific program will highlight the most recent observational and theoretical work in the field including, but not limited to, the following topics:

- the origin of stellar magnetic fields - magnetic field geometry and evolution in pre-main-sequence stars - magnetic fields, rotation, and differential rotation on the main sequence - the role of small-scale magnetic fields in stellar atmospheres - global dynamos, activity cycles, and the rotation-activity-age relation in solar-type stars - magnetic fields in massive stars and magnetically-confined winds - magnetic star/planet and disk/planet interaction - magnetism in the late stages of stellar evolution - future perspectives in theory and observational facilities

Registration: Registration and abstract submission will be opened on the 5th of January 2017.

SOC: Sydney Barnes (AIP Potsdam), Axel Brandenburg (Nordita, Stockholm University), Alfio Bonanno (INAF, Catania Astrophysical Observatory), Manfred Küker (AIP Potsdam), Caroline D'Angelo (Leiden Observatory), Swetlana Hubrig (chair, AIP Potsdam), Silva Järvinen (co-chair, AIP Potsdam), Gautier Mathys (JAO/ESO, Chile), Ansgar Reiners (Universität Göttingen), Matthias Steffen (AIP Potsdam), Klaus Strassmeier (AIP Potsdam)

LOC: Katrin Böhrs (AIP Potsdam), Silva Järvinen (chair, AIP Potsdam), Arto Järvinen (AIP Potsdam), Matthias Mallonn (AIP Potsdam)

Upcoming Meeting

Exoplanet Science with Small Telescopes: Precise Radial Velocities

24 - 26 April 2017

University of Pennsylvania, Philadelphia, PA (USA)

We are announcing the first workshop devoted to the discussion of how sub-meter-class telescopes can be used to discover, confirm, and characterize exoplanets using the Doppler method.

Registration: Registration is open now on our website at:
http://web.sas.upenn.edu/smalltrv/

Abstracts: Abstracts are due on February 3, 2017.

Please send questions or inquiries to: Prof. Cullen Blake at: smallrv@gmail.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.***