COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Coolnews on the Web

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Stellar Abstracts

Time-Dependent Behavior of Linear Polarization in Unresolved Photospheres, With Applications for the Hanle Effect

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Aims: This paper extends previous studies in modeling time varying linear polarization due to axisymmetric magnetic fields in rotating stars. We use the Hanle effect to predict variations in net line polarization, and use geometric arguments to generalize these results to linear polarization due to other mechanisms. Methods: Building on the work of Lopez Ariste et al., we use simple analytic models of rotating stars that are symmetric except for an axisymmetric magnetic field to predict the polarization lightcurve due to the Hanle effect. We highlight the effects for the variable line polarization as a function of viewing inclination and field axis obliquity. Finally, we use geometric arguments to generalize our results to linear polarization from the weak transverse Zeeman effect. Results: We derive analytic expressions to demonstrate that the variable polarization lightcurve for an oblique magnetic rotator is symmetric. This holds for any axisymmetric field distribution and arbitrary viewing inclination to the rotation axis. Conclusions: For the situation under consideration, the amplitude of the polarization variation is set by the Hanle effect, but the shape of the variation in polarization with phase depends largely on geometrical projection effects. Our work generalizes the applicability of results described in Lopez Ariste et al., inasmuch as the assumptions of a spherical star and an axisymmetric field are true, and provides a strategy for separating the effects of perspective from the Hanle effect itself for interpreting polarimetric lightcurves.

Accepted by A&A *For preprints contact*: ignace@etsu.edu

For preprints via WWW: http://lanl.arxiv.org/abs/1103.4155

New Constraints on the Chemical Evolution of the Solar Neighbourhood and Galactic Disc(s)

L. Casagrande[1], R. Schönrich[1], M. Asplund[1], S. Cassisi[2], I. Ramírez[1,3], J. Meléndez[4], T. Bensby[5], S. Feltzing[6]

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We present a re-analysis of the Geneva-Copenhagen survey, which benefits from the infrared flux method to improve the accuracy of the derived stellar effective temperatures and uses the latter to build a consistent and improved metallicity scale. Metallicities are calibrated on high-resolution spectroscopy and checked against four open clusters and a moving group, showing excellent consistency. The new temperature and metallicity scales provide a better match to theoretical isochrones, which are used for a Bayesian analysis of stellar ages. With respect to previous analyses, our stars are on average 100 K hotter and 0.1 dex more metal rich, which shift the peak of the metallicity distribution function around the solar value. From Strömgren photometry we are able to derive for the first time a proxy for [α/Fe] abundances, which enables us to perform a tentative dissection of the chemical thin and thick disc. We find evidence for the latter being composed of an old, mildly but systematically alpha-enhanced population that extends to super solar metallicities, in agreement with spectroscopic studies. Our revision offers the largest existing kinematically unbiased sample of the solar neighbourhood that contains full information on kinematics, metallicities, and ages and thus provides better constraints on the physical processes relevant in the build-up of the Milky Way disc, enabling a better understanding of the Sun in a Galactic context.

Accepted by A&A

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For preprints via ftp or WWW: http://arxiv.org/abs/1103.4651

Imaging the Dynamical Atmosphere of the Red Supergiant Betelgeuse in the CO First Overtone Lines with VLTI/AMBER

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We present the first 1-D aperture synthesis imaging of the red supergiant Betelgeuse in the individual CO first overtone lines with VLTI/AMBER. The reconstructed 1-D projection images reveal that the star appears differently in the blue wing, line center, and red wing of the individual CO lines. The 1-D projection images in the blue wing and line center show a pronounced, asymmetrically extended component up to ~1.3 stellar radii, while those in the red wing do not show such a component. The observed 1-D projection images in the lines can be reasonably explained by a model in which the CO gas within a region more than half as large as the stellar size is moving slightly outward with 0–5 km s^{-1}, while the gas in the remaining region is infalling fast with 20–30 km s^{-1}. A comparison between the CO line AMBER data taken in 2008 and 2009 shows a significant time variation in the dynamics of the CO line-forming region in the photosphere and the outer atmosphere. In contrast to the line data, the reconstructed 1-D projection images in the continuum show only a slight deviation from a uniform disk or limb-darkened disk. We derive a uniform-disk diameter of 42.05 ± 0.05 mas and a power-law-type limb-darkened disk diameter of 42.49 ± 0.06 mas and a limb-darkening parameter of $(9.7 \pm 0.5) \times 10^{-2}$. This latter angular diameter leads to an effective temperature of 3690 ± 54 K for the continuum-forming layer. These diameters confirm that the near-IR size of Betelgeuse was nearly constant over the last 18 years, in marked contrast to the recently reported noticeable decrease in the mid-IR size. The continuum

data taken in 2008 and 2009 reveal no or only marginal time variations, much smaller than the maximum variation predicted by the current 3-D convection simulations.

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For preprints via ftp or WWW: http://arxiv.org/abs/1104.0958

The Emission Line Near 1319 Å in Stellar and Solar Spectra

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An emission line near 1319 Å in stellar and solar spectra has frequently been identified with a line of N I at 1319.001 Å. However, the observed wavelength is 1318.94 ±0.01 Å and the strongest line of the N I multiplet is far weaker than the 1318.94-Å line. The line is present in cool dwarfs and giants, but is weaker in supergiants. Its behaviour relative to other N I lines present in N-rich giants also shows that it is not due to N I. Any wavelength calibration that has assumed that the line is due to N I will need to be revised. It is proposed that the 1318.94-Å line is due to a decay in S I, from the $3p^3(^2D^o)3d\ ^1D^o_2$ level, which lies above the first ionization limit. Nearby autoionizing levels are shown to have high populations through di-electronic capture. The 3d $^1D^o_2$ level might be populated by collisions from the autoionizing levels, or through the presence of a small amount of spin-orbit interaction with the autoionizing 3d $^3D^o_2$ level. A line at 1309.87 Å in cool giants is identified as a transition in P II, pumped by the O I resonance lines.

Accepted by MNRAS

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Solar Abstracts

The Evolution of Dark Canopies Around Active Regions

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As observed in spectral lines originating from the chromosphere, transition region, and low corona, active regions are surrounded by an extensive circumfac ular area which is darker than the quiet Sun. We examine the properties of these dark moat- or canopy-like areas using Fe IX 17.1 nm images and line-of-sight magnetograms from the Solar Dynamics Observatory. The 17.1 nm canopies consist of fibrils (horizontal fields containing EUV-absorbing chromospheric material) clumped into featherlike structures. The dark fibrils initially form a quasiradial or vortical pattern as the low-lying field lines fanning out from the emerging active region connect to surrounding network and intranetwork elements of the opposite polarity. The area occupied by the 17.1 nm fibrils expands as supergranular convection causes the active region flux to spread into the background medium; the outer boundary of the dark canopy stabilizes where the diffusing flux encounters a unipolar region of the opposite sign. The dark fibrils tend to accumulate in regions of weak longitudinal field and to become rooted in mixed-polarity flux. To explain the latter observation, we note that the low-lying fibrils are more likely to interact with small loops associated with weak, opposite-polarity flux elements in close proximity, than with high loops anchored inside strong unipolar network flux. As a result, the 17.1 nm fibrils gradually become concentrated around the large-scale polarity inversion lines (PILs), where most of the mixed-polarity flux is located. Systematic flux cancellation, assisted by rotational shearing, removes the field component transverse to the PIL and causes the fibrils to coalesce into long PIL-aligned filaments.

Accepted by ApJ

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For preprints via ftp or WWW: http://arxiv.org/abs/1103.4373

Revisited Sunspot Data: A New Scenario for the Onset of the Maunder Minimum

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The Maunder minimum forms an archetype for the Grand minima, and detailed knowledge of its temporal development has important consequences for the solar dynamo theory dealing with long-term solar activity evolution. Here, we reconsider the current paradigm of the Grand minimum general scenario by using newly recovered sunspot observations by G. Marcgraf and revising some earlier uncertain data for the period 16361642, i.e., one solar cycle before the beginning of the Maunder minimum. The new and revised data dramatically change the magnitude of the sunspot cycle just before the Maunder minimum, from 60-70 down to about 20, implying a possibly gradual onset of the minimum with reduced activity started two cycles before it. This revised scenario of the Maunder minimum changes, through the paradigm for Grand solar/stellar activity minima, the observational constraint on the solar/stellar dynamo theories focused on long-term studies and occurrence of Grand minima.

Accepted by ApJL

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For preprints via ftp or WWW: http://arxiv.org/abs/1103.1520

Low-Mass and Substellar Abstracts

Estimation of the XUV Radiation Onto Close Planets and Their Evaporation

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Context: The current distribution of planet mass vs. incident stellar X-ray flux supports the idea that photoevaporation of the atmosphere may take place in close-in planets. Integrated effects have to be accounted for. A proper calculation of the mass loss rate due to photoevaporation requires to estimate the total irradiation from the whole XUV range.

Aims: The purpose of this paper is to extend the analysis of the photoevaporation in planetary atmospheres from the accessible X-rays to the mostly unobserved EUV range by using the coronal models of stars to calculate the EUV contribution to the stellar spectra. The mass evolution of planets can be traced assuming that thermal losses dominate the mass loss of their atmospheres.

Methods: We determine coronal models for 82 stars with exoplanets that have X-ray observations available. Then a synthetic spectrum is produced for the whole XUV range ($\sim$1 – 912 Å). The determination of the EUV stellar flux, calibrated with real EUV data, allows us to calculate the accumulated effects of the XUV irradiation on the planet atmosphere with time, as well as the mass evolution for planets with known density.

Results: We calibrate for the first time a relation of the EUV luminosity with stellar age valid for late-type stars. In a

sample of 109 exoplanets, few planets with masses larger than $\sim$1.5 M_J receive high XUV flux, suggesting that intense photoevaporation takes place in a short period of time, as previously found in X-rays. The scenario is also consistent with the observed distribution of planet masses with density. The accumulated effects of photoevaporation over time indicate that HD 209458b may have lost 0.2 M_J since an age of 20 Myr.

Conclusions: Coronal radiation produces rapid photoevaporation of the atmospheres of planets close to young late-type stars. More complex models are needed to explain fully the observations. Spectral energy distributions in the XUV range are made available for stars in the sample through the Virtual Observatory, for the use in future planet atmospheric models.

Accepted by A&A

For preprints contact: jsanz@cab.inta-csic.es

For preprints on WWW: arXiv:1105.0550

Upcoming Meeting

4th Kepler Asteroseismic Consortium Workshop

11 - 15 July 2011

Boulder, CO

Dear Colleagues,

This summer (July 11-15), HAO will host the 4th workshop of the Kepler Asteroseismic Science Consortium (KASC). Kepler is a NASA mission to discover habitable planets like the Earth around Sun-like stars, and KASC is responsible for characterizing the target stars with asteroseismology.

The program will include asteroseismic studies of pulsating stars across the H-R diagram, but it will also include discussions of stellar activity cycles, rotation, exoplanets, and many other topics that are relevant to the broader solar physics and astrophysics communities. Details about the workshop are at http://kasc.hao.ucar.edu/ and you can pre-register for the meeting at:

http://kasc.hao.ucar.edu/pages/meeting/register-online.php

KASC is bound by a non-disclosure agreement with NASA, so the workshop is open only to KASC members – however, membership is open to everyone who signs the non-disclosure agreement and joins a working group (e.g. WG1 is devoted to solar-like oscillations). Instructions for how to join KASC are available at:

http://astro.phys.au.dk/KASC/new_member.htm

I hope you will join us for an exciting meeting this summer.

Travis Metcalfe Chair, KASC4 LOC

Upcoming Meeting

From Atoms to Stars: The Impact of Spectroscopy on Astrophysics

26 - 28 July 2011

Oxford, U.K.

Dear Colleagues:

We are pleased to announce our conference: The conference will celebrate the career of Carole Jordan and the many research fields to which she has contributed. There will be a three day science program covering topics including:

- multi-wavelength quantitative astrophysical spectroscopy
- spectroscopic plasma diagnostics
- molecular spectroscopy in cool star atmospheres
- the solar atmosphere
- chromospheres, coronae and winds of late-type stars

Invited speakers include: Vincenzo Andretta, Tom Ayres, Alex Brown, George Doschek, Andrea Dupree, Graham Harper, Louise Harra, Viggo Hansteen, Phil Judge, Jeff Linsky, Jan-Uwe Ness, Rachel Osten, Juliet Pickering.

The meeting will be held in the Physics Department, University of Oxford with a banquet at Somerville College, Oxford on the evening of 27th July, 2011.

Please pre-register your interest in attending the conference by completing the form at:

http://www.atomstars.org/reg/prereg/

or contact us for more information (soc@atomstars.org; loc@atomstars.org).

We look forward to seeing you in Oxford!

On behalf of the SOC, Stuart Sim, ssim@mso.anu.edu.au

On behalf of the LOC, Graeme Smith, g.smith2@physics.ox.ac.uk

Upcoming Meeting

6th Heidelberg Summer School: Characterizing Exoplanets - From Formation to Atmospheres

1 - 5 August 2011

Heidelberg, Germany

First Announcement and Call for Applications

Dear Colleagues:

The International Max Planck Research School for Astronomy Cosmic Physics at the University of Heidelberg (IMPRS-HD) announces the 6th Heidelberg Summer School: *Characterizing Exoplanets - From Formation to Atmospheres* to be held 1 - 5 August 2011.

MPRS Heidelberg invites graduate students and postdocs to its 6th Heidelberg Summer School.

The focus of this school is to link current observations and theory from formation and detection of planets to explore their atmosphere and characterizing habitable environments. It will highlight the newest results in extra solar planet search in a cross-disciplinary environment, discuss different formation scenarios and observables, recently discovered Super-Earths to potential habitability of rocky planets in a very interactive environment.

The main lecturing program is presented by invited speakers and is accompanied by science talks on specific topics by local experts.

Invited lecturers are: Willy BENZ (University of Bern), Peter HAUSCHILDT (University of Hamburg), Anders JOHANSEN (Lund Observatory), Lisa KALTENEGGER (MPI for Astronomy, Heidelberg), and Stephane UDRY (Observatory of Geneva).

Deadline for application is June 1, 2011.

Please find more information, our poster, and the application forms at:

www.mpia.de/imprs-hd/

www.mpia.de/imprs-hd/SummerSchools/2011/

A limited number of grants are available to partially cover travel expenses of participants. IMPRS-HD is an independent part of the Heidelberg Graduate School for Fundamental Physics.

With kind regards,
Christian Fendt

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.***