COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 79 — August 2002 Editor: Steve Skinner (coolnews@jila.colorado.edu)

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Editor's Note: No E-mail Attachments

As many COOLNEWS subscribers are now aware, the proliferation of viruses by email attachments is reaching epidemic proportions. Several subscribers (including myself) received a message in mid-July that appeared to be "From: coolnews@jila.colorado.edu" with 'Subject: RE Your password!". This message did not originate at JILA but was traced to a university in Russia. The "From:" address was forged (very easy to do) and the attachment contained the so-called Frethem worm. If you received this email or a similar message with a different forged "From:" address, you should delete it without opening the attachments. The Frethem worm can infect most versions of the Windows operating system, but Macintosh, Unix, and Linux systems are not affected. Windows is *not* used to compose or send out COOLNEWS, so the machine on which COOLNEWS originates at JILA was not affected. However, if you are a Windows user and received the above message, it would be wise to update and run your anti-virus software or consult one of the following web-pages for details on how to check for and remove the Frethem worm (easy to do):

http://europe.datafellows.com/v-descs/frethem.shtml

http://securityresponse.symantec.com (click on W32.Frethem removal tool)

The rapid proliferation of email viruses and "spam" is becoming more than a nuisance as evidenced by the recent decision to close down several email help desk accounts at GSFC due to bombardment by unsolicited email. To prevent proliferation of viruses via attachments, I will no longer accept COOLNEWS contributions in the form of attachments. *Please send all abstracts and other material directly in the body of the email message, and not as attachments.* Also, for future reference, please note that I *never* send out email to the COOLNEWS mailing list that contains attachments. If you receive an email that appears to be from coolnews@jila and contains attachments, you should assume it to be fraudulent and delete it.
Keep those abstracts coming! Steve Skinner (ed.)

Stellar Abstracts

Detection of Water Vapor in the Photosphere of Arcturus

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We report detections of pure rotation lines of OH and H_2O in the K1.5 III red-giant star Arcturus (α Boötis) using high-resolution, infrared spectra covering the regions $806-822\,\mathrm{cm}^{-1}$ ($12.2-12.4\,\mu$m) and $884-923\,\mathrm{cm}^{-1}$ ($10.8-11.3\,\mu$m). Arcturus is the hottest star yet to show water-vapor features in its disk-averaged spectrum. We argue that the water vapor lines originate from the photosphere, albeit in the outer layers. We are able to predict the observed strengths of OH and H_2O lines satisfactorily after lowering the temperature structure of the very outer parts of the photosphere ($\log\tau_{500} = -3.8$ and beyond) compared to a flux-constant, hydrostatic, standard MARCS model photosphere. Our new model is consistently calculated including chemical equilibrium and radiative transfer from the given temperature structure. Possible reasons for a temperature decrease in the outer-most parts of the photosphere and the assumed break-down of the assumptions made in classical model-atmosphere codes are discussed.

Accepted by ApJ

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For preprints via ftp or WWW: http://www.astro.uu.se/~ryde/ART/

Magnetic Activity of Six Young Solar Analogues I. Starspot Cycles from Long-term Photometry

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A long-term photometric monitoring of a selected sample of solar analogues has been carried out since early nineties as part of *The Sun in time* project, which is aimed at a multiwavelength study of stars with solar-like global properties, but with different ages and thus at different stages of their evolution. The extended time sequence of ground-based observations collected over more than a decade as part of this program has revealed the existence of starspot cycles. Also from these data it is possible to investigate surface differential rotation of the stars. In this paper we present the photometry collected to date and report on cycles search for a selected subsample of five young single G0-G5V stars with ages between $\simeq$ 130 Myr and 700 Myr: EK Dra, π^1 UMa, HN Peg, k^1 Cet and BE Cet. Also we include in this study the Pleiades-age ($\simeq$ 130 Myr) K0V star DX Leo (HD 82443). All the cited stars show activity cycles whose period is, furthermore, the first determined from photometric data. They are compared to those activity cycles derived from CaII H&K emission fluxes and differences are discussed. All the cycle periods, except for EK Dra, fit well the empirical relations with global stellar parameters derived from larger stellar samples.
The following results are also inferred from the present study: *i)* the fastest rotating stars tend to have longer cycles; *ii)* the range in the observed cycle lengths seems to converges with stellar age from a maximum dispersion around the Pleiades' age towards the solar cycle value at the Sun's age; *iii)* the overall short- and long-term photometric variability increases with inverse Rossby number with very high correlation degree, indicating that the level of magnetic activity at least in photosphere is still controlled by the stellar rotation even on the longest time scales; *iiii)* the increase with inverse Rossby number of the long-term overall photometric variability seems to level off at the highest rotation rate, which may be interpreted as due to a saturation in the level of photospheric magnetic activity around the activity maximum.

Accepted by A&A

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On the Origin of the 19.5 μm Feature. Identifying Circumstellar Mg-Fe-Oxides

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We report the detection of a broad, prominent 19.5 μm dust emission feature in ISO-SWS spectra. It is especially conspicuous in the spectra of low mass-loss AGB stars with relatively high photospheric temperatures belonging to the variability classes SRb and Lb. The feature carrier is proposed to be $Mg_{0.1}Fe_{0.9}O$, a solid solution of MgO (periclase) and FeO (wustite). This dust species has cubic crystal symmetry like spinel, the carrier of the 13, 16.8 and 31.8 μm spectral features, together with which the 19.5 μm feature is being observed. A broad emission plateau between 11 and 15 μm, which is attributable to amorphous Al_2O_3, is also detected together with the 19.5 μm and the spinel features. As a consequence of our discovery, we postulate the existence of a distinct class of circumstellar shells, dominated by oxide and not by silicate dust.

Accepted by A&A Letters

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ISO-SWS Calibration and the Accurate Modelling of Cool-star Atmospheres - II. General Results

L. Decin[1], B. Vandenbussche[1], C. Waelkens[1], K. Eriksson[2], B. Gustafsson[2], B. Plez[3], A.J. Sauval[4] and K. Hinkle[5]

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The fine calibration of the ISO-SWS detectors (Infrared Space Observatory - Short Wavelength Spectrometer) has proven to be a delicate problem. We therefore present a detailed spectroscopic study in the 2.38 – 12 μm wavelength range of a sample of 16 A0 – M2 stars used for the calibration of ISO-SWS. By investigating the discrepancies between the ISO-SWS data of these sources, the theoretical predictions of their spectra, the high-resolution FTS-KP (Kitt Peak) spectrum of α Boo and the solar FTS-ATMOS (Atmospheric Trace Molecule Spectroscopy) spectrum, both *calibration* problems and problems in *computing the theoretical models and the synthetic spectra* are revealed. The underlying reasons for these problems are sought for and the impact on the further calibration of ISO-SWS and on the theoretical modelling is discussed extensively.

Accepted by A&A

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For preprints via anonymous ftp on ftp://ftp.ster.kuleuven.ac.be/dist/leen/latex/h3317
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ISO-SWS Calibration and the Accurate Modelling of Cool-star Atmospheres - III. A0 to G2 stars

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Vega, Sirius, β Leo, α Car and α Cen A belong to a sample of twenty stellar sources used for the calibration of the detectors of the Short-Wavelength Spectrometer on board the Infrared Space Observatory (ISO-SWS). While general problems with the calibration and with the theoretical modelling of these stars are reported in Decin et al. (2002), each of these stars is discussed individually in this paper. As demonstrated in Decin et al. (2002), it is not possible to deduce the effective temperature, the gravity and the chemical composition from the ISO-SWS spectra of these stars. But since ISO-SWS is absolutely calibrated, the angular diameter (θ_D) of these stellar sources can be deduced from their ISO-SWS spectra, which consequently yields the stellar radius (R), the gravity-inferred mass (M_g) and the luminosity (L) for these stars. For Vega, we obtained $\theta_D = 3.35 \pm 0.20$ mas, R= $2.79 \pm 0.17\,R_\odot$, $M_g = 2.54 \pm 1.21\ M_\odot$ and L= $61 \pm 9\,L_\odot$; for Sirius $\theta_D = 6.17 \pm 0.38$ mas, R= $1.75 \pm 0.11\,R_\odot$, $M_g = 2.22 \pm 1.06\,M_\odot$ and L= $29 \pm 6\,L_\odot$; for β Leo $\theta_D = 1.47 \pm 0.09$ mas, R= $1.75 \pm 0.11\,R_\odot$, $M_g = 1.78 \pm 0.46\,M_\odot$ and L= $15 \pm 2\,L_\odot$; for α Car $\theta_D = 7.22 \pm 0.42$ mas, R= $74.39 \pm 5.76\,R_\odot$, $M_g = 12.80^{+24.95}_{-6.35}\,M_\odot$ and L= $14573 \pm 2268\,L_\odot$ and for α Cen A $\theta_D = 8.80 \pm 0.51$ mas, R= $1.27 \pm 0.08\,R_\odot$, $M_g = 1.35 \pm 0.22\,M_\odot$ and L= $1.7 \pm 0.2\,L_\odot$. These deduced parameters are confronted with other published values and the goodness-of-fit between observed ISO-SWS data and the corresponding synthetic spectrum is discussed.

Accepted by A&A

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ISO-SWS Calibration and the Accurate Modelling of Cool-star Atmospheres - IV. G9 to M2 stars

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A detailed spectroscopic study of 11 giants with spectral type from G9 to M2 is presented. The 2.38 – 4.08 μm wavelength-range of band 1 of ISO-SWS (Short-Wavelength Spectrometers on board the Infrared Space Observatory) in which many different molecules — with their own dependence on each of the stellar parameters — are absorbing, enables us to estimate the effective temperature, the gravity, the microturbulence, the metallicity, the CNO-abundances, the $^{12}C/^{13}C$-ratio and the angular diameter from the ISO-SWS data. Using the Hipparcos' parallax, the radius, luminosity and gravity-inferred mass are derived. The stellar parameters obtained are in good agreement with other published values, though also some discrepancies with values deduced by other authors are noted. For a few stars (δ Dra, ξ Dra, α Tuc, H Sco and α Cet) some parameters — e.g. the CNO-abundances — are derived for the first time. By examining the correspondence between different ISO-SWS observations of the same object and between the ISO-SWS data and the corresponding synthetic spectrum, it is shown that the relative accuracy of ISO-SWS in band 1 (2.38 – 4.08 μm) is better than 2 % for these high-flux sources. The high level of correspondence between observations and theoretical predictions, together with a confrontation of the estimated $T_{\rm eff}$(ISO) value with $T_{\rm eff}$ values derived from colours — which demonstrates the consistency between $V - K$, BC_K, $T_{\rm eff}$ and θ_D derived from optical or IR data — proves that both the used MARCS models to derive the stellar quantities and the flux calibration of the ISO-SWS detectors have reached a high level of reliability.

Accepted by A&A

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Solar Abstracts

Latitudinal Gradients of Solar Wind Speed Around the Ecliptic: Systematic Displacement of the Streamer Belt

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We study the effective latitudinal gradients of the solar wind (SW) speed in the two magnetic hemispheres around the heliographic equator by comparing observations at the Earth's orbit in Spring and Fall since 1964. We find that there is a large, statistically significant effective gradient of about 10 km/s/deg in the southern magnetic hemisphere around each solar minimum. However, no statistically significant effective gradient is found in the northern magnetic hemisphere. This difference implies a systematic displacement of the minimum speed locus of the streamer belt toward the northern magnetic hemisphere. We note that at least during one minimum the streamer belt and the heliospheric current sheet seem to have been oppositely displaced. We also show that the average SW speeds from the two magnetic hemispheres are roughly equal. Therefore, the earlier reported annual variation in SW speed at 1 AU is due to the displacement of the streamer belt and not due to different speeds from coronal holes of opposite polarity. The displacement of the streamer belt implies a new, persistent north-south asymmetry related to the solar magnetic cycle which needs to be explained by realistic solar dynamo models.

Accepted by Geophysical Research Letters

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Microflaring of a Solar Bright Point

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A 50 x 50 arcsec region near the solar disc center containing a bright point (BP) was observed with the *SUMER*-spectrograph of the *SOHO* observatory. The data consist of two hours observation of four far-UV emission lines formed between 2 10^4 – 6 10^5 K, with 2 arcsec spatial, 2.8 min temporal and 4 km/s spectral resolution. A striking feature was strong microflaring of the major persistent BP (with size 8 x 8 arcsec) and the appearance of several short lived transients. The microflaring of each individual 2 x 2 arcsec pixels inside the main BP was coherent, indicating strong interaction of the possible sub arcsec building blocks (magnetic flux tubes). Using the emission measure at 10^5 K as an indicator of the loop foot point area and magnetic filling factor, we suggest an average 10 per cent filling factor for the BP observed. This is similar to that on the average surface of a medium-active solar type star.

Accepted by A&A

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Annual and Solar Rotation Periodicities in IMF Components: Evidence for Phase/Frequency Modulation

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We study the annual periodicity and the solar rotation periodicity of the in-ecliptic components of the interplanetary magnetic field (IMF). It is well known that the annual periodicity undergoes a phase reversal in 11 years, reflecting the 22-year Hale cycle of the solar magnetic field. We construct a model where the annual periodicity of the IMF components is phase/frequency modulated by the Hale cycle, and show that this model can reproduce the observed

properties of the annual periodicity. We find that the solar rotation periodicity depicts an analogous nodal structure and a phase reversal with a period of about 3.2 years, implying a new periodicity in the properties of the IMF. We demonstrate that, using the observed spectral width, the phase/frequency modulation model can satisfactorily explain this structure. We also note that taking into account the observed phase reversal in the solar rotation periodicity implies that the most persistent synodic solar rotation period in the in-ecliptic IMF components is 27.6 days, i.e., somewhat longer than recently suggested.

Accepted by Geophysical Research Letters

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More on the Determination of the Coronal Heating Function from Yohkoh Data

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Two recent works have analyzed a solar large and steady coronal loop observed with Yohkoh/SXT in two filter passbands to infer the distribution of the heating along it. Priest et al. (2000) modelled the distribution of the temperature obtained from filter ratio method with an analytical approach, and concluded that the heating was uniform along the loop. Aschwanden (2001) found that a uniform heating led to an unreasonably large plasma column depth along the line of sight, and, using a two component loop model, that a footpoint-heated model loop (with a minor cool component) yields more acceptable physical solutions. We revisit the analysis of the same loop system, considering conventional hydrostatic single loop models with uniformly distributed heating, and with heating localized at the footpoints and at the apex, and an unstructured background contribution extrapolated from the region below the analyzed loop. The flux profiles synthesized from the loop models have been compared in detail with those observed in both filter passbands with and without background subtraction; we find that background-subtracted data are fitted with acceptable statistical significance by a model of relatively hot loop (~ 3.7 MK) heated at the apex, with a column depth $\sim 1/10$ of the loop length. In discussing our results, we put warnings on the importance of aspects of data analysis and modeling, such as considering diffuse background emission in complex loop regions.

Accepted by ApJ (Part 1)

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Temperature and Density Structure of Hot and Cool Loops Derived from the Analysis of TRACE Data

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We study the transversal structure (in particular the filamentation) and the longitudinal plasma stratification in two sets of solar coronal loops observed with TRACE in the 171Å and 195Å passbands. The density stratification and the thermal structuring of the plasma along the fibrils which form the loops is derived using simultaneously two techniques: a) filter ratio diagnostic (195Å/171Å) and b) modeling intensity profiles along the fibrils with hydrostatic models; in both techniques we remove the background flux. We find consistent values of temperature and density with both methods in the coronal structures selected.

We find evidence of a very warm fibril ($T \approx 5 \cdot 10^6$ K) and of rather cold ones ($T \approx 2 \cdot 10^5$ K). The hot fibril appears to have a thermal structure with a maximum at the apex compatible with temperature and density stratification, dictated by energy balance, typical of a non-isothermal hydrostatic loop. The cold fibrils appear isothermal and probably in dynamical conditions.

Accepted by ApJ

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UPCOMING MEETINGS

SIRTF Observation Planning Workshops

November 22-23 and December 6-7, 2002
SIRTF Science Center (SSC)
Pasadena, CA

The SIRTF Science Center (SSC) announces two identical "SIRTF Observation Planning Workshops", to be held at the SSC in Pasadena, CA on November 22-23 and December 6-7, 2002. The purpose of these workshops is to provide detailed information on the SIRTF observatory, the various modes of observation and how to prepare technically sound proposals that will take advantage of the extraordinary capabilities of SIRTF instruments. The workshops will be used to train a cadre of SIRTF GO science liaisons within a range of astronomical departments. The goal is to reach a broad audience, thus we expect to have only 1-2 people from a single institution. Graduate students will be required to have a letter of recommendation to attend from the head of their department. Registration details can be found on the workshop webpage (http://sirtf.caltech.edu/SSC/OST/WORKSHOP/).

Deadline for travel assistance requests: 30 August 2002, 5pm PDT

Final deadline for registration: 15 October 2002

Contact: obsplan@ipac.caltech.edu

Website: http://sirtf.caltech.edu/SSC/OST/WORKSHOP/

JOB OPENING

Postdoctoral Position
Stellar Astrophysics
University of Porto (Portugal)

The Centre for Astrophysics of the University of Porto (CAUP) accepts applications for a postdoctoral position for 1 year, starting in September 2002. Depending upon future financing, this period can be extended up to 3 years This post-doctoral position is opened under the Project entitled "Stellar Astrophysics" that covers the following topics:

- star formation
- activity and variability in Young Stellar Objects
- solar activity
- stellar winds, jets and HH objects
- stellar atmospheres
- internal structure of stars.

CAUP is an upcoming Research Institute with a staff of 19 researchers, several Ph.D. students and two Master Programs (involving more than 40 students). It is located at the University Campus of Campo Alegre, sharing a building with the town Planetarium. CAUP has an extensive set of collaborations with international partners on research and teaching projects. Portugal is a full member of ESO and ESA, which grants to CAUP researchers access to their observing facilities.

Any inquiries about this position may be directed to jlima@astro.up.pt . Applicants should forward to Dr. João Lima, at the address below, the following elements:

- Curriculum Vitae;
- list of publications;
- a brief description of past experience and of research interests;
- proposed working plan;
- the name/address of 3 referees.

The evaluation of the applications will be based on the scientific merit of the candidate and on the proposed working plan. The monthly salary will be 1.495 Euros, net. There will also be a settlement allowance of 1.000 Euros, paid once at the beginning of the grant. Travel allowances for conferences/observing trips are usually accommodated within the budget of the Project.

All complete applications sent **between 25th July and 16th August 2002** will be considered.

Applications should be sent to:

Dr. João Lima
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URL: http://www.astro.up.pt

Abstract Guidelines

*** Please send all Abstracts and other material in the body of the email message and *not* as attachments. ***

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` .

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