COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 42 — June 1999 Editor: Steve Skinner (coolnews@jila.colorado.edu)

TABLE OF CONTENTS

Stellar Abstracts

Doppler Imaging of Stellar Surface Structure. XI. The Super Starspots on the K0 giant HD 12545: Larger than the Entire Sun

K. G. Strassmeier[1]

[1]Institut für Astronomie, Universität Wien, Türkenschanzstraße 17, A-1180 Wien, Austria

The active K0 giant HD 12545 is the star with the largest starspots ever observed. We report a record light-curve amplitude of 0.63 mag in V and 0.17 mag in V-I in January 1998. At the same time, HD 12545 was at its brightest magnitude since the discovery of its light variability in 1985. We present the first Doppler image of HD 12545 from observations during this state of high-amplitude light variability and find that the star exhibits one cool high-latitude spot of gigantic dimensions ($\approx$12$\times$20 solar radii, i.e. 60 times the extension of the largest sunspot group or 10,000 times larger areal coverage). Furthermore, our map shows one smaller cool spot and one equatorial warm (bright) spot. The warm spot is situated approximately 180° from the large cool spot in the opposite hemisphere and is the cause of the exceptionally large light-curve amplitude and the stellar brightening. Within our model, no light-curve nor a reasonable line-profile solution with only cool spots was possible. Surprisingly, the fact that HD 12545 is brighter at a time of high spot activity is in agreement with solar analogy. Our data also allow to refine the orbital elements of HD 12545 and we use the Hipparcos parallax to determine absolute astrophysical quantities for this rapidly rotating K giant.

Accepted by A&A

For preprints contact: strassmeier@astro.univie.ac.at

For preprints via ftp or WWW: http://www.astro.univie.ac.at/~kgs/publications/liste.html

Spectral Classification of the Cool Giants in Symbiotic Systems

Urs Mürset[1] **and H.M. Schmid**[2]

[1] Institut für Astronomie, ETH Zentrum, CH-8092 Zürich, Switzerland; E-mail: muerset@astro.phys.ethz.ch
[2] Landessternwarte Heidelberg-Königstuhl, D-69117 Heidelberg, Germany; E-mail: hschmid@lsw.uni-heidelberg.de

We derive the spectral types of the cool giants in about 100 symbiotic systems. Our classification is mainly based on near IR spectra in order to avoid the contamination of the spectrum by the nebula and the hot component in the visual region. The accuracy of our spectral types is approximately one spectral subclass, similar to previous near IR classification work, and much better than visual spectral type estimates.

Strong, intrinsic spectral type variations (> 2 spectral subtypes) are only seen in systems containing pulsating mira variables.

We present a catalogue of spectral types for cool giants in symbiotic systems which also includes determinations taken from the literature. The catalogue gives spectral types for the cool giants in about 170 systems which is nearly the full set of confirmed symbiotics.

Based on our classifications we discuss the distribution of spectral types of the cool giants in galactic symbiotic binaries. We find that the spectral types cluster strongly between M3 and M6, with a peak at M5. The distribution of systems with a mira variable component peaks even later, at spectral types M6 and M7. This is a strong bias towards late spectral types when compared to red giants in the solar neighbourhood. Also the frequency of mira variables is much larger among symbiotic giants. This predominance of very late M-giants in symbiotic systems seems to indicate that large mass loss is a key ingredient for triggering symbiotic activity on a white dwarf companion.

Further we find for symbiotic systems a strong correlation between the spectral type of the cool giant and the orbital period. In particular we find a tight relation for the minimum orbital period for symbiotic systems with red giants of a given spectral type. This limiting line in the spectral type – orbital period diagram seems to be equivalent with the relation $R \leq \ell_1/2$, where R is the radius of the red giant and ℓ_1 the distance from the center of the giant to the inner Lagrangian point L_1. This correlation possibly discloses that symbiotic stars are – with probably only one exception in our sample – well detached binary systems.

Accepted by A&AS

For preprints contact: muerset@astro.phys.ethz.ch

The Long Period RS CVn binary IM Pegasi. I. Orbital and Stellar Parameters

S.V. Berdyugina[1], I.Ilyin[1] and I. Tuominen[1]

[1]Astronomy Division, University of Oulu, P.O.Box 3000, FIN-90401 Oulu, Finland

New high-resolution and high signal-to-noise ratio spectroscopic observations carried out in 1996–1997 are analysed. A total of 85 new high quality radial velocity measurements are used for determining the new orbital parameters: $T_{\rm conj}$=HJD2450342.883+24.64880E, e=0.0, γ=–14.09 km s^{-1}, K_1=34.39 km s^{-1}. A model atmosphere analysis of the averaged spectrum of the star has yielded a self-consistent set of fundamental parameters of the primary component: $T_{\rm eff}$=4450 K, $\log g$=2.4, [M/H]=0.0, $\xi_{\rm t}$=1.6 km s^{-1}, $v \sin i$=26.5 km s^{-1}. The primary is found to be a typical K2 III giant with the mass of about 1.5 $M_\odot$ which has undergone the first convective mixing on the Red Giant Branch ([C/H]=–0.32, [N/H]=0.30, C/N=1.15). The unspotted V magnitude of the star of 5.55 is estimated from the observed variations of the TiO band and quasi-simultaneous photometry. Combining all parameters, the radius and inclination of the primary as well as a probable spectral class of the secondary are estimated.

Accepted by A&A

For preprints contact: sveta@ukko.oulu.fi

For preprints via ftp or WWW: http://cc.oulu.fi/ sberdyug/publ99.html

Classification of EUV Stellar Sources Detected by the ROSAT WFC. I. Photometric and Radial Velocity Studies

G. Cutispoto[1], L. Pastori[2], G. Tagliaferri[2], S. Messina[3], R. Pallavicini[4]

[1] Catania Astrophysical Observatory, V.le A. Doria 6, I-95125 Catania, Italy
[2] Brera Astronomical Observatory, Via Bianchi 46, I-22055 Merate, Italy
[3] Institute of Astronomy, Catania University, V.le A. Doria 6, I-95125 Catania, Italy
[4] Palermo Astronomical Observatory, P.zza del Parlamento 1, I-90134 Palermo, Italy

We present the results of high-precision UBV(RI)$_c$ photometric observations and of spectroscopic radial velocity measurements obtained at the European Southern Observatory for a sample of 51 cool stars detected in the EUV by

the ROSAT Wide Field Camera. Using also recent results from HIPPARCOS, we infer spectral types and investigate the single or binary nature of the sample stars. Optical variability, with periods in the 0.4-13 days range, has been detected for the first time in 15 of these stars (HD 35114, HD 36869, HD 41824, HD 43162, HD 48189, HD 71285, HD 75997, HD 78644, HD 96064, HD 124672, HD 141943, SAO 111210, SAO 150508, SAO 150676, SAO 196024).

Accepted by A&AS

For preprints contact: gcutispoto@alpha4.ct.astro.it

A Spectroscopic Study of Flares on T Tauri and Zero-age Main-sequence Stars

Eike W. Guenther[1] and Mathias Ball[1]

[1] Thüringer Landessternwarte Tautenburg, Karl-Schwarzschild-Observatorium, D-07778 Tautenburg, Germany

Using a multi-object spectrograph on the Schmidt telescope in Tautenburg, we study the flare-activity of T Tauri stars and of zero-age main sequence stars. The sample comprises both classical, and weak-line T Tauri stars (cTTSs, wTTSs) in the Taurus-Auriga star forming region, as well as zero-age main-sequence stars (ZAMSSs) in the open cluster α Persei. The properties of the flares detected on V486 Per in the α Persei region, and on the Weak-Line T Tauri stars V819 Tau and V410 Tau are rather similar: All events show a rapid increase and a slow decay of the strength of the Balmer lines, and all events have similar flux-ratios of $H\gamma$ to $H\beta$. An event which shares these properties has also been detected in the cTTS FN Tau, and we correspondingly interpret it as a magnetic flare. Using the properties of observed flares as criteria for the detection of such events, we study the frequency of flares in the three classes of objects. Using these criteria, we detected flares on 80% of the wTTSs, on 56% of the cTTSs, and on 16% of the ZAMSSs. We find that the intrinsic flare rate is only about a factor of two smaller for cTTSs than for wTTSs for our sample of stars, and for flares with energies $\geq 2\,10^{32}$ erg in $H\beta$. We thus conclude that a strong flare activity is a common property of both types of T Tauri stars. In contrast to the T Tauri stars, we find a drastically lower flare rate for the zero-age main sequence stars.

Accepted by A&A

For preprints contact: guenther@tls-tautenburg.de

For preprints via ftp or WWW: http://www.tls-tautenburg.de/research/tls-research/pub99.html

Second Harmonic Plasma Radiation of Magnetically Trapped Electrons in Stellar Coronae

A.V. Stepanov[1], B. Kliem[2], A. Krüger[2], J. Hildebrandt[2], and V.I. Garaimov[3]

[1] Pulkovo Astronomical Observatory, 196140 St. Petersburg, Russia, stepanov@gao.spb.ru
[2] Astrophysical Institute Potsdam, An der Sternwarte 16, D-14482 Potsdam, Germany
[3] Special Astrophysical Observatory, 196140 St. Petersburg, Russia

Plasma radiation near the second harmonic of the plasma frequency, driven by the loss-cone instability of magnetically trapped energetic electrons in stellar coronae, is considered. Growth rates of longitudinal waves near the upper hybrid frequency are determined for warm background plasma and sufficiently high plasma densities, $\omega_{\rm p} > \omega_{\rm c}$, where the electrostatic instability prevails over the electromagnetic cyclotron maser instability, with particular attention given to the "intermediate magnetic field condition, " $1 < \omega_{\rm p}^2/\omega_{\rm c}^2 <\sim 5$. The plasma turbulence level and the brightness temperature of the second harmonic plasma radiation arising from the coalescence of upper hybrid waves are estimated. The brightness temperature can reach $\sim 10^{14}$ K for spontaneous conversion of the waves and $\sim 10^{16}$ K for induced conversion. The radiation pattern of the second harmonic plasma emission is also calculated; it shows prevalence of the extraordinary mode. Analyzing the problem of the escape of radiation from stellar coronae, it is found that the escape window is more wide for the o-mode because the x-mode radiation is strongly absorbed by the warm background plasma at the low harmonic gyrolevels, and thus the observed radiation can be polarized in the ordinary sense in the intermediate magnetic field case. Due to the high temperature of the plasma in the coronae of X-ray emitting stars, the characteristic length scale of the wave conversion and the efficiency of the plasma radiation mechanism can be much higher than on the Sun. The results are discussed in the context of nonthermal quiescent and flare radio emission from active stars.

Accepted by ApJ

For preprints contact: bkliem@aip.de

For preprints via ftp or WWW: http://www.aip.de/~preprint/Preprints.html

Sleuthing the Dynamo II. *HST* Goddard High Resolution Spectrograph Observations of Solar-Type Dwarfs in Young Galactic Clusters

Thomas R. Ayres[1]

[1] Center for Astrophysics and Space Astronomy, University of Colorado, Campus Box 389 [CASA], Boulder, CO 80309-0389

Far-ultraviolet (1150–1670 Å) spectra of three solar-type dwarfs in the young galactic clusters α Persei and the Pleiades were obtained with the *HST* Goddard High Resolution Spectrograph (G140L mode). Time series of Si IV λ1393 show erratic variability on timescales of tens of minutes. An X-ray/C IV flux-flux diagram displays a power law slope of $\sim$2, up to the level of the most active cluster stars. These fall systematically below the extrapolation owing to X-ray "saturation." In rotation-activity diagrams, the X-rays plateau above $\sim$15 km s^{-1} ($P \sim 3$ d), while C IV continues to rise until $\sim$35–50 km s^{-1} ($P \sim 1 - 1.5$ d). Such behavior is significant for understanding the magnetic "dynamo" at high rotational velocities, and is relevant for predicting the ionizing environment bathing newly formed planets around low-mass main sequence stars.

Accepted by ApJ

For preprints contact: ayres@casa.colorado.edu

For preprints via anonymous ftp: **casa.colorado.edu** /pub/ayres sleuthing_II.ps

The Rise and Fall of Mu Velorum: A Remarkable Flare on a Yellow Giant Star Observed with the *Extreme Ultraviolet Explorer*

Thomas R. Ayres[1]

[1] Center for Astrophysics and Space Astronomy, University of Colorado, Campus Box 389 [CASA], Boulder, CO 80309-0389

Mu Velorum (HD 93497; G6 III + dF) is a close visual double; a yellow giant and a fainter companion, currently 2″ apart. Mu Vel recently was the source of a large flare recorded by the *Extreme Ultraviolet Explorer.* The long 1.5 day decay phase was like the extremes seen on hyperactive RS CVn-type binaries. Mu Vel A is a 3 $M_\odot$ star, in the "rapid braking zone" redward of G0 III. Yellow giants are not commonly reported as flare stars, perhaps because the first-crossers are relatively rare and not well represented in the observational samples. The secondary star is classified G2 V, but the 1700 Å energy distribution places it earlier on the MS, probably F4 or F5 V, in a class also not usually known for coronal variability. The long duration of the μ Vel event suggests that it occurred in a significantly elongated structure of moderate density, $n_e < 10^9$ cm^{-3}. If it was a magnetic plasmoid, like a coronal mass ejection on the Sun, then such events might play a role in shedding angular momentum from active evolved stars. The associated spindown could control the activity survival time of red giants (in later stages of evolution than the first-crosser μ Vel) whose dynamos were rejuvenated by dredge-up of angular momentum from the interior, or more exotic sources such as cannibalism of close-in substellar companions during the first or second ascent.

Accepted by ApJ

For preprints contact: ayres@casa.colorado.edu

For preprints via anonymous ftp: **casa.colorado.edu** /pub/ayres mu_vel.ps

Digging Deeper in the Coronal Graveyard: Postscript

Thomas R. Ayres[1]

[1] Center for Astrophysics and Space Astronomy, University of Colorado, Campus Box 389 [CASA], Boulder, CO 80309-0389

An X-ray upper limit—from the *ROSAT* High Resolution Imager—is presented for ϵ Corvi (HD 105707), a K2 giant in the "noncoronal" zone of the Hertzsprung–Russell diagram, but which previously was detected by *HST* GHRS in far-ultraviolet coronal proxies. The new measurement strengthens the anticorrelation between coronal X-rays and

λ1380 carbon monoxide emission among the red giants.

Accepted by ApJ

For preprints contact: ayres@casa.colorado.edu

For preprints via anonymous ftp: **casa.colorado.edu** /pub/ayres coronalgraveyard_ps.ps

Solar Abstracts

X-Ray Observations of Motions and Structure Above a Solar Flare Arcade

D. E. McKenzie[1] **and H. S. Hudson**[2]

[1] Dept. of Physics, Montana State University, Bozeman, Montana 59717 USA
[2] SPRC/ISAS 3-1-1 Yoshinodai, Sagamihara-shi, Kanagawa 229 Japan

In this Letter we describe a solar flare which was observed by *Yohkoh* on 20 January 1999. This long duration event is notable because the *Yohkoh* images show not only the formation of the arcade associated with the coronal mass ejection, but also a considerable amount of motion above the arcade in the region normally identified with a large-scale current sheet, or the outflow from magnetic reconnection in the current sheet. A number of arcade events of this morphological type (i.e., a fan of spike-like "rays" above the post-eruption loops) have been seen by *Yohkoh*, but in this case we have a much clearer view of mass motions in the region above the arcade. The motions indicate field line retraction without formation of long-lasting cusps during the rise phase of the flare, and downward flow above the arcade during the decay phase. The late-phase downward motion is in the form of X-ray dark voids moving at 100 — 200 km s^{-1}, i.e., at velocities intermediate between the free-fall speed and the assumed Alfvén speed. We interpret the voids as cross-sections of evacuated flux tubes resulting from intermittent reconnection following the associated coronal mass ejection. We believe these data represent the first direct evidence of high speed flows in the region immediately above flare loops.

Accepted by ApJ Letters

For preprints contact: mckenzie@physics.montana.edu

For preprints via WWW: http://solar.physics.montana.edu/mckenzie/vitae.html

Brown Dwarf Abstracts

The Lithium Test in Young Brown Dwarf Candidates

E.L. Martín[1], **G. Basri**[1] **and M.R. Zapatero Osorio**[2]

[1] Astronomy Department, University of California, Berkeley, CA 94720
[2] Instituto de Astrofísica de Canarias, 38200 La Laguna, Spain

We present high, mid and low-resolution spectroscopy of the field brown dwarf candidate PC 0025+0447 (M9.5) spanning a 4-year baseline (1994-1998). The strength of the emission lines and the amount of optical veiling are very variable. Our spectra taken at an epoch of low veiling allow us to detect the lithium resonance line, which was not detected when the veiling was high. The presence of lithium proves that PC 0025+0447 is a substellar object less massive than $\sim$0.06 $M_\odot$ and younger than $\sim$1 Gyr. We also present mid-resolution spectra of three brown dwarf candidates in star forming regions, namely ρOph 162349.8-242601 (M8.5), V410 Tau X3 (M6.5) and V410 Tau X6 (M6). Lithium is detected in all of them, supporting their very young age. Of these three objects, only the one in ρOph is sufficiently cool to warrant an unambiguous substellar status. The spectroscopic characteristics that PC 0025+0447 and ρOph 162349.8-242601 have in common are moderately strong Li I lines (PEW$\sim$1 Å), persistent H_α emission with equivalent width >50 Å and weaker K I and Na I lines than field dwarfs of the same spectral type.

Accepted by AJ (to appear August 1999)

For preprints contact: ege@popsicle.berkeley.edu

For preprints via WWW: http://astro.berkeley.edu/ ege/

A 2MASS Survey for Brown Dwarfs Towards the Hyades

John E. Gizis[1], I. Neill Reid[2] and David G. Monet[3]

[1] Department of Physics and Astronomy, LGRT 532A, University of Massachusetts, Amherst, MA 01003-4525
[2] Palomar Observatory, 105-24, California Institute of Technology, Pasadena, California 91125
[3] U.S. Naval Observatory, P.O. Box 1149, Flagstaff, AZ 86002

We present results of a search for very low mass stars and brown dwarfs towards the central region of the Hyades cluster. Using Two Micron All Sky Survey (2MASS) near-infrared and Second Palomar Sky Survey (POSSII) optical photometry, we select candidates corresponding to spectral types M8 through L4 at the distance of the Hyades. Spectroscopic followup data indicate that none are cluster members. The lack of members in the mass range $0.08 < M < 0.06 M_\odot$ is consistent with prior evidence that this 600 Myr old cluster is deficient in very low mass objects. Three of our objects are spectral type M8, with surface gravity sensitive features intermediate between dwarfs and giants. We interpret these objects as background brown dwarfs, perhaps associated with the Taurus star formation region.

Accepted by AJ (to appear August 1999)

For preprints contact: gizis@stratford.phast.umass.edu

For preprints via WWW: http://xxx.lanl.gov/ps/astro-ph/9905168

EROS 2 Proper Motion Survey: a Field Brown Dwarf, and an L Dwarf Companion to LHS 102

Bertrand Goldman[1], Xavier Delfosse[2,3], Thierry Forveille[3], and the EROS and DENIS Collaborations

[1] CEA, DSM, DAPNIA, Centre d'Études de Saclay, F-91191 Gif-sur-Yvette Cedex, France
[2] Observatoire de Grenoble, 414 rue de la Piscine, Domaine Universitaire de S^t Martin d'Hères, F-38041 Grenoble, France
[3] Instituto de Astrofísica de Canarias, E-38200 La Laguna, Tenerife, Canary Islands, Spain

We report the discovery of two L dwarfs (the new spectral class defined for dwarfs cooler than the M type) in a two-epoch CCD proper motion survey of 413 square degrees, complemented by infrared photometry from DENIS. One of them has a strong lithium line and is therefore a brown dwarf. The other is a common proper motion companion to the mid-M dwarf LHS 102 (GJ 1001), which has a well determined trigonometric parallax. LHS 102B is thus the coolest L dwarf of known distance and luminosity.

Submitted to A&A

For preprints contact: Bertrand.Goldman@cea.fr

For preprints via ftp or WWW: http://xxx.lanl.gov/abs/astro-ph/9905162

Announcement

2MASS Data Release

The Two Micron All Sky Survey (2MASS) announces the public availability of its first large Incremental Data Release. The release data products can be accessed from the IPAC/2MASS Web site at
http://www.ipac.caltech.edu/2mass/
or directly from the NASA/Infrared Science Archive site at
http://irsa.ipac.caltech.edu/.

The 2MASS 1999 Spring Incremental Data Release consists of a Point Source Catalog containing 20.2 million objects, an Extended Source Catalog containing 73,980 resolved sources, and 233,979 compressed 512x1024 pixel (1"/pixel) images, covering about 2,483 square degrees of the northern sky. Also provided are tools for a) obtaining full resolution (non-compressed) "postage-stamp" images for the Extended Source Catalog objects, and b) for determining whether a specified position is included in the release area.

The 2MASS webpage contains general information, including sky coverage, and documentation about this data release. Assistance with the release is available via the 2MASS Help Desk at 2mass@ipac.caltech.edu.

The Two Micron All Sky Survey is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center, funded by the National Aeronautics and Space Administration and the National Science Foundation.

New Book

Introduction to Stellar Winds by Henny J.G.L.M. Lamers and Joseph P. Cassinelli

Title: Introduction to Stellar Winds
Authors: Henny J.G.L.M. Lamers and Joseph P. Cassinelli
Publisher: Cambridge University Press
Publication Date: June 17, 1999
Price: $29.95 (paperback; ISBN 0 521 595657)
Price: $74.95 (hardback; ISBN 0 521 593980)

Content: 460 pages, 112 figures, 70 problems with answers

Chapters: 1. Historical overview 2. Observations of stellar winds 3. Basic concepts: isothermal winds 4. Basic concepts: non-isothermal winds 5. Coronal winds 6. Sound wave driven winds 7. Dust driven winds 8. Line driven winds 9. Magnetic rotator theory 10. Alfven wave driven winds 11. Outflowing disks from rotating stars 12. Winds colliding with the interstellar medium 13. The effects of mass loss on stellar evolution 14. Bibliography 15. Problems and solutions 16. Appendices 17. Subject index, Keyword index

Advance praise:

1. This is an enlightening book, full of vivid physics. It fills a longstanding gap in the astrophysical literature and will stand as the foundation of the rapidly growing field of stellar winds. (Norbert Langer, University of Potsdam)

2. This badly needed book by two well-known researchers brings together theory and observation to provide an excellent, integrated treatment of a fascinating subject. (Hollis Johnson, Indiana University)

Submitted by:

Henny J.G.L.M. Lamers, Astronomical Institute, Utrecht University, Princetonplein 5, P.O.Box 80000, NL-3508 TA Utrecht, The Netherlands, tel.: +31 30 2535222 (secretary 2535200), fax: +31 30 2535201, Email: lamers@astro.uu.nl

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, or M) 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 .`