COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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TABLE OF CONTENTS

Stellar Abstracts

On the Lithium Abundance Dispersion in Late-type Pleiades Stars

R. D. Jeffries[1]

[1]Department of Physics, Keele University, Keele, Staffordshire, ST5 5BG, UK

I present the results of a programme to monitor the strengths of the Li I 6708Å, K I 7699Å and chromospheric Hα lines in a group of cool Pleiades stars. Consistent instrumentation and analysis techniques are used to show that there is no Li I variability on timescales of 1 year that could possibly account for the apparent spread in Li abundances seen in Pleiades stars between effective temperatures of 4800-5200 K. Comparison with published data reveals tentative evidence for variability on 10 year timescales, but at a very low level. The lack of chromospheric activity variability above levels of 20 to 30 percent makes it difficult however, to rule out evenly distributed magnetic activity regions causing a scatter in the Li I line strengths at a given abundance. The similar star to star scatter of K I line strengths in these and published data reinforces the conclusion that it is still unsafe to attribute the Li I line strength dispersion to a large variation in Li depletion at a given mass.

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For preprints via WWW: http://www.astro.keele.ac.uk/~rdj/

Statistics of BY Dra Type Variables

I. Yu. Alekseev[1]

[1] Crimean Astrophysical Observatory, p/o Nauchny, Crimea, 334413, Ukraine

A statistical survey of 112 spotted red dwarf stars is presented. All of these stars are known or suspected BY Dra type variables. We compared typical parameters of variability (the rotation modulation amplitude ΔV and the seasonal mean brightness variations amplitude $\Delta < V >$) with main stellar parameters. The main results are as follows: (i) The photometric variability shows weak dependence on the spectral type (or the color index $V - I$) of star. (ii) The ΔV and $\Delta < V >$ values correlate with the stellar rotation velocity. The saturation of the stellar variability growth is

found. The critical rotation velocity V_{crit} averages 15 – 20 km/s. (iii) The photometric variability anticorrelates with the Rossby number, saturating near the critical value $Ro_{crit} \sim 0.2 - 0.3$. (iv) The Sun as a star agrees with found dependences very nice. Thus, the stellar spottedness on red dwarfs depends on main stellar parameters (spectral type, rotation and Rossby number) as well as other known indicators of stellar activity.

Submitted to Astron. Rep. (in Russian)

For preprints contact: ilya@crao.crimea.ua

The UBVRI Fast Photometry of Active Flare Stars EV Lac and AD Leo

I. Yu. Alekseev[1], V. E. Chalenko[1] and D. N. Shakhovskoy[1]

[1] Crimean Astrophysical Observatory, p/o Nauchny, Crimea, 334413, Ukraine

During 1996 – 1999 we have carried out regular photometric observations of two active flare stars *EV Lac* and *AD Leo*. Flare radiation of the most powerful events and the emission from different models of hydrogen plasmas are compared in two-colour diagrams of the *UBVRI* photometric system. The statistical analysis of *EV Lac* flares confirmed and supplied the 7.5 year activity cyclic reccurency found earlier.

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For preprints contact: ilya@crao.crimea.ua

Spectroscopic Classification of Late-M and L Field Dwarfs

Eduardo L. Martín[1], Xavier Delfosse[2], Gibor Basri[1], Bertrand Goldman[3], Thierry Forveille[4] and Maria Rosa Zapatero Osorio[2]

[1] Dept. of Astronomy, 601 Campbell Hall, Univ. of California, Berkeley, CA 94720 USA
[2] Instituto de Astrofísica de Canarias, 38200 La Laguna, Spain
[3] CEA, DSM, DAPNIA, Centre d'Etudes de Saclay, 91191 Gif-sur-Yvette Cedex, France
[4] Observatoire de Grenoble, 414 rue de la Piscine, Domaine Universitaire de Saint Martin de Hères, F-38041 Grenoble, France

We present spectra for 12 new ultracool dwarfs found in the DENIS infrared survey. Seven of them have spectral types at the bottom of the M-class (M8–M9.5), and the other five belong to the cooler "L" class. We also present spectra for the two new L dwarfs found by the EROS 2 proper motion survey (Goldman et al. 1999). We introduce a scheme for L dwarf classification that is based on an extension to cooler spectra of a pseudo-continuum ratio previously defined for M dwarfs (Martín et al. 1996). For calibrating the spectral subclasses, we use a temperature scale for late M and L dwarfs obtained from synthetic spectrum fitting of high-resolution profiles of Cs I and Rb I resonance lines (Basri et al. 1999). We define that the subclass range from L0 to L6 corresponds to the temperature range from 2200 K to 1600 K. Our subclasses L0, L1 and L2 agree with Kirkpatrick et al. (1999) but then diverge such that our L6 = L8 (Kirkpatrick).

We find that late-M and L dwarf subclasses can be assigned either in the optical with the PC3 index or in the near-infrared with the H_2O H-band index. We discuss the main photospheric features present in L dwarf spectra, in particular in the region 400–650 nm which has never been shown before. The TiO bands at 549.7, 559.7, 615.9 and 638.4 nm fade with decreasing temperature, but do not vanish until well inside the L domain (∼L5). The Na I 589.0, 589.6 nm resonance doublet in our latest object (L6) becomes the broadest atomic feature ever seen in any cool dwarf. We do not detect H_α emission in our L dwarfs later than L3. We discuss the ages and masses of our objects using their temperatures and absence or presence of lithium. Finally, we compare two L1 dwarfs with different gravities (one with lithium and one without it) and discuss differences in spectral features.

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For preprints contact: ege@popsicle.berkeley.edu

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

Sodium Production in Asymptotic Giant Branch Stars

Nami Mowlavi[1]

[1] Geneva Observatory, CH-1290 Sauverny, Switzerland

A new scenario is presented for the production of ^{23}Na in asymptotic giant branch (AGB) stars. The scenario takes advantage of the periodic third dredge-up episodes characterizing those stars, which mix primary ^{12}C from their intershell layers to their surface. Two successive interpulse/pulse/dredge-up sequences are then required to produce ^{23}Na. During the first sequence carbon and oxygen are converted into ^{14}N by the hydrogen burning shell, and subsequently transformed into ^{22}Ne by the helium burning shell. During the second sequence, ^{22}Ne is converted into ^{23}Na by the hydrogen burning shell, which is brought to the surface by the subsequent dredge-up episode. The ^{23}Na produced by this scenario is thus primary.

The efficiency of this scenario is analyzed through standard evolutionary AGB model predictions combined with synthetic calculations for the surface chemical evolution. It is shown that primary ^{23}Na can efficiently be produced as soon as the surface C+N+O abundance enhancement reaches a certain level depending on the stellar metallicity. The required surface C+N+O abundance enhancement amounts to $\sim$0.4 dex in solar metallicity stars, and to $\sim$0.8 dex at a metallicity five times less than solar.

An *analytical* study of Na production further reveals that the surface ^{23}Na abundance asymptotically evolves to a 'line of primary sodium enrichment' (LOPSE) in the [C+N+O]$-$[^{23}Na] diagram. That LOPSE represents the ^{23}Na abundance evolution predicted in zero metallicity AGB stars experiencing third dredge-up episodes. An analytical relation for the surface ^{23}Na abundance evolution as a function of the surface C+N+O abundance is provided.

The predicted surface ^{23}Na enhancements can exceed 0.5 dex depending on the level of surface ^{12}C enrichment, and increases with decreasing stellar metallicity. The quantitative prediction of ^{23}Na surface abundances, however, is presently subject to a high level of uncertainty, partly due to the still poor quantitative prediction of the structural evolution of AGB stars (dredge-up episodes in particular), and partly due to the uncertainties still affecting some nuclear reaction rates (such as ^{23}Na destruction by proton capture).

The case of massive AGB stars in which hot bottom burning occurs is also discussed. The production of secondary sodium in those stars is a natural consequence of ^{22}Ne burning in their envelope, if the temperature at the base of the envelope exceeds 70 million K. It requires, however, many interpulses to be significant. The production of primary sodium from the dredge-up of primary ^{22}Ne and its subsequent burning in the envelope, on the other hand, is estimated not to be very efficient, expect maybe in low-metallicity stars.

An eventual detection of high Na overabundances in carbon stars or related objects would support the scenario of primary sodium production in AGB stars. Such an observational evidence may have been found in at least one post-AGB star. Further observations of those objects are called for. Observations of ^{23}Na in planetary nebulae are also encouraged. Finally, the production of primary ^{23}Na by AGB stars, if confirmed observationally, may have played a non-negligible role in the chemical evolution of our Galaxy.

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For preprints contact: Nami.Mowlavi@obs.unige.ch

For preprints via WWW: http://obswww.unige.ch/~mowlavi/publications

Tip-AGB Stellar Evolution in the Presence of a Pulsating, Dust-induced "Superwind"

K.-P. Schröder[1]**, J.M. Winters**[1] **and E. Sedlmayr**[1]

[1] Technische Universität Berlin, Inst. f. Astronomie u. Astrophysik, Sekr. PN 8-1, Hardenbergstr. 36, D–10623 Berlin, Germany

We present selected "superwind" mass-loss histories and the related tip-AGB stellar evolution models, which have been computed according to the characteristics of a dust-induced, carbon-rich wind, and which include several recent improvements as compared to Schröder et al. (1998). We discuss the (initial) stellar mass-range of 1 to 2.5 $M_{\odot}$, with a nearly solar composition (X=0.28, Y=0.70, Z=0.02). In each time-step, mass-loss rates are used, which are consistent with the actual stellar parameters, and which are based on our pulsating, dust-induced wind models for carbon-rich stars (Fleischer et al. 1992), including a detailed and consistent treatment of dust formation, radiative transfer and radiative wind acceleration.

The resulting "superwind" mass-loss rates reach 2 to $3 \cdot 10^{-5} M_\odot \mathrm{yr}^{-1}$. For this reason, they become an influential factor of tip-AGB stellar evolution – but also vice versa, since our mass-loss rates vary strongly with effective temperature ($\dot{M} \propto T_{\mathrm{eff}}^{-8}$ (roughly), see Arndt et al. 1997), reflecting the temperature sensitivity of the dust formation process on a macroscopic scale.

With all tip-AGB models of an initial stellar mass $M_i > 1.3 M_\odot$ we find superwinds with a total mass outflow of 0.26 to $> 0.55 M_\odot$ during their final $3 \cdot 10^4$ yrs, just as required for PN-formation. Furthermore, a thermal pulse leads to a very short (100 to 200 yrs) interruption of the "superwind" of these models.

A critical (Eddington-like) luminosity L_c is required for the radiation driven wind models, which our evolution models fail to reach for $M_i < 1.1 M_\odot$. With slightly larger stellar masses, L_{tAGB} is near L_c and thermal pulses can trigger very short "superwind" bursts, as already pointed out by Schröder et al. (1998). We find good agreement between our improved models and the mass-loss characteristics of the thin CO shells found by Olofsson et al. (1990, 1993, 1996, 1998) around some carbon-rich Mira stars.

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For preprints contact: schroder@koelsch.physik.tu-berlin.de

On Spectroscopic Filling Factors and the Solar Transition Region

P. G. Judge[1]

[1] High Altitude Observatory, National Center for Atmospheric Research, P.O. Box 3000, Boulder CO 80307-3000, USA

I re-examine the concept of spectroscopic filling factors by adopting the reasonable notion that most astrophysical plasmas are inhomogeneous, and must therefore be described using functions $\zeta(n)$, the "emission measure differential in electron density n". Based upon a formal definition for the filling factor, and using simple distribution functions, I show that the derived filling factors (1) differ from the geometric filling factor unless the plasma is truly homogeneous ($\zeta(n) = \zeta_0 \delta(n - n_0)$), (2) depend on the choice of line pairs for the same $\zeta(n)$, (3) depart more from the geometric filling factor for broader distributions $\zeta(n)$. I discuss some implications for the particular case of the solar transition region. I propose a picture for this plasma in terms of a time dependent, "classical" transition region which appears to satisfy observed properties as well or better than filamentary models based upon tiny filling factors ($10^{-5} \rightarrow 10^{-2}$) that are demonstrably lower limits. In any event, the present analysis reveals the severe non-uniqueness in the interpretation of spectral data in terms of unresolved plasma structure.

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For preprints contact: judge@ucar.edu

Spectroscopic Analysis of a Super-hot Giant Flare observed on Algol by BeppoSAX on 30 August 1997

F. Favata[1], **J. H. M. M. Schmitt**[2]

[1] Astrophysics Division – Space Science Department of ESA, ESTEC, Postbus 299, NL-2200 AG Noordwijk, The Netherlands

[2] Universität Hamburg, Hamburger Sternwarte, Gojenbergsweg 112, D-21029 Hamburg, Germany

We present an X-ray observation of the eclipsing binary Algol, obtained with the BeppoSAX observatory. During the observation a huge flare was observed, exceptional both in duration as well as in peak plasma temperature and total energy release. The wide spectral response of the different BeppoSAX instruments, together with the long decay time scale of the flare, allowed us to perform a detailed time-resolved X-ray spectroscopic analysis of the flare. We derive the physical parameters of the emitting region together with the plasma density applying different methods to the observed flare decay. The X-ray emission from the flare is totally eclipsed during the secondary optical eclipse, so that the size of the emitting region is strongly constrained (as described in a companion paper) on purely geometrical arguments. The eclipse-derived size of the flare is much smaller than the size derived from the analysis of the evolution of the spectral parameters using the quasi-static cooling formalism, showing that the time evolution of the flare is determined essentially from the temporal profile of the heating, with the intrinsic decay of the flaring loop having little relevance. The analysis of the decay with the technique recently developed for solar flares by Reale et al. (1997) on the other hand is in much better agreement with the eclipse-derived constraints.

The very high signal-to-noise of the individual spectra strongly constrains some of the derived physical parameters. In particular, very significant evidence for a three-fold increase in coronal abundance and for a large increase in absorbing column density during the initial phases of the flare evolution is present.

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For preprints contact: fabio.favata@astro.estec.esa.nl

Continuous Heating of a Giant X-ray Flare on Algol

J. H. M. M. Schmitt[1], F. Favata[2]

[1] Universität Hamburg, Hamburger Sternwarte, Gojenbergsweg 112, D-21029 Hamburg, Germany
[2] Astrophysics Division – Space Science Department of ESA, ESTEC, Postbus 299, NL-2200 AG Noordwijk, The Netherlands

Giant flares can release large amounts of energy within a few days: X-ray emission alone can be up to ten percent of the star's bolometric luminosity. These flares exceed the luminosities of the largest solar flares by many orders of magnitude, which suggests that the underlying physical mechanisms supplying the energy are different from those on the Sun. Magnetic coupling between the components in a binary system or between a young star and an accretion disk has been proposed as a prerequisite for giant flares. Here we report X-ray observations of a giant flare on Algol B, a giant star in an eclipsing binary system. We observed a total X-ray eclipse of the flare, which demonstrates that the plasma was confined to Algol B, and reached a maximum height of 0.6 stellar radii above its surface. The flare occurred around the south pole of Algol B, and energy must have been released continously throughout its life. We conclude that a specific extrastellar environment is not required for the presence of a flare, and that the processes at work are therefore similar to those on the Sun.

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For preprints contact: st8h101@hs.uni-hamburg.de

Predicting Stellar Angular Sizes

Gerard T. van Belle[1]

[1] Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109

Reliable prediction of stellar diameters, particularly angular diameters, is a useful and necessary tool for the increasing number of milliarcsecond resolution studies being carried out in the astronomical community. A new and accurate technique of predicting angular sizes is presented for main sequence stars, giant and supergiant stars, and for more evolved sources such as carbon stars and Mira variables. This technique uses observed K and either V or B broad-band photometry to predict $V = 0$ or $B = 0$ zero magnitude angular sizes, which are then readily scaled to the apparent angular sizes with the V or B photometry. The spread in the relationship is 2.2% for main sequence stars; for giant and supergiant stars, 11-12%; and for evolved sources, results are at the 20-26% level. Compared to other simple predictions of angular size, such as linear radius-distance methods or black-body estimates, zero magnitude angular size predictions can provide apparent angular sizes with errors that are 2 to 5 times smaller.

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For preprints contact: gerard@huey.jpl.nasa.gov

For preprints via WWW: http://huey.jpl.nasa.gov/~gerard/postscript/

The Active RS Canum Venaticorum Binary II Pegasi. IV. The Spot Activity Cycle

S.V. Berdyugina[1], A.V. Berdyugin[1,2], I.Ilyin[1] and I. Tuominen[1]

[1] Astronomy Division, University of Oulu, P.O.Box 3000, FIN-90401 Oulu, Finland
[2] Tuorla Observatory, University of Turku, Väisäläntie 20, FIN-21500 Piikkiö, Finland

A total of 6 new surface images of II Peg obtained for the years 1997 and 1998 confirms the recently revealed permanent active longitude structure. The lower limit of the active longitudes' lifetime is now extended up to 25 years. A new "flip-flop" phenomenon, redefined as a switch of the activity between the active longitudes, has started in summer of 1998. It coincides reasonably well with the moment predicted from the activity cycle of the star. This confirms

definitely the cyclic behaviour of the activity of II Peg we recently discovered. Therefore, we assign numbers to the cycles of 4.65 yr since the earliest photoelectric observations of II Peg and define the active longitudes as "odd" and "even" corresponding to odd and even numbers of cycles. With such a definition, in late 1998 the 7th cycle began and the "odd" active longitude became more active. From the analysis of the spot area evolution within the active longitudes we conclude that the activity cycle is developed as a rearrangement of the nearly constant amount of the spot area between the active longitudes. We discuss the "flip-flop" phenomenon as a tracer of stellar activity and the role of the unseen secondary in establishing the cycle.

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Photometric Modelling of Starspots I. A Barnes-Evans-Like Surface brightness–Colour Relation Using (I_c–K)

P.J. Amado[1,2], C.J. Butler[1] and P.B. Byrne[3]

[1] Armagh Observatory, College Hill, Armagh BT61 9DG, N. Ireland

[2] Instituto de Astrofísica de Andalucía-CSIC, Apartado 3004, 18080 Granada, Spain.

[3] Deceased

In the first part of this work, the empirical correlation of stellar surface brightness F_V as a function of the (I_c–K) broadband colour has been investigated by using a sample of stars cooler than the Sun. A bilinear correlation is found to well represent the brightness of G, K and M giant stars. The change in slope occurs at an (I_c–K) of ~ 2.1 or at about the transition from K to M spectral types. The same relationship was also investigated for dwarf stars and found to be distinctly different from that of the giants. Their correlation differs by an average of -0.4 in (I_c–K) or a maximum difference in $F_V \sim -0.1$, positioning it below that of the giants', with both trends tending to convergence for the hotter stars in our sample. The flux distribution derived from the F_V–(I_c–K) relationship for the giant stars, together with that derived from a F_V–(V–K) relationship and the blackbody flux distribution, is then utilized to compute synthetic light V and colour $(V–R)_c$, $(V–I)_c$ and (V–K) curves of cool spotted stars. We investigate the effects on the amplitudes of the curves by using these F_V–colour relations and by assuming the effective gravity of the spots to be lower than the gravity of the unspotted photosphere. We find that the amplitudes produced by using the F_V–(I_c–K) relationship are larger than those produced by the other two brightness correlations, meaning smaller and/or warmer spots.

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For preprints contact: pja@iaa.es

The Wilson-Bappu Relation for RS CVn Stars

F.F. Özeren[1,2], J.G. Doyle[1] & D. Jevremovic[1,3]

[1] Armagh Observatory, Armagh BT61 9DG, N. Ireland

[2] Dept. of Astronomy, Science Faculty of Ankara University, 06100 Tandoğan-Ankara/Turkey

[3] Belgrade Observatory, Volgina 7, 11050 Belgrade, Yugoslavia

We investigate the extent to which the Wilson-Bappu relationship holds for chromospherically active binaries using the Mg II h&k lines of 41 RS CVn stars observed with IUE. The resulting fits are different from the relationships obtained for single, less active stars. The parallax used were those from the HIPPARCOS catalogue, these give a much better correlation than the magnitudes taken from CABS. Within a particular luminosity class the relationship is good, however it tends to break down when we incorporate objects ranging in luminosity from class I to V. From model calculations there is very little dependence of the Mg II line width on effective temperature. The line width does however depend on the column mass at the transition region boundary showing increased line width at lower column mass. There is also a dependence on the column mass adopted for the temperature minimum, however, the major and dominant parameter is the surface gravity scaling as $g^{-1/4}$. Within a luminosity class more active objects will show larger lines widths reflecting a higher column mass deeper in the atmosphere, e.g. at the temperature minimum level.

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Solar Abstracts

SUMER Observations of Doppler Shift in the Quiet Sun and in an Active Region

L. Teriaca[1], D. Banerjee[1], J.G. Doyle[1]

[1] Armagh Observatory, Armagh BT61 9DG, N. Ireland

The UV spectral lines formed at transition region temperatures in the solar atmosphere, shows a prevailing redshifted emission. Using the Solar Ultraviolet Measurements of Emitted Radiation spectrometer flown on the *Solar and Heliospheric Observatory* spacecraft, we measure the amount of line shift as a function of the temperature for several spectral lines formed in the range between 10^4 and 10^6 K. We analyze spectrograms relative to the quiet Sun and to the active region NOAA 7946. The velocities derived are increasing from a redshift of $\sim$ 0 km s^{-1} at $\sim$ 20000 K to 10 km s^{-1} at 1.91$0^5$ K for the quiet Sun, and to $\sim$ 15 km s^{-1} at 10^5 K for the active region. At higher temperature an opposite behaviour is observed. In the quiet Sun a *blueshift* of ~ -2 km s^{-1} is observed at the Ne VIII formation temperature (6 10^5 K), while in the active region, a *blue-shifted* value around -8 km s^{-1} is observed for the same spectral line. The finding of blueshift in Ne VIII is due to the adoption of a new rest wavelength of 770.428 Å. By 10^6 K the *blueshift* is ~ -10 km s^{-1} in the active region as measured by Fe XII 1242.

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Radiative Cooling of a Hot Flux Tube in the Solar Photosphere

R. Schlichenmaier[1], J.H.M.J. Bruls[1] and M. Schüssler[1]

[1] Kiepenheuer Institut für Sonnenphysik, Schöneckstr. 6, 79117 Freiburg, Germany

Radiative energy transport is of key importance for the dynamics of slender magnetic flux tubes in the solar atmosphere, particularly so in connection with the filamentation of the sunspot penumbra. In investigations using the thin-flux-tube approximation of the MHD equations, the radiative exchange with the surrounding atmosphere has hitherto been described by the relaxation-time approach, also called 'Newton's law of cooling'. The strongly nonlinear temperature-dependence of the radiative absorption coefficient and large temperature differences between the tube and its environment render this concept questionable. As a simple model of a bright penumbral filament we consider the cooling of a hot horizontal flux tube with a longitudinal flow, embedded in a non-stratified, homogeneous atmosphere at 4 800 K. We compare the results of the relaxation-time approach and of a nonlinear diffusion approximation with the numerical solution of the equation of (grey) radiative transfer. We find that the cooling times given by the relaxation-time method compare well with the results from radiative transfer as long as the initial temperature of the tube is below 7 500 K and its lateral optical depth does not exceed unity. Under these conditions, the tube cools more or less homogeneously over its cross section. For hotter and optically thick tubes, the strong temperature-dependence of the absorption coefficient leads to the formation of a cooling front, which migrates radially inward at approximately constant speed. Such inhomogeneous cooling is well represented by the nonlinear diffusion approximation. The self-similar evolution of the cooling front permits an analytical estimate of the cooling time, which provides a reasonable approximation of the result of the radiative transfer calculation. This estimate can be used to derive an improved radiative cooling term in the framework of the thin-flux-tube approximation, so that both optically thin and optically thick flux tubes can be treated adequately. The results of the radiative transfer calculations are applied to obtain an estimate of the length and brightness of penumbral bright grains.

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The Radial and Angular Variation of Electron Density in the Solar Corona.

P. T. Gallagher[1,2], M. Mathioudakis[1], F. P. Keenan[1], K. J. H. Phillips[2], K. Tsinganos[3]

[1] Department of Pure and Applied Physics, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland.
[2] Space Science Department, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon. OX11 0QX, U.K.
[3] Department of Physics, University of Crete, P.O. Box 2208, 710 03 Heraklion, Crete, Greece.

We derive, for the first time, electron densities as a function of both radius (R) and position angle (θ) for the south–west quadrant of the off-limb corona, using the density-sensitive Si IX (349.9 Å/341.9 Å) and Si X (356.0 Å/347.7 Å) extreme ultraviolet line ratios. The observations were made with the Coronal Diagnostic Spectrometer (CDS) on board the *Solar and Heliospheric Observatory* (SOHO), over the range $1.00R_\odot < R < 1.20R_\odot$ and $180° < \theta < 270°$. Within the south polar coronal hole, the density varies from 2.3×10^8 cm^{-3} at $1.0R_\odot$ to 8.3×10^7 cm^{-3} at $1.20R_\odot$, while at the equator the density varies from 6.3×10^8 cm^{-3} at $1.0R_\odot$ to 1.6×10^8 cm^{-3} at $1.20R_\odot$. The density falloff with height is therefore faster in the equatorial region. We also find that electron densities are, on average, a factor of 2.7 larger in the equatorial regions than in the polar coronal hole at a given radial distance. Finally, we find remarkable agreement between our measured densities as a function of radius and position angle and those predicted by a recent analytic MHD model of the solar wind, strongly supporting its basic premises.

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For preprints contact: P.Gallagher@qub.ac.uk

Brown Dwarf Abstracts

PPl 15: The First Brown Dwarf Spectroscopic Binary

Gibor Basri[1] and Eduardo L. Martín[1]

[1] Dept. of Astronomy, 601 Campbell Hall, Univ. of California, Berkeley, CA 94720 USA

PPl 15 is the first object to have been confirmed as a brown dwarf by the lithium test (in 1995), though its inferred mass was very close to the substellar limit. It is a member of the Pleiades open cluster. Its position in a cluster color-magnitude diagram suggested that it might be binary, and preliminary indications that it is a double-lined spectroscopic binary were reported by us in 1997. Here we report on the results of a consecutive week of Keck HIRES observations of this system, which yield its orbit. It has a period of about 5.8 days, and an eccentricity of 0.35-0.45. The rotation of the stars is slow for this class of objects. Because the system luminosity is divided between 2 objects of almost equal mass this renders each of them an incontrovertible brown dwarf, with masses between 60-70 Jupiter masses. We show that component B is a little redder than A by studying their wavelength-dependent line ratios. We confirm that the system has lithium, but reject the original conclusion that it may be depleted (which would be surprising, given the new masses). This is a system of very close objects which, if they had combined, would have produced a low mass star. We discuss the implications of this discovery for the theories of binary formation and formation of very low mass objects.

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For preprints contact: basri@soleil.berkeley.edu

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An L-type Substellar Object in Orion: Reaching the Mass Boundary Between Brown Dwarfs and Giant Planets

M. R. Zapatero Osorio[1], V. J. S. Béjar[1], R. Rebolo[1], E. L. Martín[2] and G. Basri[2]

[1] Instituto de Astrofísica de Canarias, E–38200 La Laguna, Tenerife, Spain
[2] Dept. of Astronomy, 601 Campbell Hall, Univ. of California, Berkeley, CA 94720 USA

We present near-infrared photometry (J-band) and low-resolution optical spectroscopy (600–1000 nm) for one of the faintest substellar member candidates in the young σ Orionis cluster, S Ori 47 ($I = 20.53$, Béjar et al. 1999). Its very red $(I - J) = 3.3 \pm 0.1$ color and its optical spectrum allow us to classify S Ori 47 as an L1.5-type object which fits the low-luminosity end of the cluster photometric and spectroscopic sequences. It also displays atmospheric features indicative of low gravity such as weak alkaline lines and hydride and oxide bands, consistent with the expectation for a very young object still undergoing gravitational collapse. Our data lead us to conclude that S Ori 47 is a true substellar member of the σ Orionis cluster. Additionally, we present the detection of Li I in its atmosphere which provides an independent confirmation of youth and substellarity. Using current theoretical evolutionary tracks and adopting an age interval of 1–5 Myr for the σ Orionis cluster, we estimate the mass of S Ori 47 at $0.015{\pm}0.005\,M_{\odot}$, i.e. at the minimum mass for deuterium burning, which has been proposed as a definition for the boundary between brown dwarfs and giant planets. S Ori 47 could well be the result of a natural extension of the process of cloud fragmentation down to the deuterium burning mass limit; a less likely alternative is that it has originated from a protoplanetary disc around a more massive cluster member and later ejected from its orbit due to interacting effects within this rather sparse ($\sim$12 objects pc^{-3}) young cluster. The study of this object serves as a guide for future deep searches for free-floating objects with planetary masses.

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Medium-resolution Optical Spectroscopy of Young Stellar and Sub-stellar M-dwarfs in the Cha I Dark Cloud

Ralph Neuhäuser[1] and Fernando Comerón[2]

[1] MPI für extraterrestrische Physik, Giessenbachstraße 1, D-85740 Garching, Germany
[2] European Southern Observatory, Karl-Schwarzschild-Straße 2, D-85748 Garching, Germany

We obtained medium-resolution spectra of the bona-fide brown dwarf Cha Hα 1, the five brown dwarf candidates Cha Hα 2 to 6, two additional late M-type brown dwarf candidates, all originally selected by Hα emission, and four previously known T Tauri stars, all located in Chamaeleon I. The spectral types of our targets range down to M8. We show their spectra and also list their IJK magnitudes from DENIS. All objects have radial velocities consistent with kinematic membership to Cha I and show Li 6708Å absorption. Our Cha I brown dwarf candidates with lithium are young or sub-stellar or both. Cha Hα 1, 3, 6, and 7 are certainly brown dwarfs: Either they are as old or older than the Pleiades and should have burned all their original lithium if they were late M-type stars, or, if they are younger than the Pleiades, $\leq$ 125 Myrs, they are sub-stellar because of the young age and the late spectral types ($\geq$ M7), according to three different sets of evolutionary tracks and isochrones. To classify Cha Hα 2, 4, 5, and 8 as either stellar or sub-stellar, evolutionary tracks of higher reliability are needed.

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UPCOMING MEETING

First Announcement

IAU Symposium 200: The Formation of Binary Stars

April 10–15, 2000: Potsdam, Germany

The IAU has approved the holding of a symposium on "The Formation of Binary Stars" to take place from April 10–15, 2000, in Potsdam, Germany. Potsdam is located about 30 km southwest of the centre of Berlin, and the Astrophysical Institute Potsdam (AIP) will host the conference at its Telegraphenberg site.

There has never been an IAU-sponsored symposium on young binary stars, understandable given that a decade ago only a few young binaries were known. However, it is now clear that binary stars are a central theme of star formation and merit a comprehensive discussion at the level of an IAU symposium.

The symposium will include many invited talks covering both theory and observations of binary star formation, as well as an extensive poster session. Major topics will include:

- Cloud fragmentation and collapse
- Proto-binaries and infrared companions
- Main sequence and pre-main sequence binary populations
- Environments of young binaries; accretion disks and jets
- Dynamical evolution of young binaries
- Binaries as tests of pre-main sequence stellar evolution models
- Planet formation in binary systems
- Frontiers of observation and theory in the study of binary formation

Potsdam has a long tradition in binary star research dating back to Hermann Carl Vogel, who measured the radial velocities for hundreds of bright stars at the turn of the century. This line of research also led to the discovery of stationary Calcium H and K lines in the spectrum of the δ Ori binary system by Johannes Hartmann with the Potsdam double refractor, and thence to the discovery of the interstellar medium. Thus the connection of binary stars and their origin in interstellar clouds is nicely established in Potsdam. Furthermore, the AIP, as the successor of the old Berlin Sternwarte founded in 1700, will celebrate its 300th anniversary in the year of the symposium.

Scientific Organizing Committee:
H. Zinnecker (co-chair), R. D. Mathieu (co-chair), P. Artymowicz, A. Boss, J. Bouvier, C. Clarke, A. Dutrey, A. Ghez, P. Kroupa, C. Leinert, S. Miyama, B. Reipurth, M. Simon, A. Tokovinin, and A. Whitworth.

Contact information:
The symposium website (`http://www.aip.de/IAU200/`) will soon include full details on registering for the conference, arranging accommodation, how to reach Potsdam, and so on. In the meantime, preliminary interest in attending the meeting should be expressed by sending email to `iau200@aip.de`; further announcements concerning the meeting will be made via e-mail and the IAU200 website.

If you have any additional questions, please contact Hans Zinnecker at:
Astrophysikalisches Institut Potsdam, An der Sternwarte 16, 14482 Potsdam, Germany;
Phone: +49 (0)331 7499 347; Fax: +49 (0)331 7499 267; e-mail: hzinnecker@aip.de

JOB OPENING

Professor of Astronomy

Faculty of Science, University of Oulu (Finland)

Applications are invited for the position of Professor in Astronomy. A tenured position is open in the Astronomy Division of the Department of Physical Sciences for candidates with experience in research and teaching. Current fields of research in the division include solar and stellar astrophysics, interstellar matter, stellar dynamics and planetary science. Junior and senior candidates from all fields of research will be considered, with the emphasis on scientific excellence. The division has an extensive local network of workstations, and good access to the supercomputers at the Center for Scientific Computing in Espoo. Finland is connected with 155 Mb/s links to the rest of the Europe and N. America. The major observing equipment is the Nordic Optical Telescope on La Palma, where the division supports the high resolution spectrograph. Finland is a member state of European Space Agency. The teaching duties of the position cover basic and advanced courses at the undergraduate and graduate levels. The lectures can be delivered in either Finnish or English. The annual salary will be within the range of 190 000 - 240 000 FIM depending on qualifications and experience in the field. Oulu contains one of the largest concentrations of high-technology industry in the Nordic Countries, as well as being the cultural center of the surrounding region, and offering outstanding opportunities for outdoor recreation.

For informal information by email: Prof. Ilkka Tuominen, ilkka.tuominen@oulu.fi or tel. +358-8-553-1930.

For further information and application instructions to be requested by email: ritva.roth@oulu.fi or telefax +358-8-553-1060.

Applications including the documents required according to the application instructions should be received no later than September 24, 1999 at the University of Oulu, Registrar Office, P.O.Box 8000, FIN - 90401 Oulu, Finland, telefax +358-8-553-4112.

For more departmental information:

http://physics.oulu.fi/physics2/index.htm

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` .