COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Chromospherically Active Stars. XX. The Giant, Single-lined Binary HD 161570

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Spectroscopy of HD 161570 shows it to be a single-lined spectroscopic binary with a period of 45.623 days and a nearly circular orbit. The primary star has a spectral type of G7 III, and the secondary is most likely a G or K dwarf. A high-resolution spectrum of the 3950 Å region confirms that the primary has Ca II H and K emission lines. The logarithm of the giant's lithium abundance is < 0.9, indicating that it is not lithium rich. From photometric observations covering six seasons we detected periodic, short-term light variability with an amplitude ranging from 0.02 to 0.04 mag. We interpret these short-term variations as due to stellar rotation and find that the rotation period varied somewhat from season to season with a representative value of 64.1 days. Thus, the very different orbital and rotation periods make HD 161570 an asynchronous rotator. Low-amplitude, long-term photometric variability was also seen. The giant's weak Ca II H and K emission, low-amplitude photometric variations, and relatively low $v \sin i$ of 7.0 km s^{-1} indicate that this star is only modestly chromospherically active. This result, plus the spectral type and asynchronous rotation of the primary, suggest that it is just beginning to ascend the red-giant branch.

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Constraining the Properties of Non-radiative Heating of the Coronae of Cool Stars and the Sun

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The dominant mechanism that heats the coronae of the Sun and of other cool stars remains to be identified, despite numerous solar and stellar studies. We address the problem from a statistical point of view, by approximating the emission expected from the ensemble of loops in stellar coronae. We develop a prototype of a global-atmospheric, empirical model that employs *(i)* simulations of the surface magnetic field of Sun and active stars throughout sunspot cycles, *(ii)* potential-field computations of the corresponding coronal field, and *(iii)* approximation of atmospheres for 2,000 coronal loops for randomly selected field lines in each flux configuration, representative of all environments from very quiet to the interior of active regions. The latter requires specification of the flux density $P_{\rm H}$ that passes through the base of the loops to heat the corona. We parameterize $P_{\rm H}$ as a function of the base field strength, $B_{\rm base}$ (in gauss), loop half length ℓ (in Mm), and foot point velocity v (in km/s). We find a best fit for a heating flux density of $P_{\rm H} \approx 2 \times 10^7 (B_{\rm base}/100)^{1.0\pm0.5} (\ell/24)^{-0.7\pm0.3} (v/0.4)^{0.0\pm0.5}$ erg cm^{-2} s^{-1}(the allowed ranges of the exponents are shown). This parameterization matches the observed soft X-ray losses from the coronae of the Sun and more active stars with rotation periods down to 5 d, throughout their activity cycles, as well as the characteristic coronal temperatures, and the relationships between disk-averaged radiative and magnetic flux densities. We compare this parameterization to models previously published in the literature, and find that dissipation of current layers or turbulence are the most likely candidate heating mechanisms, for which both low- and high-frequency driving meet the criteria comparably well. We find, moreover, that the heating scale length of ~ 20 Mm inferred from solar observations matches the characteristic e-folding height of the field strength over solar active regions, which suggests that coronal heating depends on the local field strength. Our modeling suggests that there is no need for a strong selection mechanism to determine which loops are heated and which are not, but that the sensitive dependence of the heating on the base field strength causes the appearance of a corona that consists of bright loops embedded in less bright environments. We compare the differential emission measures for the simulated coronae to those of the Sun and more active cool stars, and also discuss the apparently weak velocity dependence of the best-fit parameterization for $P_{\rm H}$.

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Accurate $V \sin i$ Measurements in M67: The Angular Momentum Evolution of 1.2M$_\odot$ Stars

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By using FEROS spectrograph commissioning observations we build a calibration of the FEROS cross-correlation function (CCF) to determine accurate projected rotational velocities $V \sin i$ for slow rotating F-K dwarf and giant stars. We apply this calibration to a sample of 28 main sequence, turnoff and giant stars belonging to the old open cluster M67. We find that the stars behave in a very regular manner, depending on their position in the Color-Magnitude (C-M) diagram. Early main sequence G stars have a rotational velocity two times larger than the Sun, and they show a possible trend with $(B-V)$ color, in that redder colors correspond lower $V \sin i$. The stars at the turnoff are the fastest rotators, with $V \sin i$ between 6.3 and 7.6 km.s^{-1}, while stars just above the turn-off are already significantly slower , with values between 4.6 and 4.9 km.s^{-1}. Along the Red Giant Branch (RGB) rotation decreases smoothly and for stars above $(B-V) \gtrsim 1$ only upper limits can be found, including for 4 clump stars. Analyzing the angular momentum history of 1.2M$_\odot$ stars with the help of theoretical evolutionary tracks, we see that these stars probably obey different angular momentum evolution laws on the main sequence and along the RGB: while on the main sequence some extra braking is required in addition to angular momentum conservation, along the RGB the data are well represented by the $I\Omega = C$ law. Finally, comparing the $V \sin i$ of the M67 turnoff stars with their

main sequence progenitors in the younger open clusters NGC3680 and Hyades we find that the younger clusters show substantially higher rotation rates. This indicates that 1.2$M_\odot$ stars do experience main sequence braking. This could be relevant also for the interpretation of the nature of the "Lithium gap".

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Discovery of Three Lead-rich Stars

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About half of the stable nuclei heavier than iron are believed to be synthesized during the late stages of evolution of stars with masses in the range 0.8-8 solar masses. These elements are then expelled into the interstellar medium through stellar winds after being 'dredged up' towards the surface of the stars. These processes occur when the star is in the 'asymptotic giant branch' (AGB) phase of its life. Nuclei (mainly iron) deep inside the star slowly capture neutrons and progressively build up heavier elements (the 's-process'). For AGB stars that formed early in the history of the Galaxy, and that therefore have very low abundances of elements heavier than helium ('metals'), models predict that the s-process will accumulate synthesized material with atomic weights in the Pb-Bi region. Such stars will therefore have large overabundances of lead relative to other heavy elements. Here we report the discovery of large amounts of lead in three metal-poor stars (HD187861, HD196944 and HD224959). Our analysis shows that these stars are more enriched in lead than in any other element heavier than iron. The excellent agreement between the observed and predicted abundances reinforces our current understanding of the detailed operation of the s-process deep in the interiors of AGB stars.

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Rotational Studies of Late-Type Stars. VII. M34 (NGC 1039) and the Evolution of Angular Momentum and Activity in Young Solar-type Stars

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We analyze Keck Hires observations of rotation and activity in F, G, and K dwarf members of the open cluster M34 (NGC 1039), which is 250 Myr old, and we compare them to the Pleiades, Hyades, and NGC 6475. The upper bound to rotation seen in M34 is about a factor of two lower than for the 100 Myr-old Pleiades, but most M34 stars are well below this upper bound, and it is the overall convergence in rotation rates that is most striking. A few K dwarfs in M34 are still rapid rotators, suggesting that they have undergone core-envelope decoupling, followed by replenishment of surface angular momentum from an internal reservoir. Our comparison of rotation in these clusters indicates that the time scale for the coupling of the envelope to the core must be close to 100 Myr if decoupling does, in fact, occur.

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The Galactic Evolution of Beryllium and Boron Revisited

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The largest, highest quality, and most near-homogeneously treated extant available samples of Be, B, Fe, and O abundances are analyzed on four different stellar parameter scales, considering different O abundance indicators, and deriving uncertainties in their relation with the required aid of jackknife and bootstrap simulations/resampling. Despite large slope and zero-point differences, the various Fe-poor ($[Fe/H]\leq -1$) BeB-FeO relations are found to be independent of parameter scale within the present, sometimes substantial, uncertainties. Variations in the BeB-O relations (as large as 1.12 dex/dex and 1.24 dex in slope and zero-point) from differing O indicators do significantly differ; surprisingly, the largest differences are within the same parameter scale and not across different ones. The well-defined mean Be-Fe relation is $\mathrm{Be}\propto\mathrm{Fe}^{1.16\pm0.04}$; the B-Fe relation is virtually identical, $\mathrm{B}\propto\mathrm{Fe}^{1.17\pm0.08}$. The BeB-mean O relations show smaller dispersion than BeB-OH or BeB-OI relations alone due to significant reduction in parameter uncertainties, and are in remarkable agreement indicating $\mathrm{Be}\propto\mathrm{meanO}^{1.51\pm0.05}$ and $\mathrm{B}\propto\mathrm{meanO}^{1.61\pm0.12}$. The latter is in good agreement with the slope ($\mathrm{B}\propto\mathrm{O}^{1.39\pm0.08}$) derived for metal-rich dwarfs by Smith et al. [2001, AJ, 122, 370] utilizing enhanced Mg I b-f opacity and presumed reliable λ6300 [O I] and λ6158 O I features. The BeB-FeO slopes are also all in excellent agreement with the reanalysis of Garcia Lopez [1999, ASP Conf. Ser., 171, 77], who utilizes a *Hipparcos*-based gravity scale. The equivalence of the Be- and B-FeO slopes limits prodigious ν-process ^{11}B production at low metallicity and suggests little Galactic evolution of the B/Be ratio. The BeB-mean O slopes differ significantly from pure "primary" and "secondary" values, requiring a combination of production mechanisms. The differing behavior of [O/Fe] and [Be/Fe] with [Fe/H] seems to rule out production by accelerated CO-rich grain debris in ejecta of Type II supernovae having progenitor masses $M\geq 8M_\odot$. Instead, the data are in fine accord with near-primary/intermediate BeB-FeO slopes produced by various two-component models including standard GCR and superbubble production. Such models with a low-energy cosmic ray source from supernovae restricted to very large progenitor mass may be consistent with the large Be abundance in the ultra-metal-poor dwarf G64-12 [Primas et al. 2000; A&A,364,L42]; however they predict unobserved maxima in B/Be evolution near $[Fe/H]\sim -2$, produce too much total Li at intermediate metallicity, and have been suggested to be energetically untenable. Superbubble models considering a range of SN progenitor mass and a constant cosmic-ray source composition predict the inferred modest or flat slopes in B/Be evolution. These models face possible difficulties in reproducing any non-primordial Be plateaus at very low [Fe/H], and not underproducing ^{6}Li for $[Fe/H]\leq -2$; additional data are required to provide firmer observational constraints. The BeB/FeO ratios do not show consistent evidence for two metal-poor populations expected from bimodal (isolated supernovae and collective supernovae in superbubbles) production mechanisms, though these signatures may be lost in the scatter or have drastically different contributing fractions. Finally, comparison of the metal-poor BeB-Fe and BeB-mean O slopes suggests that $[O/Fe]\propto -0.25[Fe/H]$– not constant, but not as steep as suggested in some recent analyses, and in agreement with the shallow [O/Fe] increase with declining [Fe/H] suggested by King [2000; AJ, 120, 1056].

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Beryllium in the Hyades F and G Dwarfs from Keck/HIRES Spectra

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Although there are extensive observations of Li in field stars of all types and in both open and (recently) globular cluster stars, there are relatively few observations of Be. Because Be is not destroyed as easily as Li, the abundance of Li and Be together can tell us more about the internal physical processes in stars than either element can alone. We have obtained high-resolution (45,000) and high signal-to-noise (typically 90 per pixel) spectra of the Be II resonance lines in 34 Hyades F and G dwarfs with the Keck I telescope and HIRES. In addition we took a spectrum of the daytime sky to use as a surrogate solar spectrum so we could determine the value for Be in the sun– analyzed in

the same manner as that for the stars. We have adopted the stellar parameters and some of the Li abundances for these stars from the literature. For most of the F dwarfs we have rederived Li abundances. The Be abundances have been derived with the spectrum synthesis method. We find that Be is depleted, but not detected, in the Li gap in the F stars reaching down to values of A(Be)= 0.60, or a factor of nearly seven below the meteoritic Be abundance (a factor of 3.5 below the solar value of Chmielewski et al.). There is little or no depletion of Be in stars cooler than 6000 K, in spite of the large depletions (0.5-2.5 dex) in Li. The mean value of A(Be) for the ten coolest stars is 1.33±0.06, not far from the meteoritic value of 1.42. The pattern in the Be abundances– a Be dip and undepleted Be in the cool stars– is well matched by the predictions of slow mixing due to stellar rotation. We have interpolated the calculations of Deliyannis and Pinsonneault for Be depletion due to rotational mixing to the age of the Hyades; we find excellent agreement of the predictions with the observed Be abundances but less good agreement with the observed Li abundances. Some of our Hyades stars have photometrically-determined rotation periods, but there is no relation between Be and rotation period. (Generally, the lower mass stars have lower Li and longer periods which may indicate greater spin-down and thus more Li depletion relative to Be.) The Li and Be abundances are correlated for stars in the temperature range of 5850 - 6680 K, similar to results from earlier work on Li and Be in F and G field stars. This indicates that the depletions are not just correlated– as is the only thing that can be claimed for the field stars– but are probably occurring together during main-sequence evolution. The Hyades G dwarfs have more Be than the sun; their initial Be may have been larger or they may not be old enough to have depleted much Be. For those Hyades stars which appear to have little or no depletion of Li or Be, the Li/Be ratio is found to be 75±30; the meteoritic ratio Li/Be is 78. The Hyades ratio is a representative value for the initial ratio in the material out of which the Hyades cluster was formed.

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Capella: Separating the Giants

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Images from the Faint Object Camera (FOC) on the *Hubble Space Telescope* (*HST*) are used to spatially separate the two giants of Capella (α Aurigae; HD 34029) for the first time at ultraviolet wavelengths. The images were obtained with broadband filters that isolate the wavelength regions 2500–3000 Å and 1300–1500 Å. The cool G8 giant is found to be weaker than the hot G1 giant by factors of around 4 and 17, respectively, in these bands. The latter factor is largely due to the much stronger G1 continuum at short wavelengths. No evidence is found for material lying between the two stars in the images.

In addition, the objective prisms of the FOC were used to obtain low resolution spectra from 1200 to 3000 Å, allowing individual emission lines from each star to be spatially separated. Cool star to hot star ratios for the emission lines H I Lyα, O I λ1305, Si II λ1816, C II λ1335, He II λ1640 and Si IV λ1393 are presented, showing that the cool giant is weaker than the hot giant by factors of 5–10 in these lines. The O I emission is only a factor 2.5 weaker in the cool giant most probably resulting from fluorescence in the extended atmosphere of the cool giant. The line ratios are compared with values derived from *International Ultraviolet Explorer* and *HST*/Goddard High Resolution Spectrograph spectra, which could separate the stars spectrally but not spatially. Reasonable agreement is found although the FOC ratios generally imply lower contributions from the cool giant.

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The Metallicity of CM Draconis

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We compare observations of the eclipsing binary system CM Draconis (hereafter CM Dra) with synthetic spectra computed using the stellar atmosphere code PHOENIX. High resolution infrared spectroscopic observations of six 0.05 micron-wide regions between 1.51 to 2.45μm, combined with previous work, particularly CM Dra's accurately known surface gravity, enable us to estimate its metallicity using detailed spectral synthesis. We find significant discrepancies between the observed and synthetic spectra throughout most of the region emphasising the need for higher quality atomic data in the infrared. Nevertheless, the $\Delta\nu = 2$ CO bands beyond 2.3 μm seem well modelled and metal-sensitive and thus high resolution spectra should be a most powerful diagnostic tool for spectroscopic analyses for M dwarfs and brown dwarfs. The CO bands indicate a metallicity of around −1 dex for CM Dra. This result is supported by observations of two M dwarfs of similar spectral type GJ 699 (Barnard's star) and GJ 725B. This result supports inferences from previous infrared work though does not agree with standard evolutionary models or optical analyses which both suggest an abundance for CM Dra close to that of the Sun.

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X-ray Emission from the Ultracool Dwarf LHS 2065

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We report the results of a 68 ksec long X-ray observation of the M9V ultracool dwarf star LHS2065 with the ROSAT high resolution imager (HRI). During the observations a major X-ray flare occurred with a peak X-ray luminosity of 4×10^{27} erg/sec and a total soft energy release of 2×10^{31} erg. In addition, another flare with smaller peak X-ray luminosity and energy release occurred. The X-ray observations were carried out half a year apart. In the first half of the observations no significant X-ray emission from LHS2065 could be detected, while in the second half in addition to flares also quiescent X-ray emission at a level of 2.3×10^{26} erg/sec was seen. LHS2065 belongs to the coolest hydrogen burning stars known. The ROSAT observations show that coronal emission may be quite common even among such very late-type stars.

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The Evolution of Galactic Beryllium and Boron Traced by Magnesium and Calcium

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Beryllium and boron abundances are consistently derived on the parameter scale of two recent uniform stellar Mg and Ca abundance studies– one utilizing NLTE parameters and abundances, the other assuming LTE. The results are used to explore the BeB-Mg and BeB-Ca relations at low metallicity as urged by Fields et al. (2000). The slope of all logarithmic BeB-MgCa relations– regardless of light element (Be or B), metallicity tracer (Mg or Ca), or parameter scale (NLTE or LTE)– is found to lie in the range $1.1 - 1.3$. These results using the α-elements Mg and Ca confirm the need for a metal-poor "primary" BeB production mechanism (perhaps in addition to standard GCR) previously inferred from BeB-Fe and questioned BeB-O relations.

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Solar Abstracts

Energy Balance in the Solar Transition Region. IV. Hydrogen and Helium Mass Flows with Diffusion

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In this paper we have extended our previous modeling of energy balance in the chromosphere-corona transition region to cases with particle and mass flows. The cases considered here are quasi-steady, and satisfy the momentum and energy balance equations in the transition region. We include in all equations the flow velocity terms and neglect the partial derivatives with respect to time. We present a complete and physically consistent formulation and method for solving the non-LTE and energy balance equations in these situations, including both particle diffusion and flows of H and He. Our results show quantitatively how mass flows affect the ionization and radiative losses of H and He, thereby affecting the structure and extent of the transition region. Also, our computations show that the H and He line profiles are greatly affected by flows. We find that line shifts are much less important than the changes in line intensity and central reversal due to the effects of flows. In this paper we use fixed conditions at the base of the transition region and in the chromosphere because our intent is to show the physical effects of flows and not to match any particular observations. However, we note that the profiles we compute can explain the range of observed high spectral and spatial resolution Lyman alpha profiles from the quiet Sun. We suggest that dedicated modeling of specific sequences of observations based on physically consistent methods like those presented here will substantially improve our understanding of the energy balance in the chromosphere and corona.

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Ultraviolet Coronagraph Spectrometer Observations of a High-latitude Coronal Hole with High Oxygen Temperatures and Next Solar Cycle Polarity

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We announce the resurgence of extreme ion properties in a large, high-latitude coronal hole observed above the north heliographic pole in February 2001 at solar maximum. The observations were taken with the Ultraviolet Coronagraph Spectrometer on the *Solar and Heliospheric Observatory*. These observations are part of an ongoing campaign to determine the plasma properties of coronal holes during the current solar cycle. In this Letter, we compare the observations and analysis of O VI $\lambda\lambda$1032, 1037 spectral lines of a high-latitude coronal hole in 2001 with observations of an equatorial solar maximum hole in 1999 and polar coronal holes observed near solar minimum (1996–1997). These lines provide spectroscopic diagnostics of O^{5+} velocity distributions and outflow velocities. The O VI line profiles show a narrow core and broad wings. The narrow core is attributed to foreground and background streamers and, possibly, dense polar plumes at the lowest observed heights. The broad wings are attributed to the coronal hole. The comparison of the coronal hole line widths shows that the O^{5+} perpendicular kinetic temperatures in the 2001 high-latitude hole are similar to those observed in polar coronal holes at solar minimum. These observations of extremely high ion kinetic temperatures (exceeding 10^8 K) at the north pole in 2001 occurred nearly simultaneously with the polarity change of the Sun's magnetic field, as seen in recent magnetogram data. This coronal hole in 2001 may represent the first manifestation of the negative polarity polar coronal holes that will dominate the Sun's open magnetic flux tubes at the next solar minimum. The reappearance of broad O VI profiles at a time when not all of the "new polarity" magnetic flux has migrated to the poles was an interesting development. The variations in coronal hole parameters with the solar cycle provide constraints on models of extended coronal heating.

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Dynamics of the Solar Chromosphere III. Ultraviolet Brightness Oscillations from TRACE

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We analyze oscillations in the solar atmosphere using image sequences from the *Transition Region and Coronal Explorer* (TRACE) in three ultraviolet passbands which sample the upper solar photosphere and low chromosphere. We exploit the absence of atmospheric seeing in TRACE data to furnish comprehensive Fourier diagnostics (amplitude maps, phase-difference spectra, spatio-temporal decomposition) for quiet-Sun network and internetwork areas with excellent sampling statistics. Comparison displays from the ground-based Ca II H spectrometry that was numerically reproduced by Carlsson & Stein are added to link our results to the acoustic shock dynamics in this simulation. The TRACE image sequences confirm the dichotomy in oscillatory behaviour between network and internetwork and show upward propagation above the cutoff frequency, the onset of acoustic shock formation in the upper photosphere, phase-difference contrast between pseudo-mode ridges and the interridge background, enhanced three-minute modulation aureoles around network patches, a persistent low-intensity background pattern largely made up of internal gravity waves, ubiquitous magnetic flashers, and low-lying magnetic canopies with much low-frequency modulation. The spatio-temporal occurrence pattern of internetwork grains is found to be dominated by acoustic and gravity wave interference. We find no sign of the high-frequency sound waves that have been proposed to heat the quiet chromosphere, but such measurement is hampered by non-simultaneous imaging in different passbands. We also find no signature of particular low-frequency fluxtube waves that have been proposed to heat the network. However, internal gravity waves may play a role in their excitation.

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Magnetic Properties of Photospheric Regions with Very Low Magnetic Flux

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[2] Instituto de Astrofísica de Canarias, E-38200, La Laguna, Tenerife, Spain The magnetic properties of the quiet Sun are investigated using a novel inversion code, FATIMA, based on the Principal Component Analysis of the observed Stokes profiles. The stability and relatively low noise sensitivity of this inversion procedure allows for the systematic inversion of large data sets with very weak polarization signal. Its application to quiet Sun observations of network and internetwork regions reveals that a significant fraction of the quiet Sun contains kilogauss fields (usually with very small filling factors) and confirms that the pixels with weak polarization account for most of the magnetic flux. Mixed polarities in the resolution element are also found to occur more likely as the polarization weakens.

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The Effect of Coherent Scattering on Radiative Losses in the Solar Ca II K line

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We investigate the influence of partial frequency redistribution (PRD) on radiative cooling due to the Ca II K line in a hydrostatic model of the quiet-Sun, and in a series of twenty snapshots from a chromospheric radiation-hydrodynamics simulation. The net radiative rates in the K line were calculated through these models with three different frequency redistribution formalisms: complete redistribution (CRD), angle-averaged PRD and angle-dependent PRD. It is found that the approximation of CRD generally leads to an overestimate of the net radiative rates, due to its neglect of coherent scattering. Compared to the more realistic full angle-dependent solution angle-averaged PRD provides accurate emergent profiles and cooling rates in the hydrostatic model, and also provides accurate instantaneous profiles in the dynamical snapshots, even when considerable macroscopic velocities are present. Instantaneous angle-averaged cooling rates in the dynamical snapshots may be different at times, but on average cooling is very similar to the angle-dependent case. In the temperature minimum the Ca II K line provides, on average, more cooling in the dynamic chromosphere at the same column mass than in the hydrostatic model. It provides less cooling in the chromosphere.

Finally, we formulate an approximation for angle-averaged redistribution in a moving atmosphere employing the unshifed redistribution function. This approximation is easy to implement in existing numerical codes and should provide an efficient method for PRD transfer solutions in dynamic models without loss of accuracy in emergent profiles and radiative cooling rates.

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Height and Dynamics of the Quiet Solar Chromosphere at the Limb

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In this paper we present observations of He I 1083.0 nm, He D_3 587.6 nm and Hβ 486.1 nm taken at various positions at the solar limb. We determine and compare the emission of the lines in terms of line-parameters. The height of the chromosphere as seen in the helium lines varies in space and time and reaches values between 1100 and 1800 km above the continuum and is the same for both helium lines within the errors of the measurement. From a time-sequence of slit–spectra of about 23 min we study the oscillation signature of the chromosphere near the solar limb. We find velocity oscillations in He I 1083.0 nm that do not drop to zero near the limb as would be expected of vertically oriented oscillations, we even get horizontal oscillations in the off–limb emission data of both helium lines.

Accepted by A&A

For preprints contact: kmuglach@aip.de

Low-Mass and Sub-Stellar Abstracts

No Planet for HD 166435

D. Queloz[1], **G. W. Henry**[2], **J. P. Sivan**[3], **S. L. Baliunas**[2,4,5], **J. L. Beuzit**[6], **R. A. Donahue**[4,5], **M. Mayor**[1], **D. Naef**[1], **C. Perrier**[6], **S. Udry**[1]

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[4] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[5] Mount Wilson Observatory, 740 Holladay Road, Pasadena, CA 91106 USA
[6] Observatoire de Grenoble, 414 rue de la Piscine, Domaine Universitaire de St Martin d'Hières, 38041, France

The G0 V star HD 166435 has been observed by the fiber-fed spectrograph ELODIE as one of the targets in the large extra-solar planet survey that we are conducting at the Observatory of Haute-Provence. We detected coherent, low-amplitude, radial-velocity variations with a period of 3.7987 days, suggesting a possible close-in planetary companion. Subsequently, we initiated a series of high-precision photometric observations to search for possible planetary transits and an additional series of Ca II H and K observations to measure the level of surface magnetic activity and to look for possible rotational modulation. Surprisingly, we found the star to be photometrically variable and magnetically active. A detailed study of the phase stability of the radial-velocity signal revealed that the radial-velocity variability remains coherent only for durations of about 30 days. Analysis of the time variation of the spectroscopic line profiles using line bisectors revealed a correlation between radial velocity and line-bisector orientation. All of these observations, along with a one-quarter cycle phase shift between the photometric and the radial-velocity variationss, are well explained by the presence of dark photospheric spots on HD 166435. We conclude that the radial-velocity variations are not due to gravitational interaction with an orbiting planet but, instead, originate from line-profile changes stemming from star spots on the surface of the star. The quasi-coherence of the radial-velocity signal over more than two years, which allowed a fair fit with a binary model, makes the stability of this star unusual among other active stars. It suggests a stable magnetic field orientation where spots are always generated at about the same location on the surface of the star.

Accepted by A&A

For contact: didier.queloz@obs.unige.ch

For preprints: astro-ph/0109491

The Spectra of T Dwarfs I: Near-Infrared Data and Spectral Classification

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We present near-infrared spectra for a sample of T dwarfs, including eleven new discoveries made using the Two Micron All Sky Survey. These objects are distinguished from warmer (L-type) brown dwarfs by the presence of methane absorption bands in the 1–2.5 micron spectral region. A first attempt at a near-infrared classification scheme for T dwarfs is made, based on the strengths of CH_4 and H_2O bands and the shapes of the 1.25, 1.6, and 2.1 micron flux peaks. Subtypes T1 V through T8 V are defined, and spectral indices useful for classification are presented. The subclasses appear to follow a decreasing T_{eff} scale, based on the evolution of CH_4 and H_2O bands and the properties of L and T dwarfs with known distances. However, we speculate that this scale is not linear with spectral type for cool dwarfs, due to the settling of dust layers below the photosphere and subsequent rapid evolution of spectral morphology around $T_{eff} \sim 1300$–1500 K. Similarities in near-infrared colors and continuity of spectral features suggest that the gap between the latest L dwarfs and earliest T dwarfs has been nearly bridged. This argument is strengthened by the possible role of CH_4 as a minor absorber shaping the K-band spectra of the latest L dwarfs. Finally, we discuss one peculiar T dwarf, 2MASS 0937+2931, which has very blue near-infrared colors ($J\text{-}K_s = -0.89\pm0.24$) due to suppression of the 2.1 micron peak. The feature is likely caused by enhanced collision-induced H_2 absorption in a high pressure or low metallicity photosphere.

Accepted by ApJ, to appear in v. 563 December 2001

For preprints contact: adam@astro.ucla.edu

For preprints via ftp or WWW: http://www.gps.caltech.edu/ pa/adam/classification/index.html

Four Brown Dwarfs in the Taurus Star-Forming Region

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[5] Laboratoire d'Astrophysique de Grenoble, BP 53, 38041 Grenoble, France

We have identified four brown dwarfs in the Taurus star-forming region. They were first selected from R and I CCD photometry of 2.29 square degrees obtained at the Canada-France-Hawaii telescope. Subsequently, they were recovered in the 2MASS second incremental data release point source catalog. Low-resolution optical spectra obtained at the William Herschel telescope allow us to derive spectral types in the range M7–M9. One of the brown dwarfs has very strong Hα emission (EW=-340 Å). It also displays Brγ emission in an infrared spectrum obtained with IRCS on the Subaru telescope, suggesting that it is accreting matter from a disk. The KI resonance doublet and the NaI subordinate doublet at 818.3 and 819.5 nm in these Taurus objects are weaker than in field dwarfs of similar spectral type, consistent with low surface gravities as expected for young brown dwarfs. Two of the objects are cooler and fainter than GG Tau Bb, the lowest mass known member of the Taurus association. We estimate masses of only 0.03 $M_\odot$ for them. The spatial distribution of brown dwarfs in Taurus hints to a possible anticorrelation between the density of stars and the density of brown dwarfs.

Accepted by ApJ

For preprints contact: ege@ifa.hawaii.edu

Ph.D. Thesis Abstracts

The Discovery and Characterization of Methane-bearing Brown Dwarfs and the Definition of the T Spectral Class

Adam J. Burgasser

Thesis work conducted at: Physics Dept., California Institute of Technology, USA

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Ph.D dissertation directed by: Michael E. Brown & J. Davy Kirkpatrick

Ph.D degree awarded: August 2001

I present the discovery of 18 T dwarfs, brown dwarfs exhibiting CH_4 absorption analogous to Gliese 229B, identified in the Two Micron All Sky Survey. Follow-up spectroscopic observations reveal the presence of strong H_2O and CH_4 bands in these objects, as well as broadened Na I and K I absorption in the red optical; fine lines of K I, Cs I, and Rb I; and FeH absorption at 9896 Å. Three objects are analyzed in detail; the widely-separated companion brown dwarf Gliese 570D, the coolest known brown dwarf with T_{eff} = 810±45 K; the active T dwarf 2MASS 1237+6526, whose unique and steady Hα emission may be the result of Roche-lobe overflow accretion from a closely-separated companion; and 2MASS 0559-1404, the brightest T dwarf currently known, which appears to be overluminous but unresolved in HST images. The variation in spectral features amongst these objects and those identified by the Sloan Digital Sky Survey have been used to derive a near-infrared spectral classification scheme, tied to the observed strengths of H_2O and CH_4 bands, color ratios, and K-band spectral morphology. The grid of subclasses segregates the currently known population into seven distinct groups, ranging from T1 V to T8 V. I show that the possible presence of CH_4 in the L7 V DENIS 0205-1159AB argues for few subtypes between the latest known L dwarfs and the earliest T dwarfs. One peculiar object, 2MASS 0937+2931, has a highly suppressed K-band peak, likely due to increased H_2 opacity in a high-gravity or low-metallicity atmosphere. Examination of absolute brightness and effective temperature across the L/T transition indicates rapid evolution of spectral features, possibly linked to heterogenous cloud coverage as condensibles rain out of the photosphere. Finally, I have used the T dwarf search samples to constrain the substellar field mass function. Through rigorous analysis of selection biases and Monte Carlo simulations, I show that my results are consistent with a power-law mass function scaling as $0.5 < \alpha < 1.0$, consistent with young stellar cluster surveys but significantly less than current estimates in the field.

Thesis-related Publications: ApJ, 522, L65; ApJ, 531, L57; AJ, 120, 473; AJ, 120, 1100; ApJ, 563, in press

UPCOMING MEETING

Sunspots and Starspots
1st Potsdam Thinkshop
First Announcement and Call for Papers

May 6 - 10, 2002
Potsdam, Germany
Web site: www.aip.de/thinkshop/

The Astrophysical Institute Potsdam (AIP) is pleased to announce its first international Work- and Thinkshop on the physics of Sunspots and Starspots. The meeting will be held in the ASTRON Hotel Voltaire downtown Potsdam and is intended to bring together active researchers to discuss the current situation and future projects in the fields of Sunspots and Starspots and their related magnetic fields. Due to the narrow topic and the medium-sized meeting location, we must limit the number of participants to 100. Note that all participants will be accommodated in the meeting hotel.

Scientific Questions

In this first Thinkshop, we aim to identify the differences and analogies of Sunspots and starspots. What could the detailed solar observations tell the stellar colleague and, vice versa, how can stellar data constrain models for solar spots? What is the state-of-the-art in observing and modelling solar and stellar magnetic fields and what is foreseen for the near future? Can we use the Sun as a model star to interpret the surface structure as a fingerprint of the underlying dynamo? Part of the meeting will be dedicated to new and novel instrumentation, solar and stellar alike, that will help to disentangle the one or other paradigm in the field.

Speakers and Posters

A first list of invited speakers will be presented in the second announcement, but we already emphasize that equal time will be allocated to discussions and to short paper presentations. We now invite all those interested to contribute papers to submit your ideas and suggestions to `kstrassmeier@aip.de`. Poster space will be available in a room adjacent to the lecture hall and will remain open during the entire meeting. We suggest speakers to bring also a poster with the topic of their talk.

Registration

A web-based registration form will be available soon. Please visit the meeting homepage. Registration fee will be approximately 200 Euros and will cover the proceedings, an abstract booklet, coffee and cake, and daily lunch at the hotel. It will not include the social program.

Proceedings

Instead of a classical proceedings, we intend to publish real papers in a dedicated volume of a refereed journal, as was done previously, e.g., for the first round from XMM in Astronomy & Astrophysics Vol. 365 (2001, L1-L344). Instead of A&A, we will publish the papers in a dedicated issue of Astronomische Nachrichten / Astronomical Notes (AN) without page charges (check out http://www.aip.de/AN). Each paper will be refereed and treated as a regularly submitted paper, just that it will appear in a dedicated issue. Therefore, no strict page limits are imposed on these contributions, but it requires original articles. The idea is that the authors bring their paper(s) to the meeting where it will be refereed anonymously by someone among the participants. The deadline for final submission will then be four weeks after the meeting, or you may even resubmit during the meeting. The editorial office will be located at the meeting location. When accepted, AN provides full electronic access including ADS/CDS cross referencing including an abstract service. MPEG or animated gif movies can be published as well for no extra costs. For more details please check our home page at http://www.aip.de/thinkshop/.

Further Mailings

Hotel information will be detailed on the Web and with the second announcement during early 2002. The third announcement, which will be distributed approximately March 2002, will contain the final list of speakers as well as final details of the social program. (*cont.* →)

Members of the Scientific Organizing Committee (SOC): C. Keller (U.S.A.), M. Knoelker (U.S.A.), J. L. Linsky (U.S.A.), O. v.d. Luehe (Germany), N. E. Piskunov (Sweden), J. B. Rice (Canada), M. Rodonó (Italy), S. Solanki (Germany), J. O. Stenflo (Switzerland), K. G. Strassmeier (Germany, Chair), N. O. Weiss (U.K.), S. White (U.S.A.)

Local Organizing Committee (LOC): H. Balthasar, K. Götz, T. Granzer, B. Kliem, K. Muglach, G. Rüdiger, J. Staude, M. Steffen, K. G. Strassmeier, A. Washuettl, M. Weber

UPCOMING MEETING

Stellar Rotation
IAU Symposium No. 215
First Announcement

November 11 - 15, 2002
Cancun, Yucutan, Mexico
Web site: http://www.astro.ugto.mx/∼eenens/iau215/

The IAU Executive Committee has agreed to our proposal for the above mentioned IAU symposium.

SCOPE OF THE SYMPOSIUM:

Since the discovery of the solar rotation by Galileo Galilei in 1612, the rotation of celestial bodies has remained a topic of interest in Astrophysics. A major revival of the study of stellar rotation has occured over recent years. The organisation of an IAU Symposium on Stellar Rotation now appears to be timely, since the last IAU meeting specifically devoted to rotation was IAU Colloquium 4 "Stellar Rotation" by Arne Slettebak in 1969.

The last years have seen new observations of rotational velocities in solar types stars, in red giants, in intermediate and massive stars, which put new constraints on the evolution of the angular momentum. Anomalies of chemical abundances also constrain the effects of rotation, these are: the Li abundances in low mass stars, the CNO anomalies in red giants, in OB stars and in A- and B-supergiants. Some recent observations in the Galaxy, the LMC and SMC suggest possible differences of v sini and of the related N/C excesses between galaxies. For the Sun, the results on the constancy of the angular velocity in the interior and on the thickness of the tachocline offer major constraints on the hydrodynamics of rotation. The velocities of rotation in binaries are a test of the tidal interaction and of the synchronisation mechanisms. Last but not least, the asymmetric nebulae around Luminous Blue Variables, WR and Be stars, and around planetary nebulae are also signatures of rotational effects and mass loss in these advanced stages.

On the theoretical side, there are new hydrodynamical studies of the various rotational instabilities and of the meridional circulation. There are 2D- and 3D-hydrodynamic simulations, new studies of the synchronisation in binaries and of the interaction between rotation, mass loss, convection and magnetic chromospheric coupling. New models of the evolution of rotating stars are currently being calculated by several groups for low and high mass stars from the MS to the final stages.(We do not intend to cover the theory of star formation and pre-MS evolution because it is a whole subject in itself). The many broad consequences of stellar rotation will be analysed: for the age determinations, the star populations, the chemical yields at low and high metallicities, the nature of the supernovae and the rotation periods of pulsars.

We shall take the opportunity, at this meeting, to honour Dr. Jean-Paul Zahn, who has so much contributed to our understanding of stellar rotation.

SUPPORTING INSTITUTIONS:

This meeting is supported by IAU Division IV (Stars), IAU commission No. 35 "Stellar Constitution" (sponsoring Commission), Commission No. 27 "Variable Stars", Commission No. 29 "Stellar Spectra" and by Commission No. 36 "Theory of Stellar Atmospheres".

SOC:

Beatriz Barbuy (Brasil); Joergen Christensen-Dalsgaard (Danemark); Philippe Eenens (co-chair, Mexico); Ian Howarth (UK); Gloria Koenigsberger (Mexico); Henny Lamers (The Netherlands); Andre Maeder (co-chair, Switzerland); Sabatino Sofia (USA); Don VandenBerg (Canada); Jean-Paul Zahn (France)

LOC:

Philippe Eenens (chairman, Guanajuato); Gloria Koenigsberger (UNAM); Jane Arthur (UNAM); Octavio Cardona (INAOE); Luis Corral (IAC); Cesar de la Cruz (Universidad de Veracruz); Filiberto Gonzalez (Guanajuato); Leticia Martinez (Guanajuato); Jaime Noriega (Guanajuato). (*cont.* →)

VENUE, DATE, EXCURSION:

The resort of Cancun in Mexico has been chosen, because it offers many direct airline connections, excellent conference and accomodation facilities, together with the beauty of Caribbean Sea and the high cultural interest of the Maya sites in the Yucatan Peninsula. An excursion to the famous site of Chichen Itza will be organized on Saturday 16 November.

Participants are expected to arrive in Cancun not later than Sunday 10 November, and to depart from Cancun not earlier than Saturday 16 November 2002.

PARTICIPATION AND REGISTRATION:

All participants, including invited speakers and SOC/LOC members, must register. Following the Rules for IAU Sponsored Meetings "participation in Symposia is by invitation of the SOC chairperson. Invitations may be sought by suitably qualified scientists working in the field". If you are interested to participate in the symposium, PLEASE FILL OUT THE ENCLOSED PRE-REGISTRATION FORM AND RETURN IT BEFORE DECEMBER 15, 2001, TO:

Prof. A. Maeder, co-chairman of the SOC (andre.maeder@obs.unige.ch)

with a copy to the LOC (iau215@astro.ugto.mx)

PRELIMINARY SCIENTIFIC PROGRAMME:

The scientific programme will consist of invited reviews (35 min) and invited talks (15 min). Oral and poster presentations will be accepted upon review by the SOC. A list of the invited speakers, who will be contacted over the coming months, and a preliminary programme will be given in the Second Announcement, to be distributed at the beginning of 2002.

The programme will include the following topics:

I . OBSERVATIONS OF ROTATING STARS: Calibrations of rotational velocities, Rotation of pre-MS stars, Rotation of intermediate and low mass MS stars, Rotation of red giants, HB and AGB stars, Rotation of O, B, A stars and supergiants, Rotation of Be, B[e], LBV and WR stars, Rotation in binary stars, Rotation and pulsations

II . ROTATION IN RELATION TO ABUNDANCES AND MAGNETIC FIELDS: Rotation and chemical anomalies in OB stars and supergiants, Rotation in Am and Ap stars, Rotation and Li, CNO abundances in low mass stars and red giants, Observations of rotation and magnetic activity, X-rays, Braking of rotation by magnetic coupling

III: ROTATION AND STELLAR PHYSICS: Stellar interiors, The instabilities driven by rotation, Rotational transport processes, Internal rotation and magnetic field, Rotation and pulsations, Stellar winds: Rotation and asymmetric nebulae, Stellar winds and rotation, Disks formation by rotational ejection, Be-stars

IV: ROTATION AND STELLAR EVOLUTION: The Sun: The internal solar rotation from helioseismology, Constraints on the physical processes, the tachocline, Models of solar evolution with rotation, 2-D and 3-D models for solar interior.
Other stars: Models for lower and intermediate masses, red giants, Evolution with rotation for massive stars and supergiants, Evolution close to the break-up limit, Evolution of rotation in binaries

V : FINAL STAGES, NUCLEOSYNTHESIS: Rotation and WD properties: observations and theory, Effects of rotation on the chemical abundances and yields, Pre-supernova evolution with rotation, Comparisons with pulsar periods, 2-D models of supernova explosions, Core collapse and gamma-ray bursts, Concluding remarks and perspectives

CONTACTS:

SOC:

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email: andre.maeder@obs.unige.ch eenens@astro.ugto.mx

LOC:

IAU 215 Dept Astronomia email:iau215@astro.ugto.mx University of Guanajuato phone: 52-4 732 9607 GUANAJUATO GTO 36000 fax : 52-4 732 0253 Mexico

http://www.astro.ugto.mx/~eenens/iau215/ (*continued* →)

Please cut here and send it by email BEFORE DECEMBER 15, 2001 to: andre.maeder@obs.unige.ch with a copy to: iau215@astro.ugto.mx

******************** * Pre-Registration * ********************

IAU Symposium No. 215

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* S T E L L A R   R O T A T I O N *

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Cancun, Yucatan, Mexico, 11 - 15 November 2002

name:

institute address:

tel:

fax:

e-mail:

I would like to participate in IAU Symposium No.215: yes / maybe

and present a contribution yes / maybe / no

The title of my intended contribution is:

preference: oral / poster

The number of accompanying persons I intend to bring along is:

date:

JOB OPENING

Research Positions
Centre for Astrophysics
University of Porto (Portugal)

CAUP accepts applications for positions of

- **Invited Researcher** - from one to twelve months
- **Advanced Post-Doctoral** - one year, renewable up to six years (prior experience as a postdoc for a minimum of four years required)
- **Post-Doctoral** - one year, renewable up to six years

Review of applications will be done regularly until these positions are filled, beginning on the **13th of October 2001**. Future review dates will be announced at the WWW site.

CAUP is a young Research Institute with a staff of 19 researchers, Ph.D. students and two Master Programs, involving more than 40 postgraduate students. The Institute is located at the Campus of the University.

Current research projects cover *Stellar Astrophysics*, *Extragalactic Astronomy* and *Cosmology* involving both observations and theory. Portugal is a member of ESO and also of ESA. CAUP staff uses regularly the ESO facilities and other international observatories and participates in some of the current missions of ESA as well as in the preparation of future missions. There is a wide international collaboration on research and teaching projects. For further information see *http://www.astro.up.pt/*.

Applicants should forward a curriculum vitae, list of publications, a brief description of past experience and of research interests and a proposal for future research projects. For applications to Post-Doctoral positions the name, address and email of three referees are also required (reference letters will be requested to these persons).

Inquiries on the positions may be directed to

Prof M. Teresa V.T. Lago (mtlago@astro.up.pt)
Centro de Astrofísica
Universidade do Porto
Rua das Estrelas
P-4150-762 Porto, PORTUGAL

Fax 351-226 089 831

JOB OPENING

Postdoctoral Fellowship in Stellar Astrophysics
GRAAL
Montpellier University (France)

The astrophysics research group at Montpellier University (France) MAY have a postdoctoral position starting October 1, 2002 (or shortly thereafter), for a period of 12 months (with a possible 6 months extension).

Research Activities at GRAAL include: model atmospheres for late-type stars, stellar evolution, chemical analysis of metal-poor stars, cool stars, AGB and post-AGB stars, circumstellar envelopes, winds, planetary nebulae.

Further information may be obtained on:

http://www.isteem.univ-montp2.fr/GRAAL/index.html

Application are invited for this postdoctoral position in stellar physics and spectroscopy. Only candidates under 35 years before december 31, 2002, and from the following countries will be considered:
Argentina, Australia, Brazil, Canada, Chile, China, Corea, Czech Republic, Hungary, India, Israel, Japan, Mexico, New-Zeeland, Norway, Poland, Romania, Russia, Slovakia, South-Africa, Switzerland, Turkey and USA.

The candidates must have a Ph.D. that has not been prepared in a french university.

The monthly salary will be around 1 830 Euros ($\sim$ 1 600 US \$),

starting October 1, 2002 (or in any case before the end of 2002).

Applications including a curriculum, a 1 or 2 pages research project and two references (name, address, and email) should be sent before December 15, 2001 to the director:

Gerard Jasniewicz

GRAAL cc072

Université de Montpellier II

F-34095 Montpellier cedex 5

France

or by email to gjasniew@graal.univ-montp2.fr

For more information please contact Bertrand Plez: plez@graal.univ-montp2.fr

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` .