COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Lithium in Blanco 1: Implications for Stellar Mixing

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We obtain lithium abundances for G and K stars in Blanco 1, an open cluster with an age similar to, or slightly younger than, the Pleiades. We critically examine previous spectroscopic abundance analyses of Blanco 1 and conclude that while there were flaws in earlier work, it is likely that Blanco 1 is close in overall metallicity to the older Hyades cluster and more metal-rich than the Pleiades. However, we find Blanco 1 has Li abundances and rotation rates similar to the Pleiades, contradicting predictions from standard stellar evolution models, in which convective pre-main sequence (PMS) Li depletion should increase rapidly with metallicity. If the high metallicity of Blanco 1 is subsequently confirmed, our observations imply (1) that a currently unknown mechanism severely inhibits PMS Li depletion, (2) that additional non-standard mixing modes, such as those driven by rotation and angular momentum loss, are then responsible for main sequence Li depletion between the ages of Blanco 1 and the Hyades, and (3) that in clusters younger than the Hyades, metallicity plays only a minor role in determining the amount of Li depletion among G and K stars. These conclusions suggest that Li abundance remains a useful age indicator among young ($< 700\,$Myr) stars even when metallicities are unknown. If non-standard mixing is effective in Population I stars, the primordial Li abundance could be significantly larger than present day Population II Li abundances, due to prior Li depletion.

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Oxygen in Unevolved Metal-Poor Stars from Keck UV HIRES Spectra

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The determination of the abundance of oxygen (O) is important in our understanding of mass–spectrum of previous generations of stars, the evolution of the Galaxy, stellar evolution, and the age–metallicity relation. We have measured O in 24 *unevolved* stars with Keck HIRES observations of the OH lines in the ultraviolet spectral region at a spectral resolution of ∼45,000. The spectra have high signal–to–noise, typically 60 - 110, and high dispersion, 0.022 Å per pixel. Very special care has been taken in determining the stellar parameters in a consistent way and we have done this for two different, plausible temperature scales. The O abundance from OH has been computed by spectrum synthesis techniques for all 24 stars plus the sun for which we have a Keck spectrum of the daytime sky. In addition, we determined O abundances from the O I triplet with our stellar parameters and the published equivalent widths of the three O I lines from six sources. The comparison of data analyzed with the same, consistently–determined, parameter sets show generally excellent agreement in the O abundances; differences in the origin of the models (not the parameters) may result in abundance differences of 0.07 to 0.11 dex. We show that the O abundances from OH and from O I are reliable and independent and average the two for the adopted O. This averaging has the great benefit of neutralizing uncertainties in the parameters since OH and O I strengths depend on effective temperature and gravity in opposite directions. For these cool, unevolved stars we find that O is enhanced relative to Fe with a completely linear relation between [O/H] and [Fe/H] over three orders of magnitude with very little scatter; taking the errors into account in determining the fits, we find [O/H] = +0.66 (±0.02) [Fe/H] + 0.05 (±0.04). The O abundances from 76 disk stars of Edvardsson *et al.* have a measured slope of 0.66 (identical to our halo dwarf stars) and fit this relationship smoothly. The relation between [O/Fe] and [Fe/H] is robustly linear and shows no sign of a break at metallicities between −1.0 and −2.0, as has been discussed by others. At low metallicities, [Fe/H] < -3.0, [O/Fe] is $>+1.0$. The fit to this relationship (taking the errors into account) is [O/Fe] = −0.35 (±0.03) [Fe/H] + 0.03 (±0.05). The enrichment of O is probably still from massive stars and Type II supernovae; however, the absence of a break in [O/Fe] vs [Fe/H] runs counter to traditional galactic evolution models, and the interplay of supernovae Type II's and Type Ia's in the production of O and Fe should be re-examined. It appears that either Fe or O can be used as a chronometer in studies of galactic evolution.

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The Optical Mass-Luminosity Relation at the End of the Main Sequence (0.08 to 0.20 $M_\odot$)

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The empirical mass-luminosity relation at M_V is presented for stars with masses 0.08 to 0.20 $M_\odot$ based upon new observations made with Fine Guidance Sensor #3 on the Hubble Space Telescope. The targets are nearby, red dwarf multiple systems in which the magnitude differences are typically measured to ±0.1 mag or better. The M_V values are generated using the best available parallaxes and are also accurate to ±0.1 mag because the errors in the magnitude differences are the dominant error source. In several cases this is the first time the observed sub-arcsecond multiples have been resolved at optical wavelengths. The mass-luminosity relation defined by these data reaches to M_V =

18.5 and provides a powerful empirical test for discriminating the lowest mass stars from high mass brown dwarfs at wavelengths shorter than 1μm.

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Radii and Effective Temperatures for G, K And M Giants and Supergiants

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Interferometrically determined angular diameters obtained at the Palomar Testbed Interferometer (PTI) for 69 giant and supergiant stars are presented. Spectral types of the 59 giant stars generally lie between G6 and M6, although a B7 giant is included; the 9 bright giants and supergiants have spectral types between F5 and M5. Comparison of the results to those from the IOTA interferometer indicate no statistically significant difference between the two datasets. The use of Hipparcos parallaxes (Perryman et al. 1997) allows us to directly measure linear sizes for these stars, which range in size from 10 to 260 solar radii. In conjunction with previous results as reported by Dyck et al. (1996, 1998), the total of 113 giant stars provide empirically determined dependencies of effective temperature and linear radius upon spectral type and V-K color.

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X−ray Spectroscopy of Rapidly Rotating, Late-type Stars

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We present an X-ray spectroscopic analysis of two active dwarf stars with extremely short rotation periods, HD 197890 (Speedy Mic) and Gliese 890, using X-ray data acquired with the *ASCA* Observatory. We analyze the X-ray spectrum of Speedy Mic in two separate time intervals, one corresponding to an apparent stellar flare, the other to 'quiescence' or the nonflaring state. We also present a re-analysis of the *ASCA* spectrum of the M dwarf stellar binary YY Gem, during both quiescent and flaring states. We use the recently updated MEKAL plasma code to model these spectra and find that a minimum of two temperature components are required to obtain good fits for all three stars. The inferred emission measures of the hot components in YY Gem and Speedy Mic, and the temperature of the hot component in the case of YY Gem, increase significantly during the observed X-ray flares, in agreement with previous studies of similar stellar X-ray flares. In addition, metal abundances that are low compared to the solar photospheric values are preferred (but not required) for the quiescent coronae of Gliese 890 and Speedy Mic, while, for the quiescent corona of YY Gem, subsolar metal abundances are required and solar-abundance models can be ruled out with high confidence.

We combine the results of this study with those of previous *ASCA* and *ROSAT* analyses of late-type dwarf stars with known rotation rates to obtain a sample of 17 G, K and M dwarfs. We find a strong correlation of the X-ray to bolometric luminosity ratio, L_x/L_{bol}, both with the rotation period and the Rossby number (R_o), in agreement with previous studies. Using a homogeneous subset of 10 dwarfs for which we have purely *ASCA*-derived temperatures and elemental abundances, we find that the temperature of the hottest component present in their coronae is correlated with this luminosity ratio, as expected. Finally, we note that the Fe abundances for all active dwarf stars having normalized X-ray luminosities log $(L_x/L_{bol}) > -3.7$ are significantly sub-solar, whereas the Fe abundances in the less active stars are within a factor of two of the solar value.

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The Outer Atmosphere of α Tau. 1. A New Chromospheric Model

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A new model of the chromosphere of α Tau (K5 III) has been developed. The lower part of the model is based on an earlier one designed mainly to fit the Ca II H and K lines. The new model extends through the upper chromosphere, to account for lines of C I, C II, Si II, and Mg II and into the transition region up to 10^5K to account for emission from C IV. It is based on observations made with the Goddard High-Resolution Spectrograph (GHRS) on the Hubble Space Telescope (HST). The model produces fluxes that for collisionally excited lines agree to within a factor of two with those observed and in particular gives an improved fit to the C II (uv1) lines. Thus, the collisionally excited lines can be accounted for by a plane-parallel, hydrostatic, one-component atmosphere. The new model also gives an improved fit to the O I (uv2) lines, which depend on the H Lyman β flux.

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The Outer Atmosphere of α Tau (K5 III). 2. Fluorescent Lines

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The Goddard High Resolution Spectrograph (GHRS) on the Hubble Space Telescope (HST) has been used to observe α Tau. The resulting spectra contain many sharp fluorescent lines. Most of these have been identified as lines of Fe II, Ca II, and H_2, radiatively excited by Lyman α. The chromospheric model developed in an accompanying paper has been used to calculate the fluxes in these lines. The Ca II lines have been modelled with a full radiative transfer calculation, but the Fe II and H_2 systems are more complex and, for these, a simpler calculation has been made. Overall, the trend in the Fe II line fluxes provides evidence for a multi-component model of the atmosphere, a chromosphere with intrusions of hotter material or vice versa. The hotter material could be in shocks propagating through the chromosphere. Comparisons of the observed and calculated fluxes of individual lines of Fe II show that some atomic data need to be improved. The analysis of the H_2 lines was restricted by a lack of suitable molecular data. The two observed Ca II lines are reproduced to within a factor of 2.

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Optimizing the Opacity Sampling Method

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Modern computers allow solutions of the radiative transfer problem at a large number of frequencies during the iterative process of computing a detailed line-blanketed hydrostatic model atmosphere. However, the computing time increases approximately linearly with the number of frequency points. For computationally more complex and time-consuming problems, such as dust driven winds or pulsating AGB stars, it is therefore often not feasible to solve the radiative transfer problem for more than a single (i.e. mean or constant opacity) or a very modest number of frequencies. This paper analyzes how to optimize the selection of frequency points in particular when solving the radiative transfer problem at a very small number of points. We compute opacity sampled hydrostatic model atmospheres based on a large number of opacity sampling frequency points (of the order of 10.000), and successively reduce the number of frequencies in order to quantify the statistical error in the model structure introduced by a too coarse sampling. The results are compared to hydrostatic model atmospheres obtained by using other opacity approximations (Rosseland

mean, straight means, constant opacity). We conclude that a considerable improvement in the accuracy of the model structure over such approximations can be achieved with a very modest number (20 - 50) of sampling frequencies, and give recommendations on how to choose the frequencies optimally.

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The Distance to NGC 6397 by M-Subdwarf Main-Sequence Fitting

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Recent years have seen a substantial improvement both in photometry of low luminosity stars in globular clusters and in modelling the stellar atmospheres of late-type dwarfs. We build on these observational and theoretical advances in undertaking the first determination of the distance to a globular cluster by main-sequence fitting using stars on the lower main sequence. The calibrating stars are extreme M subdwarfs, as classified by Gizis (1997), with parallaxes measured to a precision of better than 10%. Matching against King et al's (1998) deep (V, (V-I)) photometry of NGC 6397, and adopting $E_{B-V} = 0.18$ mag, we derive a true distance modulus of 12.13±0.15 mag for the cluster. This compares with $(m\text{-}M)_0 = 12.24 \pm 0.1$ derived through conventional main-sequence fitting in the (V, (B-V)) plane. Allowing for intrinsic differences due to chemical composition, we derive a relative distance modulus of $\delta(\mathrm{m} - \mathrm{M})_0 = 2.58$ mag between NGC 6397 and the fiducial metal-poor cluster M92. We extend this calibration to other metal-poor clusters, and examine the resulting RR Lyrae (M_V, [Fe/H]) relation.

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Solar Abstracts

SUMER Observations of the Quiet Sun Transition Region

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We present new results from observations of the quiet Sun taken with the SUMER spectrograph on the *SOHO* spacecraft. This study includes line and continuum emission covering a wide range of temperatures, and the data have been used to create a number of intensity maps with a field of view of $\sim 60 \times 300$ and a spatial resolution of ~ 1 . These maps reveal bright features that extend from ~ 6000 K to ~ 2 MK, indicating that much of the observed transition region emission arises in an atmospheric interface between the chromosphere and corona. The emission line intensities over our field of view vary by up to two orders of magnitude, and have log-normal distributions suggestive of small scale magnetic fragmentation. We find empirical evidence for a power law relationship between line emission and electron density, with an exponent in the range ~ 0.3 to 1.0. Possible temperature dependence of the exponent is reflected in the slope of the emission measure curve, which appears to change slightly with varying electron density. However, there is no major variation in the shape of the lower transition region emission measure distribution with either the intensity or size of the area studied. This indicates that ensembles of "cool loops" (loops physically distinct from those structures which reach coronal temperatures) are unlikely to be the source of this emission, unless the size of the structures is considerably less than 1 . We also find that the Li-sequence NV λ1240 emission is higher than expected, in agreement with several previous studies. It seems that this effect diminishes with intensity, suggesting that it is unlikely to be due to the omission of density dependence in di-electronic recombination calculations.

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Coronal Radiation and Helium λ584 Emission in Active Regions

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Based on EUV observations of eleven sunspot regions obtained with the Coronal Diagnostic Spectrometer, CDS, on SOHO we have studied the spatial distribution, temporal variation and wavelength shift of the He I λ584 line. We find a relatively high spatial correlation between the coronal line Fe XVI λ360 and the He I λ584 line. This points to coronal back-radiation as an important contributor to the formation of the He I line in active regions. However, contribution to the line formation from another source is suggested by the following two findings: First, the redshifted line profiles of both He I λ584 and the transition region lines tend to be more intense than blueshifted profiles. Second, the He I λ584 emission changes significantly faster than the coronal line emission.

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The Magnetic Association of Coronal Bright Points

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Several coronal bright points identified in a quiet region of the Sun from *SOHO*/EIT Fe XII images are found to have a time evolution from birth to decay which is extremely well correlated with the rise and fall of magnetic flux as determined from photospheric magnetograms made with the *SOHO*/MDI instrument. Radiative losses of the bright points are found to be much less than conductive losses but the sum of the two is comparable with the available energy of the associated magnetic field. Several small 'network flares' occur during the course of the lifetimes of these bright points, emphasizing the strong connection of such events with the magnetic field.

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Brown Dwarf Abstracts

The First L-type Brown Dwarf in the Pleiades

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We have obtained low-resolution optical spectra of three faint brown dwarf candidates in the Pleiades open cluster. The objects observed are Roque 12 (I_C=18.5), Roque 5 (I_C=19.7) and Roque 25 (I_C=21.2). The spectrum of Roque 25 does not show the strong TiO bandheads that characterize the optical spectra of M-type stars, but molecular bands of CaH, CrH and VO are clearly present. We classify Roque 25 as an early L-type brown dwarf. Using current theoretical evolutionary tracks we estimate that the transition from M-type to L-type in the Pleiades (age~120 Myr) takes place at $T_{\rm eff}$ ~2200 K or M~0.04$M_\odot$. Roque 25 is a benchmark brown dwarf in the Pleiades because it is the first known one that belongs to the L-type class. It provides evidence that the IMF extends down to about 0.035$M_\odot$, and serves as a guide for future deep searches for even less massive young brown dwarfs.

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ROSAT X-ray Detection of a Young Brown Dwarf in the Chamaeleon I Dark Cloud

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Photometry and spectroscopy of the object *Cha Hα 1*, located in the Chamaeleon I star-forming cloud, show that it is a $\sim 10^6$-year-old brown dwarf with spectral type M7.5 to M8 and 0.04 ± 0.01 solar masses. Quiescent x-ray emission was detected in a 36-killosecond observation with 31.4 ± 7.7 x-ray photons, obtained with the Röntgen Satellite (ROSAT), with 9 σ detection significance. This x-ray count rate corresponds to an x-ray luminosity of 2.57×10^{28} ergs per second and an x-ray to bolometric luminosity ratio of $10^{-3.44}$. These are typical values for late M-type stars. Because the interior of brown dwarfs may be similar to that of convective late-type stars, which are well-known x-ray sources, x-ray emission from brown dwarfs may indicate magnetic activity.

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Brown Dwarfs in the Pleiades Cluster. III. A Deep IZ Survey

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We present the results of a deep CCD-based IZ photometric survey of a $\sim 1\,\mathrm{deg}^2$ area in the central region of the Pleiades Galactic open cluster. The magnitude coverage of our survey (from $I \sim 17.5$ down to 22) allows us to detect substellar candidates with masses between 0.075 and $0.03\,M_\odot$. Details of the photometric reduction and selection criteria are given. Finder charts prepared from the I-band images are provided.

Accepted by A&AS

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Ph.D. Thesis Abstract

Oscillating Prominences

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Ph.D degree awarded: September 1998

In this thesis oscillations of quiescent prominences are studied from a theoretical point of view. In particular the influence of the solar photosphere and corona on such oscillations was studied.

The photospheric conservation of magnetic flux is an important boundary condition for prominence dynamics. In a truly dynamical situation, this boundary condition is conveyed to the prominence by magneto-acoustic waves that travel with the typical speed v_{A}. This introduces a delay $\tau \sim z/v_{\mathrm{A}}$ in the system as the main prominence body is located at a height z above the photosphere. Solving the equations of prominence motion simultaneously with the time-dependent Maxwell equations it was possible to study the effects of retardation ($\tau \neq 0$)[1,2]. It is shown that a dynamical treatment ($\tau \neq 0$) of the evolving magnetic field destabilizes the prominence in comparison to a quasi-stationary treatment ($\tau = 0, v_{\mathrm{A}} \to \infty$) of the field. However, under specific conditions it is possible to obtain stable prominence equilibria by including a damping mechanism like the emission of magneto-acoustic waves. This is not always possible and for instance Kippenhahn-Schlüter prominences are unlikely to exist on the sun[4].

The motion of an oscillating prominence generates waves in the corona that leak energy to infinity. This can lead to substantial damping of the oscillation. Using a numerical MHD code the dynamics of a Kuperus-Raadu prominence were studied. It is shown that damping through wave emission can indeed be an important effect in prominence oscillations. Moreover, the amount of damping depends, amongst others, on the kind of wave (slow, Alfvén or fast) and is therefore sensitive to the magnetic field topology[5].

Observational tests of the theoretical results of this thesis are discussed.

A copy of the thesis can be obtained through the author.

Thesis-related Publications:

(1) N.A.J. Schutgens, 1997, Astron. & Astrophys. 323, 969
(2) N.A.J. Schutgens, 1997, Astron. & Astrophys. 325, 352
(3) N.A.J. Schutgens, M. Kuperus, G.H.J. van den Oord, 1998, Astron. Soc. Pacific Conf. Ser. 150 in print
(4) G.H.J. van den Oord, N.A.J. Schutgens, M. Kuperus, 1998, Astron. & Astrophys. in print
(5) N.A.J. Schutgens & G. Tóth, 1998, Astron. & Astrophys. submitted

Meeting Report

SOLAR AND STELLAR VARIABILITY: SIMILARITIES AND DIFFERENCES

A Meeting Dedicated to P. Brendan Byrne
Armagh, N. Ireland
2 - 4 September 1998

Over 60 astronomers from 15 countries gathered in Armagh from 2–4 September 1998 for the meeting 'Solar and Stellar Variability: Similarities and Differences', dedicated to Dr. P. Brendan Byrne (1947–1997), Research Astronomer and former Assistant Director at the Armagh Observatory. The meeting summarised progress and outstanding problems in solar and stellar astrophysics touching particularly on Brendan's own research interests.

Tangled Webs

A key question in stellar activity is the role played by the magnetic field. Effects of magnetic fields are detected across virtually the whole of the H-R diagram (J. Linsky, Boulder), even in stars such as those of spectral types O, B, and A that have no significant convection. Models for the B-A types include fast rotating oblique magnetic rotators, generating non-thermal emission by synchrotron or electron cyclotron radiation, but the source of the field (possibly primordial?) remains uncertain. An important question is the extent to which observations of the Sun inform theorists of processes for the origin and evolution of stellar magnetic fields generally, and of the causes of stellar activity in so-called 'cool' stars like the Sun, of spectral types G, K and M. By the same token, do observations of activity in these stars really inform our knowledge of the long-term evolution of the Sun? The problem was touched upon many times, though several speakers (e.g. H. Mason, Cambridge, A. Lanzafame, Catania) cautioned that the community should be very careful in extrapolating relatively simple physical models based on observations of the Sun, which is itself enormously complex, to the situation of other stars, not to mention the use and abuse of simple physical estimates based on atomic calculations. Other stars show a far greater range of activity than the Sun, and provide direct evidence for much more violent events than those seen in our own backyard.

Turning to the latter, a surprising result presented by K. Schrijver (Palo Alto) suggested that the replenishment time-scale for the solar magnetic flux is of the order of days. The field emerges into the surface, and then sinks, apparently without trace, demonstrating a significant *lack* of correlation between the observed surface structures and the underlying solar dynamo. Meanwhile, on a different scale, instrumental and theoretical inversion techniques (reviewed by J.-F. Donati, Toulouse) are now reaching a stage when high-resolution spectroscopic monitoring of distant stars offers the prospect of probing the evolution of both the dynamo field and differential rotation in distant stars.

On the Ropes

More controversial topics were introduced by M. Mathioudakis (Belfast), for example the reality or otherwise of the so-called 'high-T tail' ($T > 3 \times 10^7$ K) in stellar coronae, in which the effects of increased resonance scattering (real or not?) play a crucial role. Others (R. Stern, Palo Alto, and R. Jeffries, Keele) introduced further puzzles: for example, why does the X-ray activity of the Sun show variations by factors in the range 10–10^2, whereas that seen in other, more active, stars varies by a factor of 2 or less?

One of the highlights of the meeting was the extraordinarily impressive TRACE videos presented by K. Schrijver, demonstrating just how complex are the phenomena we are groping to understand. The solar transition region comprises a turbulent mass of complex, dynamic structures, with tubes or jets of material thrusting up from lower regions, mingling with cooling, down-flowing material from higher up. Someone tentatively suggested that perhaps it was now time to abandon the concept of a plane-stratified 'transition region'? Amidst laughter, E. Priest (St. Andrews) suggested that solar theorists should now give up their life's work, possibly to contemplate simpler subjects ...like cosmology?

Cool Dwarfs

It is perhaps fortunate that other stars are too far away to show such details. S. Hawley (Michigan) reviewed new problems and results arising from observations of M-dwarf stars, both active and non-active, a project with which Brendan had been closely involved. These data lead to estimates, based on stellar activity, of the ages of groups of stars formed more or less coevally in nearby open clusters, though many observational problems must be overcome before reliable results can be obtained.

Stellar activity decreases with age, but whether the fundamental driver is age, angular velocity, mass or even Rossby number (rotational period divided by convective turnover time-scale) remains to be determined. Various correlations between chromospheric activity in late-type dwarfs were described by M. Cuntz (Huntsville), providing a beautiful illustration of how a coherent theoretical understanding of the correlation between stellar activity and rotation period might be developed; but the TRACE images of the Sun, firmly impressed in our minds, refused to go away. To what extent is the 'solar model' of stellar activity a valid starting point; and does the undoubted complexity of the Sun undermine any 'simple' attempt to understand the activity of other stars?

Turning to the earliest stages of stellar evolution, another subject close to Brendan's heart, F. Walter (Stony Brook) reviewed activity in pre-main-sequence stars. He highlighted what has become a new standard picture of the evolution of T Tauri stars and their circumstellar discs, and emphasized that the activity parameters may be a function of stellar *mass* rather than rotation period, with the decline of stellar activity being associated with the decay of a large-scale organized magnetic field.

Bed of Nails

The meeting moved on to consider various physical manifestations of activity in the Sun and other stars: spots, plages, prominences and flares. S. Solanki (Zurich) and B. Schmieder (Meudon) reintroduced the solar perspective, while A. Lanza (Catania) and A. Collier-Cameron (St. Andrews) highlighted the complex, two- or multi-component picture emerging from observations of stellar coronae. The latter focused on increasingly persuasive evidence for the presence of cool, absorbing material, similar to that seen in solar prominences, lying high above the co-rotating stellar surface in a region exactly where *cool* material should not be! Another surprise was that the coronal abundances of many stars are depleted in heavy elements by factors ranging from 3 up to an order of magnitude compared to their photospheres. This is possibly an element mass-segregation effect, but the precise mechanism remains uncertain. Flares, by contrast, show a more 'normal' pattern of abundances (B. van den Oord, Utrecht).

The review of solar flares by K. Phillips (Rutherford) focused on the bright 'kernel' seen at the top of one or more flare loops, and on the question how it maintains its identity despite the very high thermal conductivity along the length of the loop structure. The improved spatial resolution of YOHKOH showed that the hard X-ray emission, previously believed to emanate from the footpoints of the magnetic loops where they intersect the chromosphere and photosphere, in fact sometimes originates high in the loop close to the site where the magnetic reconnection is thought to take place. Still dealing with flares, W. Abbett (Michigan) discussed possible dynamical constraints on model atmospheres which might reproduce the observed time delay between the Hα line brightening and the optical continuum emission.

The solar chromosphere, reviewed by R. Rutten (Utrecht), and presumably the chromospheres of other stars also, has a complex three-dimensional 'bed of nails' structure, varying rapidly in time and space, and comprising bright 'nails' (narrow network structures showing enhanced EUV emission, some 25000 km long and 300 km wide), and strong concentrated magnetic fields. Between these spikes lies a rapidly varying internetwork region, relatively free of magnetic field but containing shocks and diverse upwardly mobile structures. What generates the narrow network structures and shocks, all lying above the $\sim$2000 km thick solar photosphere, remains to be understood. Again in contradiction to simple plane-stratified theoretical models, the real world is found to be much more complex. Solar and stellar astrophysics, like most branches of astronomy, are strongly observationally driven.

Chromospheres

Theorists nevertheless do their best, and P. Ulmschneider (Heidelberg) provided an admirably clear overview of chromospheric models. He began by reminding the audience that, in fact, the subject is relatively simple: the good news is that there are only four basic parameters — effective temperature, surface gravity, metallicity and rate of rotation. The bad news, for theorists, is that these parameters still allow the full physical complexity of hydrodynamics and magneto-hydrodynamics.

Looking at all possible chromospheric heating mechanisms, the dominant modes would appear to be mechanical acoustic ones. Whereas the significant length-scales for these heating processes have dimensions on the order of metres in the case of the Sun (and are therefore unobservable from Earth), it turns out perhaps surprisingly that observations of distant stars can be used to discriminate between models. Although the Sun is close, it is unique. By contrast, the set of active stars contains examples in which the basic parameters vary by orders of magnitude. Although theories are far from precise, the trends allow the heating processes to be indirectly constrained.

Heating processes were also discussed in relation to the solar corona. R. Rutten took the view that the real problem for the Sun is how to keep its (corona) cool, since ingeneous theorists have invented so many ways of transporting the heat upwards from the cooler to the hotter region. But E. Priest's admirably clear review of the subject, beginning with the memorable phrase: 'MHD is extremely simple', focused minds on the necessity to develop a three-dimensional theory of magnetic reconnection. Lastly, returning to observations and to the stellar arena, R. Pallavicini (Palermo) drew attention to recent observations of highly energetic stellar flares, where which what appears to be predominantly thermal emission has been detected at energies exceeding 20 keV.

Unfortunately, observations can never 'prove' the theories of these phenomena, only disprove them. This is sad (for theorists), but — in keeping with Brendan's approach to astronomy — a source of endless amusement to observers.

The proceedings of the meeting including the invited reviews and contributed papers will appear in a forthcoming volume of the Astronomical Society of the Pacific Conference Series, entitled "Solar and Stellar Activity - Similarities and Differences".

Irish Tree

The meeting was highly productive and one of which Brendan would have been proud. Many speakers drew attention to Brendan's continuing influence on the field, while others took the opportunity to recall his generosity and friendship. Many typically 'Brendan' anecdotes were told, and Brendan's wife 'Gay' touched everyone with her dignity, bravery and good humour. The discussion, of course, overflowed the lecture theatre, running into a full social programme. Brendan's contributions, both to stellar astrophysics and Armagh Observatory, were marked by a short ceremony at the Observatory in which an Irish oak tree was dedicated to his memory — coincidentally on the same day as the visit to the City of Armagh of the British Prime Minister and the President of the United States.

J.G. Doyle, C.J. Butler and M.E. Bailey
Armagh Observatory
September 1998

Charles Prosser (1963 - 1998)

Charles F. Prosser was born in San Diego on 26 August 1963. He received a B.S. in physics and astronomy from Ohio State University in 1986. While at OSU, he attended summer programs at NRAO and NCAR, working respectively with C.P. O'Dea and D. Mihalas. He subsequently attended the University of California at Santa Cruz, from which he obtained a PhD in astronomy in 1991. His thesis was entitled "Low-mass Membership of the Open Clusters α Persei and IC 4665." While at UCSC, Charles primarily worked with Burton Jones and Robert Kraft, and he maintained collaborations with them throughout his too-brief career. Charles was killed in an automobile accident on August 16, 1998 in Tucson, Arizona.

Following his graduate education, Charles moved to the Smithsonian Astrophysical Observatory where he worked as a research assistant, primarily funded via a NASA Long-Term Space Astrophysics grant to John Stauffer. The main goal for that grant was a multi-wavelength observational study of the nearest open clusters in order to develop better (more complete, to lower masses) membership lists for those clusters and to use the new data for the cluster members to constrain theoretical evolutionary models of low mass stars. Charles wrote or co-authored some thirty papers on that topic over the six years he worked at SAO, including subjects ranging from proper motion membership studies to time-series photometric monitoring in order to determine rotation periods for spotted stars to the analysis of ROSAT x-ray imaging data in order to determine the coronal activity levels of the open cluster members. Charles was the world's expert on the Alpha Persei cluster, with most of the known members of the cluster having been identified by him from his proper motion membership studies or from deep, CCD imaging surveys. From analysis of HST WF/PC images of the Trapezium cluster in Orion, Charles also provided the best available membership study of that cluster.

Following his stay at SAO, Charles moved to Kitt Peak National Observatory where he began work with Abhijit Saha in the analysis of HST data for RR Lyrae stars. Charles was also continuing his research on coronal activity of low mass stars in open clusters using new ROSAT HRI data (in collaborations with M. Giampapa and G. Micela) and on rotational periods of stars in Alpha Persei (in collaboration with K. Grankin).

Charles worked harder and put in longer hours than all but perhaps a few present-day professional astronomers. He could usually be found at the office seven days a week, arriving before almost everyone else and departing in the evening long after most of the other astronomers had gone home. Charles enjoyed being a harvester of astronomical data, whether via spending long observing runs on mountain tops or sleuthing through the little-used observatory publications of the Lick or SAO library in search of obscure papers. Charles was conservative in both his personal and his professional life - he very much preferred simply to state the results of his observations and make as few extravagant interpretations of those observations as possible.

One of the major contributions to the astronomical community made by Charles is not revealed in his publication list because it is not in the form of a journal article. While at SAO, Charles created a database of the members of ten of the nearest open clusters, including a compilation of the existing photometry, spectroscopy and x-ray activity, along with J2000 coordinates and a comprehensive reference list. The clusters include Alpha Persei, the Pleiades, the Hyades, Praesepe and Coma (as well as several other less well-known clusters). Charles made this database available over the internet, free to everyone. Following Charles' death, I moved the database back to SAO, where I will attempt to maintain it in his honor. The database can be found at URL
http://cfa-www.harvard.edu/ stauffer/opencl/index.html.

Charles is survived by his parents who live in Suwanee, GA and by his sister Evelyn. Charles was buried in West Virginia on 22 August 1998. He will be remembered as a kind, dedicated and highly moral colleague whose greatest desire was to be allowed to work 12 hours per day in the field to which he devoted himself completely.

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 .`