COOLNEWS

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Stellar Abstracts

A Census of AGB Stars in Local Group Galaxies. II. NGC 185 and NGC 147

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We present results of our ongoing photometric survey of Local Group galaxies, using a four filter technique based on the method of Wing (1971) to identify and characterise the late-type stellar content. Two narrow band filters centred on spectral features of TiO and CN allow us to distinguish between AGB stars of different chemistries [M-type (O-rich) and C-type (C-rich)]. The major parts of two dwarf galaxies of the M 31 subgroup – NGC 185 and NGC 147 – were observed. From photometry in V and i we estimate the tip of the RGB, and derive distance moduli. With additional photometric data in the narrow band filters TiO and CN we identify 154 new AGB carbon stars in NGC 185 and 146 in NGC 147. C/M ratios are derived, as well as mean absolute magnitudes $\langle M_i \rangle$, bolometric magnitudes M_{bol}, luminosity functions, and the spatial/radial distributions of the C stars in both galaxies.

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A Systematic Study of X-Ray Variability In The ROSAT All-Sky Survey

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We present a systematic search for variability among the ROSAT All-Sky Survey (RASS) X-ray sources. We generated lightcurves for about 30 000 X-ray point sources detected sufficiently high above background. For our variability study different search algorithms were developed in order to recognize flares, periods and trends, respectively. The variable X-ray sources were optically identified with counterparts in the SIMBAD, the USNO-A2.0 and NED data bases, but a significant part of the X-ray sources remains without cataloged optical counterparts. Out of the 1207 sources classified as variable 767 (63.5 %) were identified with stars, 118 (9.8 %) are of extragalactic origin, 10 (0.8 %) are identified with other sources and 312 (25.8 %) could not uniquely be identified with entries in optical catalogs. We give a statistical analysis of the variable X-ray population and present some outstanding examples of X-ray variability detected in the ROSAT all-sky survey. Most prominent among these sources are white dwarfs, apparently single, yet nevertheless showing periodic variability. Many flares from hitherto unrecognised flare stars have been detected as well as long term variability in the BL Lac 1E1757.7+7034.

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The Lithium Depletion Boundary and the Age of NGC 2547

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We present the results of a photometric and spectroscopic survey of cool M dwarf candidates in the young open cluster NGC 2547. Using the 2dF fiber spectrograph, we have searched for the luminosity at which lithium remains unburned in an attempt to constrain the cluster age. The lack of a population of individual lithium-rich objects towards the faint end of our sample places a very strong lower limit to the cluster age of 35 Myr. However, the detection of lithium in the averaged spectra of our faintest targets suggests that the lithium depletion boundary lies at $9.5 < M_I < 10.0$ and that the cluster age is < 54 Myr. The age of NGC 2547 judged from fitting isochrones to low-mass pre-main-sequence stars in colour-magnitude diagrams is 20−35 Myr using the same evolutionary models. The sense and size of the discrepancy in age determined by these two techniques is similar to that found in another young cluster, IC 2391, and in the low-mass pre main-sequence binary system, GJ 871.1AB. We suggest that the inclusion of rotation or dynamo-generated magnetic fields in the evolutionary models could reconcile the two age determinations, but only at the expense of increasing the cluster ages beyond that currently indicated by the lithium depletion. Alternatively, some mechanism is required that increases the rate of lithium depletion in young, very low-mass fully convective stars.

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Field ZAMS Stars in the Solar Neighborhood: Where Have They Come From ?

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In the course of an all-sky survey for young stars in the solar neighborhood we have found a tight kinematic group of ten F-G type zero-age main sequence stars in the field. Here we discuss the origin of these stars. Backtracking the space motions of these stars we argue that likely candidates for the parent association are the Perseus OB3 (Per OB3), Upper Centaurus-Lupus (UCL), and Lower Centaurus-Crux (LCC) associations, and that we are witnessing the ongoing diffusion of (at least one of) these associations into the field.

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The Low-level Radial Velocity Variability in Barnard's Star (=GJ 699). Secular Acceleration, Indications for Convective Redshift, and Planet Mass Limits

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We report results from 2 1/2 yr of high precision radial velocity (RV) monitoring of Barnard's star. The high RV measurement precision of the VLT-UT2+UVES of 2.65 m s^{-1} made the following findings possible. (1) The first detection of the change in the RV of a star caused by its space motion (RV secular acceleration). (2) An anti-correlation of the measured RV with the strength of the filling-in of the H_α line by emission. (3) Very stringent mass upper limits to planetary companions. Using only data from the first 2 years, we obtain a best-fit value for the RV secular acceleration of 5.15 ± 0.89 m s^{-1} yr^{-1}. This agrees within 0.95σ with the predicted value of 4.50 m s^{-1} yr^{-1} based on the Hipparcos proper motion and parallax combined with the known absolute radial velocity of the star. When the RV data of the last half-year are added the best-fit slope is strongly reduced to 2.97 ± 0.51 m s^{-1} yr^{-1} (3.0σ away from the predicted value), clearly suggesting the presence of additional RV variability in the star. Part of it can be attributed to stellar activity as we demonstrate by correlating the residual RVs with an index that describes the filling-in of the H_α line by emission. A correlation coefficient of -0.50 indicates that the appearance of active regions causes a blueshift of photospheric absorption lines. Assuming that active regions basically inhibit convection we discuss the possibility that the fundamental (inactive) convection pattern in this M4V star produces a convective redshift which would indicate that the majority of the absorption lines relevant for our RV measurements is formed in a region of convective overshoot. This interpretation could possibly extend a trend indicated in the behaviour of earlier spectral types that exhibit convective blueshift, but with decreasing line asymmetries and blueshifts as one goes from G to K dwarfs. Based on this assumption, we estimate that the variation of the visible plage coverage is about 20%. We also determine upper limits to the projected mass $m \sin i$ and to the true mass m of hypothetical planetary companions in circular orbits. For the separation range $0.017 - 0.98$ AU we exclude any planet with $m \sin i > 0.12$ $M_{\rm Jupiter}$ and $m > 0.86$ $M_{\rm Jupiter}$. Throughout the habitable zone around Barnard's star, i.e. $0.034 - 0.082$ AU, we exclude planets with $m \sin i > 7.5$ $M_{\rm Earth}$ and $m > 3.1$ $M_{\rm Neptune}$.

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White-light Oscillations During a Flare on II Peg

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In the present paper we analyse the intensity oscillations observed in the gradual phase of a white-light flare on the RS CVn binary II Peg. Fast Fourier transform power spectra and Wavelet analysis reveal a period of 220 seconds. The reliability of the oscillation is tested using several criteria. Oscillating coronal loop models are used to derive physical parameters such as temperature, electron density and magnetic field strength associated with the coronal loop. The derived parameters are consistent with the near-simultaneous X-ray observations of the flare. There is no evidence for oscillations in the quiescent state of the binary.

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On Coronal Structures and Their Variability in Active Stars: The Case of Capella Observed with Chandra/LETGS

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In this paper we present a detailed analysis of two X-ray spectra of Capella, taken eleven months apart with the Low Energy Transmission Grating Spectrometer (LETGS) of the *Chandra Observatory*. We have studied variability of the coronal emission over different time scales, both in the whole X-ray band and in narrow temperature ranges identified by lines. The comparison of the two observations shows that the whole coronal emission of Capella in March 2000 was 3% higher than in February 2001; there also appears to be a tendency, albeit a marginal one, for the hottest lines to show the largest changes between the two observations. A detailed search for short-term variability (on time scales ranging from 10^2 to 10^4s) in the emission of individual lines shows that in all cases the emission is compatible with a constant source; the firm upper limits of $5\% - 10\%$ to the source variability on short time scales suggests that the intense X-ray emission is due to stable coronal structures and not to flaring activity. We have also determined the coronal thermal structure, as described with the emission measure distribution vs. temperature and with the help of plasma density, derived from the analysis of the O VII, , Ne IX, Mg XI, and Si XIII He-like ion triplets. The emission measure distribution, $em(T)$, and the element abundances, have been reconstructed with the Markov-Chain Monte Carlo method by Kashyap & Drake (1998); the $em(T)$ presents a previously known sharp peak around $\log T = 6.8-6.9$, but we have also found evidence of a small amount of plasma at $T > 10^7$ K. With the help of the $em(T)$ and the density values we have estimated the pressure and volume of the emitting plasma at different temperatures, and we have derived information about the structure of individual loops and about the population of loops having different maximum temperatures. Our results indicate that loops with higher maximum temperature have higher pressure and smaller volume than lower temperature loops.

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Effect of Chromospheric Activity on the Mean Colours of late-type Stars II. Is $(B–V)_0$ Also Affected?

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We confirm the existence of an “excess” in the mean dereddened $(U–B)_0$ colour of active single-lined spectroscopic giants over quiescent stars of the same spectral type and find evidence for this “excess” in $(B–V)_0$, although at a lower scale, when plotted against $(R–I)_0$. This result suggests that the use of $(B–V)_0$ calibrations to determine fundamental parameters or spectral types for late-type active stars should be taken with caution. Since magnetic activity is definitely involved, these and similar calibrations using $(U–B)_0$ and/or $(B–V)_0$ should not be used for the study of late-type young clusters' members or late-type pre-main sequence stars without some consideration. Instead, near-infrared colours like $(R–I)_0$ should be better temperature indicators for these stars.

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Starspots and Active Regions on the Chromospherically Active Binary $MSSer$

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The quasisimultaneous electrophotometric, polarimetric and spectroscopic observations of the chromospherically active binary $MS\ Ser$ are presented. The photometric variability of the star can be described completely by a zonal spottedness model. Spotted regions occupy up to 21 % of the total stellar surface. The temperature difference between the unspotted photosphere and starspots is about 1300 K. Starspots are localized at the middle latitudes. We detected the broad-band linear polarization of the stellar light and its rotational modulation connected with the local magnetic region on the stellar surface. We suspect that there is a space connection between plages, magnetic regions and the mostly spotted stellar longitudes.

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Dynamics of Magnetic Flux Tubes in Close Binary Stars I. Equilibrium and Stability Properties

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Surface reconstructions of active close binary stars based on photometric and spectroscopic observations reveal non-uniform starspot distributions, which indicate the existence of preferred spot longitudes (with respect to the companion star). We consider the equilibrium and linear stability of toroidal magnetic flux tubes in close binaries to examine whether tidal effects are capable to initiate the formation of rising flux loops at preferred longitudes near the bottom of the stellar convection zone. The tidal force and the deviation of the stellar structure from spherical symmetry are treated in lowest-order perturbation theory assuming synchronised close binaries with orbital periods of a few days. The frequency, growth time, and spatial structure of linear eigenmodes are determined by a stability analysis. We find that, despite their small magnitude, tidal effects can lead to a considerable longitudinal asymmetry in the formation probability of flux loops, since the breaking of the axial symmetry due to the presence of the companion star is reinforced by the sensitive dependence of the stability properties on the stellar stratification and by resonance effects. The orientation of preferred longitudes of loop formation depends on the equilibrium configuration and the wave number of the dominating eigenmode. The change of the growth times of unstable modes with respect to the case of a single star is very small.

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Dynamics of Magnetic Flux Tubes in Close Binary Stars II. Nonlinear Evolution and Surface Distributions

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Observations of magnetically active close binaries with orbital periods of a few days reveal the existence of starspots at preferred longitudes (with respect to the direction of the companion star). We numerically investigate the non-linear dynamics and evolution of magnetic flux tubes in the convection zone of a fast-rotating component of a close binary system and explore whether the tidal effects are able to generate non-uniformities in the surface distribution of erupting flux tubes. Assuming a synchronised system with a rotation period of two days and consisting of two solar-type components, both the tidal force and the deviation of the stellar structure from spherical shape are considered in lowest-order perturbation theory. The magnetic field is initially stored in the form of toroidal magnetic flux rings within the stably stratified overshoot region beneath the convection zone. Once the field has grown sufficiently strong, instabilities initiate the formation of rising flux loops, which rise through the convection zone and emerge at the stellar surface. We find that although the magnitude of tidal effects is rather small, they nevertheless lead to the formation of clusters of flux tube eruptions at preferred longitudes on opposite sides of the star, which result from the cumulative and resonant character of the action of tidal effects on rising flux tubes. The longitude distribution of the clusters depends on the initial parameters of flux tubes in the overshoot region like magnetic field strength and latitude, implying that there is no globally unique preferred longitude along a fixed direction.

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From the Heart of The Ghoul: C and N Abundances in the Corona of Algol B

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Chandra Low Energy Transmission Grating Spectrograph observations of Algol have been used to determine the abundances of C and N in the secondary star for the first time. In order to minimise errors arising from an uncertain coronal differential emission measure as a function of temperature, the analysis was performed relative to similar observations of an adopted "standard" star HR 1099. It is shown that HR 1099 and Algol are coronal twins in many respects and that their X-ray spectra are very similar in nearly all details, except for the observed strengths of C and N lines. The H-like 2p $^2P_{3/2,1/2} \rightarrow$ 1s $^2S_{1/2}$ transitions of C and N in the coronae of Algol and HR 1099 demonstrate that the surface abundances of Algol B have been strongly modified by CN-processing, as demonstrated earlier by Schmitt & Ness (2002). It is found that N is enhanced in Algol B by a factor of 3 compared to HR 1099. No C lines are detected in the Algol spectrum, indicating a C depletion relative to HR 1099 by a factor of 10 or more. These C and N abundances indicate that Algol B must have lost at least half of its initial mass, and are consistent with predictions of evolutionary models that include non-conservative mass transfer and angular momentum loss through magnetic activity. Based on H-like and He-like transitions in O and Ne, it is estimated that Algol is slightly metal-poor by 0.2 dex in terms of the coronal abundances of light elements relative to HR 1099, while the Fe XVII $2p^5 3d$ $^1P_1$ $\rightarrow 2p^6$ $^1S_0$ transition indicates a very similar Fe abundance. In reviewing coronal abundance results for active stars in the literature, and drawing on an earlier *Chandra* study of the coronal abundances of HR 1099, it is concluded that Fe is very likely depleted in the coronae of both Algol and HR 1099 by 0.5 dex relative to their photospheric compositions, but that Ne is enhanced by a similar magnitude. Light elements such as C, N and O are likely depleted in both stars by of order 0.3 dex. The similarities in these large abundance anomalies in HR 1099 and Algol is notable. Despite such compositional fractionation in these coronae, the relative C and N abundances in HR 1099, determined by comparing observed line strengths to theoretical C/N line ratios, are consistent with recent solar values, indicating that differential fractionation between these elements is not significant and that little or no dredge-up of material subjected to CN-processing has occurred on the subgiant component.

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The Evolution of Lithium Depletion in Young Open Clusters: NGC 6475

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We have carried out a high resolution spectroscopic survey of the 220–250 Myr old cluster NGC 6475: our main purpose is to investigate Li evolution during the early stages of the Main Sequence. We have determined Li abundances for 33 late F to K–type X–ray selected cluster candidates, extending the samples already available in the literature; for part of the stars we obtained radial and rotational velocities, allowing us to confirm the membership and to check for binarity. We also estimated the cluster metallicity which turned out to be over–solar ([Fe/H]= $+0.14 \pm 0.06$). Our Li analysis evidenced that (i) late F–type stars ($T_{\rm eff} \gtrsim$6000 K) undergo a very small amount of Li depletion during the early phases on the ZAMS; (ii) G–type stars (6000$\gtrsim$ $T_{\rm eff}$ $\gtrsim$5500 K) instead do deplete lithium soon after arrival on the ZAMS. Whereas this result is not new, we show that the time scale for Li depletion in these stars is almost

constant between 100 and 600 Myr; (iii) we confirm that the spread observed in early K–type stars in younger clusters has converged by 220 Myr. No constraints can be put on later–type stars. (iv) Finally, we investigate the effect of metallicity on Li depletion by comparing NGC 6475 with the similar age cluster M 34, but we show that the issue remains open, given the uncertain metallicity of the latter cluster. By using the combined NGC 6475+M 34 sample together with the Hyades and the Pleiades, we compare quantitatively Li evolution from the ZAMS to 600 Myr with theoretical predictions of standard models.

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Solar Abstracts

La Palma Observations of Umbral Flashes

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We present high-quality Ca II H & K data showing chromospheric flashes in sunspot umbrae collected with the Swedish Vacuum Solar Telescope, the Dutch Open Telescope, and the Swedish 1-m Solar Telescope at the Roque de los Muchachos Observatory on La Palma. Differential movies, time slices, spectrograms, and Fourier power maps demonstrate that umbral flashes and running penumbral waves are closely related oscillatory phenomena, combining upward shock propagation with coherent wave spreading over the entire spot. We attribute the flash brightening to large redshift by post-shock material higher up. We find no obvious relation between umbral dots and umbral flashes.

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The Lost Sunspot Cycle: Reanalysis of Sunspot Statistics

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We have recently suggested that one low sunspot cycle was possibly lost in 1790s (Usoskin et al., A&A, 370, L31, 2001). In this paper we present the results of a rigorous statistical analysis of all available sunspot observations around the suggested additional cycle minimum in 1792–1793. First we estimate the uncertainty of a monthly mean sunspot number reconstructed from a single daily observation. Then we compare, using quantitative statistical tests, the average level of sunspot activity in 1792–1793 with the average activity during the minimum, mid-declining and maximum phases of cycles in the well-measured reference period 1850–1996. We show that, contrary to the results by Krivova et al. (A&A, 396, 235, 2002), the level of sunspot activity in 1792–1793 is statistically similar to that in the minimum phase, and significantly different from that in the mid-declining and maximum phases. Using the estimated uncertainties, we also calculate new, weighted annual values of $R_{\rm g}$ in 1790–1796 which show a clear minimum in 1792–1793 and a maximum in 1794–1795, supporting the idea of an additional weak cycle in 1790's.

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Investigating the Role of Plasma Topography on Chromospheric Oscillations Observed by TRACE

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We present the results of an investigation into the interaction of the topographic structure of the solar chromospheric plasma with the wave modes manifesting themselves in the EUV continua formed there. We show that there is a distinct correlation between the inferred plasma topography, the phase-differences between and suppression of oscillations in different levels of the solar atmosphere. We interpret these factors as evidence of interaction between the oscillations and the extended magnetic "canopy". This work is based on the analysis of joint observations made by the Solar and Heliospheric Observatory (SOHO) spacecraft and the Transition Region and Coronal Explorer (TRACE).

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The Accuracy of the Center-of-gravity Method for Measuring Velocity and Magnetic Field Strength in the Solar Photosphere

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I investigate the accuracy with which the line-of-sight velocity and magnetic field strength in the solar photosphere can be recovered from spatially resolved spectral line profiles with the center of gravity (COG) method. For this purpose theoretical Non-LTE polarized line profiles of a series of Fe I lines were calculated through a two-dimensional slice from a snapshot of a three-dimensional solar magneto-convection simulation. The calculated profiles were analyzed with the COG method for all positions along the slice, and retrieved values of velocity and field strength were compared with actual values at the heights of formation of the lines. The average formation heights of the employed lines range from 60 to almost 400 km above the average photospheric level. The COG method appears reliable for measuring velocities in the lower half of these formation heights, and for measuring field strength over the whole range of heights, for fields up to intermediate strength. Moreover, it is shown that the COG determination is independent of spectral resolution, making it particularly suitable for applications which require high throughput and a correspondingly large spectral bandpass, such as high spatial resolution observations with a large diameter telescope. Finally, the effect of broad angle scattering, which includes a schematic representation of image deterioration through seeing, on the retrieved velocity and field strength is discussed.

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Angular Velocity During the Cycle Deduced Using the Sunspot Group Age Selection Methodology

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We have used the "age selection methodology" (ASM) (Zappalá and Zuccarello, 1991) to study the variability of the sunspot groups angular velocity during the activity cycle. The ASM allows us to separate the contribution of Young Sunspot Groups (YSG) from that of Recurrent ones (RSG) in the $\Omega(\theta)$ determination and therefore to evaluate whether the increase in angular velocity during minima (reported in literature using all sunspot groups as tracers), is due to a greater statistical weight of YSG on RSG or whether it reflects a global characteristic of the Sun. The results obtained from the analysis of sunspot groups data collected during the period 1874-1981 (Greenwich Photoheliographic Results) indicate that during minima, besides the fact that the percentage of RSG drops to $\leq 5\%$, both YSG and RSG show the same increase in angular velocity, i.e. 0.15 degrees/day. Comparing our results with those reported in literature and taking into account the internal angular velocity as deduced by p -mode oscillations, it is possible to

conclude that the observed higher angular velocity of the Sun during minima concerns several layers of the Sun.

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Modelling the Rotational Modulation of the Sun as a Star

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We analyse the time variability of the total solar irradiance (TSI) as measured by VIRGO/SoHO in order to model the variability of the Sun as a star. Apart from the phases near the minimum at the beginning of the activity cycle 23, the period of the rotational modulation is significantly different from the solar synodic period as a consequence of the growth and decay of active regions on time scales shorter than a solar rotation. In order to model the variability of the TSI, we have considered the contributions of discrete active regions and a uniformly distributed background emission. To reproduce the rotational modulation of the TSI, we used three active regions, the areas and coordinates of which were changed every seven days to account for their evolution. The simultaneous presence of dark spots and bright faculae was considered by means of appropriate contrast functions which took into account the observed center-to-limb dependence of their contrast with respect to the unperturbed photosphere. The method proved to be capable of modelling the variability of the TSI on time scales going from $7-10$ days up to the solar cycle. The relative amplitude of the residuals was of the order of $(1-2) \times 10^{-4}$ with the larger values observed during the phases of maximum solar activity of cycle 23. The application of a similar technique to solar-like stars, such as those that will be observed by the next generation of space-borne photometers, should allow us to minimize the effects of stellar magnetic activity on the detection of planetary transits. Moreover, the availability of long-term highly accurate light curves will allow us to measure stellar rotation period, detect stellar activity cycles, and derive information on the inclination of the stellar rotation axis. The location of the active regions and their irradiance properties can also be retrieved with moderate accuracy from single-band light curves. However, a combination of multi-band photometry and spectroscopy will allow us to constrain some of the free parameters of the model and improve the mapping of stellar surfaces.

Accepted by A&A

For preprints contact: nlanza@ct.astro.it

For preprints via ftp or WWW: http://web.ct.astro.it/preprints/preprint/lanza6.ps

A Comparison Between the X-ray Variable Sun and Solar-like Main Sequence Stars

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We analyze the time variations of the solar X-ray luminosity observed with Yohkoh/SXT with the aim to compare the X-ray variability of the Sun with that of the other solar-like main sequence stars as function of the relevant time scales. Since the observational set-up and strategies used to observe the Sun differ from those used for the other stars, we have explored the solar X-ray variability properties starting from the available solar data, trying to reproduce the observational procedures adopted for the stars. We have quantified how the solar variability amplitude increases with the explored time scales and found that solar-cycle variability can contribute at most up to 60% to the spread observed in nearby solar-like star X-ray luminosity distribution functions. The comparison between the Sun and the nearby stars is consistent with a scenario in which a fraction of moderately active stars ($\overline{L}_x < 10^{28}$ erg/sec) have X-ray variability similar to the Sun, while more active stars lack solar-like cyclic coronal activity.

Accepted by A&A

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Low-Mass and Substellar Abstracts

Evolutionary Models for Cool Brown Dwarfs and Extrasolar Giant Planets. The Case of HD 209458

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[4] Hamburger Sternwarte, Gojenbergsweg 112, 21029 Hamburg, Germany

We present evolutionary models for cool brown dwarfs and extra-solar giant planets. The models reproduce the main trends of observed methane dwarfs in near-IR color-magnitude diagrams. We also present evolutionary models for irradiated planets, coupling for the first time irradiated atmosphere profiles and inner structures. We focus on HD 209458-like systems and show that irradiation effects can substantially affect the radius of sub-jovian mass giant planets. Irradiation effects, however, cannot alone explain the large observed radius of HD 209458b. Adopting assumptions which optimise irradiation effects and taking into account the extension of the outer atmospheric layers, we still find $\sim 20\%$ discrepancy between observed and theoretical radii. An extra source of energy seems to be required to explain the observed value of the first transit planet.

Accepted by A&A

For preprints contact: ibaraffe@ens-lyon.fr

For preprints via ftp or WWW: http://babbage.sissa.it/astro-ph/0302293

Measurements of Differential Rotation in Line Profiles of Solar-like Stars

Ansgar Reiners

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Ph.D dissertation directed by: Prof. J.H.M.M. Schmitt

Ph.D degree awarded: January 2003

The plethora of activity phenomena observed on the Sun and indicated in X-ray and Ca II H & K measurements on other stars are believed to be of common origin; a stellar dynamo situated at the base of the convection zone transforms kinetic into magnetic energy and causes the magnetic topology, sun- and starspots, coronal phenomena and even the solar and stellar cycles. The underlying mechanism driving a stellar dynamo is believed to be differential rotation; magnetic field lines are wound up and amplified by the latitudinal shear occuring if a star does not rotate rigidly. The amount of differential rotation in this picture would be crucial for a stellar dynamo to work and the dependencies of stellar activity on rotation and differential rotation could help us to understand the physics of solar-like stars including the solar activity cycle.

While the solar rotation law can easily be measured tracking sunspots and can nowadays even be followed in radial direction using helioseismology, surfaces of other stars cannot be spatially resolved and measurements of stellar differential rotation are much more difficult. One way measuring stellar differential rotation is to search for the subtle effects deviations from solid body rotation have on the shape of absorption line profiles. These tiny signatures of the stellar rotation law are smeared out by additional Doppler broadening due to turbulence velocity fields. Interaction of rotation, turbulence, limb darkening and intrinsic line broadening is difficult to overview, and time-consuming modelling of stellar atmospheres was carried out in previous searches for stellar differential rotation.

In the first part of this thesis the signatures of differential rotation in line profiles are studied in detail. As in previous works the advantages of Fourier transform are utilized. Exensive line profile modelling of differentially rotating stars revealed that the zeros of Fourier transformed absorption lines are well-defined tracers of solar-like differential rotation with the equator rotating faster than polar regions. Following this strategy full modelling of the stellar atmospheres becomes obsolete. Further studies on the influence of surface spots and spot groups on the profiles showed that mimicking of solar-like differential rotation by surface features only occurs in some extremely unprobable cases. The detection of stellar differential rotation with the equator faster than the pole turned out to be feasible with the Fourier transform method in a single high resolution, high signal-to-noise spectrum.

Observations of 142 field stars of spectral types F, G and K were carried out in the second part of this thesis. The projected rotational velocity $v\,\sin i$ was measured utilizing the zeros of the Fourier transformed spectral lines. For the acquired data quality a measurement of the rotation law was possible for stars with values of $v\,\sin i \geq 12\,\mathrm{km\,s^{-1}}$; for 84 of the 142 stars values of $v\,\sin i$ smaller than that threshold were measured. Among the faster rotators 21 stars had to be disregarded since their line profiles were dominated by surface features or the stars turned out to be binaries. Measurements of the rotation law were possible for 32 stars of spectral types F and G.

In ten of the 32 stars signatures of solar-like differential rotation were detected, 22 stars are consistent with solid body rotation. Most of the differential rotators have values of $v\,\sin i < 20\,\mathrm{km\,s^{-1}}$, but the fastest star showing differential rotation rotates as fast as $v\,\sin i = 42\,\mathrm{km\,s^{-1}}$; differential rotation is no attribute restricted to slow rotators. Lap times of the order of ten days have been detected, i.e., that the solar lap time of $\sim 130\,\mathrm{d}$ is not necessarily typical for all stars harbouring magnetic dynamos. All "fast" rotating ($v\,\sin i > 15\,\mathrm{km\,s^{-1}}$) differential rotators with lithium abundances available in the literature are Li-depleted. The idea of internal mixing processes due to differential rotation is supported by this result. Further correlations between differential rotation and other stellar parameters are expected and the relations indicated in the examined sample are discussed.

Thesis-related Publications: A&A 398, 647; A&A 393, L77; A&A 388, 1120; A&A 384, 155; A&A 376, L13

Ph.D. Thesis Abstracts

Identification of the Coronal Sources of the Slow Solar Wind

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Ph.D dissertation directed by: Prof. Ester Antonucci and Prof. Maria Adele Dodero

Ph.D degree awarded: January 2003

The origin and the acceleration of the solar wind is one of the most interesting problems in solar physics. The existence of two kinds of solar wind, fast and slow, has been known since the 70's, but the identification of the source regions was clear only for the fast wind while it is still discussed the precise origin of the slow wind. In fact, it was evident from the first solar space observations of the Skylab mission that fast streams originate from the dimmer regions of the corona, called coronal holes, characterized by open magnetic field lines and formed especially at the polar regions. The primary source of the slow wind at solar minimum is believed to be the streamer belt but there are several theories concerning the possible coronal sources: some of these propose the internal part of the streamer, other the external region, close to the streamer, as slow wind source. Therefore, it becomes crucial from the observational point of view, to investigate in the extended corona the transition between the streamer and the adjacent coronal hole region, where presumably the slow wind originates and accelerates.

The objective of this thesis is to study coronal streamers at solar minimum in order to investigate the source regions of the slow solar wind. The analysis performed is based on data obtained with the UltraViolet Coronagraph Spectrometer, UVCS, the first instrument capable of measuring the expansion velocity of the solar wind (Kohl *et al.*, 1995), on board the SOlar and Heliospheric Observatory (SOHO), ESA-NASA spacecraft. Through the spectroscopic analyses of the observed line profiles of the O VI λ 1031.93, 1037.62 Å doublet and of the HI Lyα λ 1215.67 Å, it is possible to determine the plasma physical parameters (e.g. kinetic temperature of ions, electron density, abundance of oxygen relative to hydrogen) inside and outside streamer and in particular to derive the outflow velocity of the solar wind. The diagnostics used in the analysis, has been developed by the solar group of Torino. In order to apply this method, information on the magnetic configuration of the solar corona is required, since a physical constraint is given by the mass flux conservation along the flow tube connecting the corona to the heliosphere. Since there are no direct measurements of the magnetic field in the extended corona up to now, the magnetic topology is extrapolated from the photospheric magnetic field through theoretical magnetic models.

The results of the analysis allow the identification of the acceleration region of the slow wind that is found to correspond with the transition between closed and open magnetic field lines. The resulting outflow velocity values vary from 60-90 km/s at 1.7 $R_\odot$ up to 120-150 km/s at 3.5 $R_\odot$. Moreover, the presence of outflowing plasma has been detected where the heliospheric current sheet is forming. This implies that a contribution to the slow wind comes also from the cusp of the streamer above the closed magnetic field lines. The analysis of the composition of the plasma, in terms of oxygen abundance relative to hydrogen, confirms the identification of the slow solar wind sources since they are characterized by an oxygen abundance typical of the heliospheric slow wind.

UPCOMING MEETING

JENAM 2003: New Deal in European Astronomy: Trends and Perspectives
Budapest, Hungary
25 - 30 August 2003

The 12*th* Meeting of the European Astronomical Society (EAS) will be held in Budapest, Hungary. The meeting will cover the basic fields of astronomy and astrophysics focusing on the major goals of research in the coming decades. One of the 10 minisymposia is a two-day meeting on

The Palette of Magnetic Phenomena from Active Stars to the Sun

held in tandem with **Active Stars and Interacting Binaries**.

SOC: Katalin Oláh (Konkoly Observatory, olah@konkoly.hu), Lidia van Driel- Gesztelyi (MSSL, University College London and Konkoly Observatory, lidia.vandriel@obspm.fr), Klaus Strassmeier (Astrophysical Institute Potsdam, Kstrassmeier@aip.de)

Main topics:

1. Where is the solar/stellar dynamo?
2. Activity on single and close binary stars: what is the difference?
3. Multi-wavelength observations of solar and stellar activity patterns - active region evolution, differential rotation, cycles
4. Eruptive events and atmosphetic heating on the Sun and on stars

Confirmed invited speakers:

Giuseppe Cutispoto (Astrophysical Observatory Catania), Robert Erdélyi (University of Sheffield), Antonio Frasca (Astrophysical Observatory Catania), Alvaro Gimenez-Canete (ESA/ESTEC RSSD), Thomas Granzer (Astrophysical Institute Potsdam), Volkmar Holzwarth (School of Physics and Astronomy at the University of St. Andrews, Scotland), Heidi Korhonen (Astrophysical Institute Potsdam), Nuccio Lanza (Astrophysical Observatory Catania), Salvatore Orlando (Astronomical Observatory G. S. Vaiana, Palermo), Kristóf Petrovay (Eötvös University Budapest), Ignasi Ribas (University of Barcelona, Michal Weber (Astrophysical Institute Potsdam)

Websites:
http://astro.elte.hu/jenam2003/ (for general information)
http://astro.elte.hu/jenam2003/minisymp/activestars.html

Registration deadline for early registration fee: 31 May.

See you in Budapest!

UPCOMING MEETING

Early Stages of Star Formation
Minisymposium held within the framework of JENAM-2003 Symposium
Budapest, Hungary
26 -27 August 2003

Scientific rationale:

In the last decade considerable progress has been made on fundamental issues linked to the star formation process, to the physics of young stellar objects and their circumstellar environment. There remain, however, important open problems related to the understanding of physical processes which lead to the onset of star formation and shape the properties of nascent stellar aggregates.

Why and how do molecular clouds start forming stars? What is the role of turbulence, magnetism and gravity during the star formation process? How do brown dwarfs form? How has the physics of star formation evolved over cosmological time scales due to the varying environment? Theoretical and observational studies of the earliest stages of star formation, as well as numerical modelling of cloud evolution in the last years led to radically new views on these issues.

This mini-symposium will address problems related to the early phases of star formation - starting with the fragmentation and collapse of molecular cloud cores to the time when the forming protostars become visible in the optical - the T Tauri phase. We will discuss observations and theory related to this timespan, in which stars gain most of their final mass. The symposium should include the formation processes of single and multiple stars, as well as accretion and outflow phenomena that are connected to them. Properties of the star formation process in the early universe and their evolution to the present state will also be touched upon.

Main topics of the five sessions of the minisymposium:

(1) initial conditions, fragmentation

(2) collapse, accretion, outflows

(3) clustered and isolated star formation, IMF

(4) formation of brown dwarfs

(5) star formation in the early universe

Scientific Organizing Committe:

P. Abraham, Hungary
J. Alves, ESO
M. Bate, UK
J. Eisloeffel, Germany (convenor)
M. Kun, Hungary (convenor)
H. Zinnecker, Germany

Invited speakers:

Joao Alves
John Bally
Philippe Andre
Zoltan Haiman
Ralf Klessen
Hans Zinnecker

Proceedings of the minisymposium:

Invited and contributed talks, as well as poster presentations will be published in a special issue of Baltic Astronomy.

For more details and registration, see **http://www.konkoly.hu/jenam03/**

Announcement

Oslo Summer School on Radiative Transfer and Numerical MHD
Institute of Theoretical Astrophysics
Oslo, Norway
2 - 13 June 2003

A summer school on radiative transfer and numerical magnetohydrodynamics is to be held as part of the European Solar Magnetism Network (http://esmn.astro.uu.nl/).

The aim of the school is to give a basic understanding of radiation, radiative transfer, polarimetry and numerical magnetohydrodynamics in the context of stellar atmospheres. Special emphasis will be given to applications through extensive practical work with numerical methods.

The principal lecturers will be:

- Rob Rutten (SIU Utrecht): Introduction to Radiative Transfer
- Mats Carlsson (ITA, Oslo): Numerical Methods in Radiative Transfer
- Jorge Sánchez Almeida (IAC, La Laguna): Methods of Polarimetry
- Rony Keppens (Rijnhuizen, Nieuwegein): Numerical Magnetohydrodynamics

The course is aimed at graduate students and post-docs entering the field. The school cost is 2500 NOK (about EUR 320 or USD 350 at present) and includes teaching materials, housing and local transportation within Oslo, but no food or travel to Oslo.

Detail: http://www.astro.uio.no/school-03/

The closing date for applications is 15th April. Applicants should use the form at http://www.astro.uio.no/school-03/ and supply one letter (preferably email) of reference. Contact email address: school-03@astro.uio.no

Announcement

XV CANARY ISLANDS WINTER SCHOOL OF ASTROPHYSICS
Payload and Mission Definition in Space Sciences

November 17th - 28th, 2003
Puerto de La Cruz, Tenerife, Spain
Organized by the Instituto de Astrofísica de Canarias

The XV Canary Islands Winter School of Astrophysics (WS), organized by the Instituto de Astrofísica de Canarias (IAC), will be dedicated to instrumentation for space sciences in a broad sense with an emphasis on the missions included in the newly released ESA Cosmic Vision 2020 program. The WS focuses on how the scientific drivers impact the definition of the missions and their payloads. The WS welcomes a maximum of 70 PhD students and young Post-Docs, and provides each year a unique opportunity for the participants to broaden their knowledge in a key field of Astronomy.

This year WS on instrumentation for space astronomy will provide firm ground for young researchers that will play a key role in the development of future spacecrafts. Attention will be paid in particular to those missions that are included in the ESA program Cosmic Vision 2020 (which will be formally introduced by ESA D/Sci Prof. David Southwood). Being a scientifically driven school, the starting point will be how the science drivers define the missions and their instrumentation. But it will also show how the technology limitations imposed by the space environment severely constrains the scientific scope of the missions. The WS will address traditional topics for space research as interplanetary medium in-situ measurements, planetary exploration and the detection of electromagnetic windows unobservable from the ground (Gamma-, X-ray and UV). However, and as spacecrafts like HST and SOHO have shown, observations in visible wavelengths greatly benefit from the absence of atmospheric turbulence and continuous observations. Thus, the WS will also cover visible and IR observations as planned in a number of future missions. Cosmic Vision 2020 missions included here are Rosetta, Mars and Venus Express, Bepi Colombo, Solar Orbiter, Herschel, Planck, Eddington, JWST, Gaia and the future projects Xeus and Darwin. The WS also focuses on the general problems related to every mission such as launchers, orbits, service modules and ground segment.

The lectures (5 hours each) included in the Winter School are:

- Measurements of electromagnetic fields and particles in space. Prof. Andre Balogh
- Planetary observations and landers. Prof. Angioletta Coradini
- EUV and UV imaging and spectroscopy from space. Prof. Richard Harrison
- Design issues for space science missions. Prof. Yves Langevin
- Space infrared astronomy. Dr. Mark McCaughrean
- Gamma and X ray instrumentation. Prof. Victor Reglero
- Spacecraft and ground segment. Dr. Gerhard Schwehm
- Visible light telescopes and instruments. Dr. Ted Tarbell

In addition, Prof. Alvaro Giménez (Head of RSSD, ESA/ESTEC) will give a two hours lecture on: Basic steps in designing a space mission and making a proposal

Fax: + 34 922 605210
E-mail: xvwinter@ll.iac.es
Internet: `http://www.iac.es/winschool2003/info.html`

SOC: V. Martínez Pillet, A. Aparicio, F. Sánchez (IAC, Tenerife)

Announcement: 2MASS Availability

The Two Micron All Sky Survey (2MASS) is pleased to announce that the All-Sky Data Release Point Source Catalog (PSC) and Extended Source Catalog (XSC) are now available. The All-Sky PSC contains accurate positions and J, H and Ks photometry for over 470 million sources, most of which are stars in the Milky Way. The All-Sky XSC contains positions, three-band photometry and basic shape information for over 1.6 million resolved sources, most of which are galaxies. The 2MASS "Quicklook" Atlas Images, have been available online since October of last year.

An introduction to the Release data products and supporting documentation is available at
http://www.ipac.caltech.edu/2mass/releases/allsky/
or you may access the Catalogs and Images directly from the NASA/Infrared Science Archive at
http://irsa.ipac.caltech.edu/ .

The Catalogs will also be available via bulk ftp download and on a limited-distribution DVD-ROM in the near future.

Users are strongly encouraged to review the Explanatory Supplement to the 2MASS All-Sky Data Release at
http://www.ipac.caltech.edu/2mass/releases/allsky/doc/explsup.html
for general information about the Survey, the formats, characteristics and cautionary notes about the Catalogs.

User support is available via the 2MASS Help Desk at 2mass@ipac.caltech.edu.

The Two Micron All Sky Survey is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology. Funding for the survey has been provided by the National Aeronautics and Space Administration and the National Science Foundation.

Announcement: New Book

I N F O R M A T I O N The publisher ASTROPRINT (Odessa, Ukraine) has published in *Russian* a monograph *The Solar-type Activity Amongst the Main Sequence Stars* by R.E. Gershberg. The results of study of solar-type activity that is inherent in the majority of low- and middle-mass main sequence stars, its manifestations during flares and in the quiet state within the whole range of the electromagnetic spectrum are systematized and summarized. Comprehensive analysis of the variety of stellar activity manifestations leads to the identification of these phenomena with macroscopic non-linear processes in magnetized plasma. The conception is that matter is self-organized on different spatial and temporal scales. A star as a whole is a dissipative system of the largest scale where global magnetic fields are self-organized due to stellar rotation and convection. In smaller scale structures, dissipative systems arise which lead to stellar flares and other events related to local magnetic fields.

The content of the monograph is: Preface Introduction: short history of the flare red dwarf stars' studies and terminological notes The first part. Flare stars in a quiet state 1.1. General characteristics of flare stars 1.2. Photospheres: undisturbed photospheres, starspots and magnetic fields at the photospheric level 1.3. Chromospheres and transition regions: optical and ultraviolet spectra of chromospheres and transition regions, models of stellar chromospheres 1.4. Coronae and stellar winds: soft X-ray emissions of coronae, EUV and X-ray spectroscopy, microwave and shortwave emissions, stellar winds and far IR emissions 1.5. Heating mechanisms for stellar atmospheres The second part. Flares 2.1. General picture of stellar flares 2.2. Temporal characteristics of flares: time scales of flares and time distribution of flares 2.3. Flare energy: energy of flare optical emission and estimates of a total energy of flares 2.4. Time development and radiation mechanisms of flares in different ranges of the electromagnetic spectrum: X-ray, radio, ultraviolet and optical emissions of flares 2.5. Models of the stellar flares The third part. Long-term variations of stellar activity 3.1. Activity cycles 3.2. Evolutionary changes in stellar activity: stellar and solar activity evolution Conclusion: the main problems of magnetism of low- and middle- mass stars of the main sequence References Appendix. Catalogue of the UV Cet-type flare stars in the solar vicinity

The total volume of the book is 688 pages, it contains 20 tables, 74 figures and 1432 references. The price is 50 USD, postal expenses included. Orders can be sent to aprint@ukr.net.

Job Opening (Postdoctoral)

Two Postdoctoral Fellowships in Solar Physics
Armagh Observatory (N. Ireland)

Applications are invited for postdoctoral fellowships in Solar Physics to be held at Armagh Observatory beginning September 2003 or as soon as possible thereafter. One post is for 2 years while the second is for 2.5 years. The PDRA's work activities will be directed towards an extensive data reduction/interpretation programme (including modelling) relating to a range of transient phenomena and their interrelationships. This will involve the use of data (both ground and satellite based) from several different instruments. A knowledge of spectroscopy and atomic processes would be an advantage for one of the two posts.

Further information about Armagh Observatory, and in particular the current Solar Physics research, may be obtained by consulting the Observatory web-site http://www.arm.ac.uk or via email to Gerry Doyle (jgd@star.arm.ac.uk).

The closing date for applications is 14 June 2003. Prospective applicants should obtain an application pack from the Administrator or it may be downloaded from http://star.arm.ac.uk/~jgd/outgoing/JOB/. The completed application form, together with a full curriculum vitae and bibliography should be sent to: The Administrator, Armagh Observatory, College Hill, Armagh BT61 9DG, N. Ireland. [Tel. +44-(0)28-3752-2928, Fax. +44-(0)28-3752-7174, email lfy@star.arm.ac.uk]. Applicants are asked to ensure that references from three referees should also reach the Administrator by the same date.

Ph.D. Student Openings and Research Assistantships
Astronomy Group
University of Texas at Arlington

The Astronomy Group at the Department of Physics, University of Texas at Arlington (Dallas-Fort Worth Metroplex) has one or more openings for Ph.D. students. The Astronomy Group has a broad range of research interests, including solar and stellar physics, magnetohydrodynamics, extra-solar planets, orbital stability analysis and chaos, stellar habitable zones and astrobiology. Research assistantships are available.

Applicants should indicate their interest directly to

Prof. Manfred Cuntz
Department of Physics
Science Hall
University of Texas at Arlington
Arlington, TX 76019-0059

Email: cuntz@uta.edu

and should arrange for two letters of recommendation. Offer available until position(s) are filled.

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` .

*** Please send abstracts in the body of the message and *not* as attachments.***