COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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TABLE OF CONTENTS

Stellar Abstracts

Observations and Modelling of a Large Optical Flare on AT Microscopii

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Spectroscopic observations covering the wavelength range 3600–4600Å are presented for a large flare on the late type M dwarf AT Mic (dM4.5e). A procedure to estimate the physical parameters of the flaring plasma has been used which assumes a simplified slab model of the flare based on a comparison of observed and computed Balmer decrements. With this procedure we have determined the electron density, electron temperature, optical thickness and temperature of the underlying source for the impulsive and gradual phases of the flare. The magnitude and duration of the flare allows us to trace the physical parameters of the response of the lower atmosphere. In order to check our derived values we have compared them with other methods. In addition, we have also applied our procedure to a stellar and a solar flare for which parameters have been obtained using other techniques.

Accepted by A&A

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Absolute Radial Velocities for 889 Late-type Stars

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We report absolute radial velocities with accuracy of 0.03 km s^{-1} for 889 FGKM–type main sequence stars. The velocities agree within 0.035 km s^{-1} (RMS) with the 26 standard stars of Udry, et al. (1999) IAU Coll 170, 367 "Towards a New Set of High-Precision Radial-Velocity Standard Stars." The velocity zero–point was set using observations of the day sky and the asteroid Vesta. The resulting zero–point of our velocities is only slightly different from that of Udry et al.: $< V_{\rm present} - V_{\rm Udry} > = +0.053$ km s^{-1} . Gravitational redshifts and convective blueshifts are accounted for in our velocity measurements to first order, by using the known velocity of the Sun to set the velocity zero–point. Nonetheless these two effects will cause systematic velocity errors of $\sim$0.3 km s^{-1}as a function of spectral type. Multiple spectra were obtained for all 889 stars during four years, and 782 of them exhibit velocity scatter less than 0.1 km s^{-1}. These stars may serve as radial velocity standards if they remain constant in velocity. We found 11 new spectroscopic binaries and report orbital parameters for them.

Submitted to ApJ

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The Capella Giants and Coronal Evolution Across the Hertzsprung Gap

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We present an analysis of the coronal Fe XXI 1354 Å line observed in medium resolution HST/STIS echelle spectra of Capella obtained on 12 September 1999. These data were collected in support of a multiwavelength spectroscopic campaign designed to provide detailed temperature and density diagnostics over a wide range of temperatures, and are accompanied by simultaneous Chandra, EUVE, SAX, and VLA observations. The Fe XXI 1354 Å line formed at 10^7 K is crucial to interpretation of these datasets as it allows deconvolution of the coronal flux of the two binary components. While earlier observations implied comparable coronal emission from both stars, our data indicate that nearly all the Fe XXI flux in the C I/Fe XXI blend at 1354 Å arises from the rapidly rotating G1 III secondary. This suggests a significant decline in the hottest part of the corona of the G8 III primary over the past five years. For the first time, we can assign the variability of the high temperature X-rays to the cooler He-core burning star in the system. This result suggests that nascent coronae in the early Hertzsprung gap phase apparently do not vary, and cyclic activity and strong variability is seen only in later evolutionary stages when dynamos are more developed in deeper convective envelopes.

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The Quadruple System μ Orionis: Three-dimensional Orbit and Physical Parameters

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μ Orionis is a spectroscopic-visual quadruple system in which each visual component is a short-period spectroscopic binary. The visual orbit has a period of 18.644 years, a high eccentricity of 0.7426, and a high inclination of 96.2 degrees. The visual primary consists of an Am star and probably a G or early-K dwarf, which orbit each other in a nearly circular orbit with a period of 4.4475858 days. The visual secondary consists of a pair of F5: V stars in a circular orbit with a period of 4.7835361 days. While the masses of the two stars are nearly identical and the magnitude difference between the pair is close to zero, the projected rotational velocities differ by almost a factor of two. The orbit for the B subsystem is not coplanar with the visual orbit, while that for the A subsystem is probably not coplanar as well. The orbital parallax of 0.02107" ± 0.00018" is more accurate than that obtained from the *Hipparcos* satellite observations and corresponds to a distance of 47.5 ± 0.4 pc. A comparison with evolutionary tracks indicates that the Am star is near the end of its main-sequence evolution.

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Solar Abstracts

Modelling of Explosive Events in the Solar Transition Region in a 2D environment: Part II. Various MHD Experiments

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We examine the response of various physical environments representing the solar atmosphere to a magnetic reconnection event. The reconnection is driven by a localized increase of the magnetic diffusivity in the current concentration formed between two magnetic fluxes of opposite polarity. The time dependent evolution is then followed by numerically solving the 2-dimensional (2D) dissipative magnetohydrodynamic (MHD) equations, including also effects of thermal conduction, radiative losses, and volumetric heating.

This work continues a previous related study (Roussev et al 2001a), and compares results obtained from exploring different initial states. The choice of the initial states is found to be crucial to the dynamics of the reconnection jets. The numerical experiments are aimed at modelling transient events on the quiet Sun, with an emphasis on explosive events. The 2D reconnection experiments presented in this paper are the basis for a detailed analysis on the line synthesis in transition region resonant lines, presented by Roussev et al (2001b).

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Modelling of Explosive Events in the Solar Transition Region in a 2D Environment: Part III. Observable Consequences

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We examine the response via line synthesis of two representative transition region lines, namely C IV 1548.2 Å and O VI 1031.9 Å, in various physical environments representing the 'quiet' Sun to magnetic reconnection events. Our calculations of ion populations allow for departures from equilibrium ionization (EI), which is critical in studies of transient events. Both lines reveal highly blue- and red-shifted Doppler components, and some of the results are examined in the context of solar explosive events. The observable consequences of magnetic reconnection are subtle in the various physical circumstances examined here and differ from one emission line to another, because of the difference in their formation temperatures.

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Temporal Evolution of Different Temperature Plasma During Explosive Events

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High cadence observations (10 s exposure time) obtained with the SUMER spectrometer on-board SoHO in the Ly 6 (20 000 K) and S VI (200 000 K) lines reveal new insight on the nature of explosive events. A time delay in the response of the S VI line with respect to the Ly 6 line has been observed, with the Ly 6 line responding with about 20-40 seconds earlier. A temporal series obtained with 30 s exposure time and covering the entire Lyman series plus O I, C II and S VI (temperature range from 15 000 to 200 000 K) has also been explored showing the response of all these lines during transient phenomena. New common features linking explosive events and blinkers were found. During explosive events, the central intensity increases between 1.6 and 2.0 times the pre-event value while the same range of intensity increase was already reported during blinker phenomena. On the other hand the maximum intensity increase in Ly 6 was only 13 %.

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Signatures of Very Long Period Waves in the Polar Coronal Holes

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We examine long spectral time series of a coronal hole observed on the 7th March 2000 with the Coronal Diagnostic Spectrometer (CDS) on-board SoHO. The observations were obtained in the chromospheric He I, and a series of higher temperature oxygen lines. In this letter we report on the presence of long period oscillations in a polar coronal hole region on the disk. Our observations indicate the presence of compressional waves with periods of 20-30 minutes or longer.

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Long Period Oscillations in the Inter-plume Regions of the Sun

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We examine long spectral time series of inter-plume lanes observed on the 14th & 15th March 2000 with the Coronal Diagnostic Spectrometer (CDS) on-board SoHO. The observations were obtained in lines over a wide temperature range, from the chromosphere to the corona. The statistical significance of the oscillations was estimated by using a randomisation method. Our observations indicate the presence of compressional waves with periods of 20-50 minutes or longer, both off-limb and on-disk and up to 70 minutes further out to at least 25 arcsec off-limb. To our knowledge this is the first time that long period oscillations in the inter-plume regions close to the limb of the Sun have been detected. We interpret these oscillations as outward propagating slow magneto-acoustic waves which may contribute significantly to the heating of the lower corona by compressive dissipation and which may also provide enough energy flux for the acceleration of the fast solar wind. These slow waves may have been produced at the network boundaries in the coronal hole.

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Location of Narrowband Spikes in Solar Flares

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Narrowband spikes of the decimeter type have been identified in dynamic spectrograms of Phoenix-2 of ETH Zurich and located in position with the Nançay Radioheliograph at the same frequency. The spike positions have been compared with the location of hard X-ray emission and the thermal flare plasma in soft X-rays and EUV lines. The decimetric spikes are found to be single sources located some 20" to 400" away from the flare site in hard or soft X-rays. In most cases there is no bright footpoint nearby. In at least two cases the spikes are near loop tops. These observations do not confirm the widely held view that the spike emission is produced by some loss-cone instability masering near the footpoints of flare loops. On the other hand, the large distance to the flare sites and the fact that these spikes are all observed in the flare decay phase make the analyzed spike sources questionable sites for the main flare electron acceleration. They possibly indicate coronal post-flare acceleration sites.

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Regular Structures of the Solar Photosphere (Persistence of the Granular Field and Trenching in the Brightness Relief)

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The simple procedure of time averaging, when applied to the photospheric brightness field, reveals quasi-regular structures of the photospheric and subphotospheric flows. We use an 8-h sub-set of the series of photospheric images obtained on 5 June 1993 with the Swedish Vacuum Solar Telescope, La Palma. First, the averaged images are far from completely smeared and contain a multitude of bright, granular-sized blotches even if the averaging period is as long as 8 h. This suggests that granules prefer to originate at certain sites, where they emerge repeatedly, and the granular field demonstrates a sort of persistence for many hours. Second, the resulting patterns display relatively regular structures, which can be revealed only if the averaging period is sufficiently long (the optimum seems to lie between 2 and 3 h). The averaged brightness relief is "trenched": it comprises systems of concentric rings and arcs as well as straight or slightly wavy lines and systems of parallel strips. The trenching patterns resemble the so-called target patterns observed in experiments on Rayleigh–Bénard convection. In addition, the brightness values at a local averaged-field maximum and at a nearby minimum exhibit a distinct tendency to vary in antiphase. Thus, a previously unknown type of self-organization is manifest in the solar atmosphere, and our findings support the suggestion that granules are associated with overheated blobs carried by the convective circulation.

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Low-Mass and Sub-Stellar Abstracts

Atmospheric Analysis of the M/L– and M/T–Dwarf Binary Systems LHS 102 and Gliese 229

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We present 0.9—2.5μm spectroscopy with R$\sim$800 and 1.12—1.22μm spectroscopy with R$\sim$5800 for the M dwarfs Gl 229A and LHS 102A, and for the L dwarf LHS 102B. We also report $IZJHKL'$ photometry for both components of the LHS 102 system, and L' photometry for Gl 229A. The data are combined with previously published spectroscopy and photometry to produce flux distributions for each component of the kinematically old disk M/L–dwarf binary system LHS 102 and the kinematically young disk M/T–dwarf binary system Gliese 229. The data are analyzed using synthetic spectra generated by the latest "AMES-dusty" and "AMES-cond" models by Allard & Hauschildt. Although the models are not able to reproduce the overall slope of the infrared flux distribution of the L dwarf, most likely due to the treatment of dust in the photosphere, the data for the M dwarfs and the T dwarf are well matched. We find that the Gl 229 system is metal–poor despite having kinematics of the young disk, and that the LHS 102 system has solar metallicity. The observed luminosities and derived temperatures and gravities are consistent with evolutionary model predictions if the Gl 229 system is very young (age $\sim 30\,$Myr) with masses (A,B) of $(0.38,\geq 0.007)\mathrm{M}_{\odot}$, and the LHS 102 system is older, aged 1—10 Gyr with masses (A,B) of $(0.19,0.07)\mathrm{M}_{\odot}$.

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No Disks Around Low-mass Stars and Brown Dwarfs in the Young σ Orionis Cluster?

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We report on the analysis of 2MASS near-infrared data of a sample of low-mass stars and brown dwarfs in the σ Orionis cluster. Youth and cluster membership have been spectroscopically confirmed using the Li I spectral line. We find little evidence in the $JHK_{\rm s}$ colour-colour diagram for near-infrared excess emission for these cluster members. By comparison with model expectations, at most 2 out of 34 stars show $(H-K_{\rm s})$ colour consistent with a near-infrared excess. This scarcity of near-infrared signatures of circumstellar disks in the lower-mass and substellar regimes of this cluster contrasts with findings in younger clusters, hinting at an age dependence of the disk frequency. Taking into account the apparent cluster age, our result supports the idea of a relatively fast (few Myr) disk dissipation and extends this conclusion to the substellar regime. We also find some evidence that, in this cluster, the disk frequency as measured by the $\mathrm{K_s}$-band excess may be mass dependent.

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For preprints via ftp or WWW: http://arXiv.org/abs/astro-ph/0112319

New Instruments

The STELLA Project: Two 1.2m Robotic Telescopes for Simultaneous High-resolution Echelle Spectroscopy and Imaging Photometry

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We present an overview and a brief report on the status of the STELLA project (abbreviation for STELLar Activity). The STELLA-I telescope will be the first robotic telescope that feeds a bench-mounted high-resolution Echelle spectrograph with a set of 50 and 100μm fibres and provides spectral resolutions of up to 47,000 with a 1 arcsec slit. The

spectrograph is a white-pupil design located in a separated temperature-controlled room to guarantee long-term stability. The building will have a roll-off roof and is capable to host two telescopes. First light for STELLA-I is planned for summer 2002. STELLA-II is foreseen to be a photometric imaging telescope for the optical and near-infrared wavelengths and will follow in 2003.

Accepted by AN

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Automation Hardware and Software for the STELLA-I Robotic Telescope

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STELLA-I will be among the first fully robotic telescopes for high-resolution Echelle spectroscopy. First light is scheduled for summer 2002. We present a first status report on the development of the computer hardware and the operating software for the STELLA facility. All computers for STELLA are standard PCs running under the Linux operating system and with communication based on specialized hardware via a RS232/RS485 bus system. The high level (java based) control software consists of independent modules to ease bug-tracking and to allow the system to be extended without changing existing modules.

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The Wolfgang and Amadeus Automatic Photoelectric Telescopes: A "Kleine-Nacht-Musik" During the First Five Years of Routine Operation

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We present a summary of five years of continuous operation of the University of Vienna twin Automatic Photoelectric Telescopes (APTs) – *Wolfgang* and *Amadeus*. These two telescopes are part of the Fairborn Observatory facility located in the Sonoran desert close to Washington Camp in southern Arizona. The detection and distinction procedure between weather-induced data-quality loss and systematic data-quality loss turned out to be a crucial task. Therefore, special emphasis is laid on the data quality monitoring tools developed throughout the years. Furthermore, we summarize the scientific highlights from the first five years of operation.

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ANNOUNCEMENT

New IAU Working Group on Abundances in Red Giants

The IAU has recently approved the formation of a new Working Group, dedicated to advancing our understanding of abundances in red giant stars. This has become increasingly important in the last decade. For example, the continuing question of the abundance anomalies in globular cluster red giants now seems to require both primordial abundances as well as interior mixing beyond the standard theory. Solutions to these problems may be within reach soon, as a result of both theoretical breakthroughs as well as access to larger telescopes and finer instruments.

Concurrent with this has been the continued growth in our understanding of the importance and variety of nucleosynthesis occurring in AGB stars. These have implications well beyond the structure and evolution of the stars themselves. The related subject of the chemical evolution of the galaxy, for example, is intimately tied to AGB star nucleosynthesis. This is another area which is extremely rich for research at the moment, with incredible insights, constraints and data coming from meteorite analysis of pre-solar grains.

As a result of these recent and complementary developments, there has been a renewed synergy between cross-disciplinary areas related to red giants of all kinds. Hence we have formed the new Working Group, whose initial functions will be:

- to enhance communication among interested researchers by drawing up an email address list and sending messages about planned activities;
- to set up a new web site for posting relevant announcements, data sets, etc.
- to organize a symposium as part of the next IAU General Assembly in Sydney in 2003.

We are sponsored by Division IV (Stars) as well as Commissions 29, 35, 36 and 45.

Please see the following web-site for information:

http://www.maths.monash.edu.au/~johnl/wgarg/

Submitted by: John Lattanzio (Chair, WG-ARG)

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

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