COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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TABLE OF CONTENTS

Stellar Abstracts

A Survey of Chromospheric Activity in the Solar-Type Stars in the Open Cluster M67

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We present the results of a spectroscopic survey of the Ca II H & K core strengths in a sample of solar-type stars that are members of the solar-age and solar-metallicity open cluster M67. The spectra were obtained with the 3.5-m WIYN telescope in conjunction with the *Hydra* multi-object spectrograph. The sample consists of 60 stars in the $(B-V)_0$ color range of 0.58—0.76, corresponding to a range in spectral type of approximately F9 V—G9 V. We adopt the HK index, defined as the summed H+K core strengths in 0.1 nm bandpasses centered on the H and K lines, respectively, as a measure of the chromospheric activity that is present. In order to gain insight on the potential range of the solar cycle, we compare the distribution of mean HK index values for the M67 solar-type stars with the variation of this index as measured for the Sun during the contemporary solar cycle. We find that the stellar distribution in our HK index is broader than that for the solar cycle. Approximately 17% of the M67 sun-like stars exhibit average HK indices that are less than solar minimum. About 7%—12% are characterized by relatively high activity in excess of solar maximum values while 72%—80% of the solar analogs exhibit Ca II H+K strengths within the range of the modern solar cycle. The ranges given reflect uncertainties in the most representative value of the maximum in the HK index to adopt for the solar cycle variations observed during the period A.D. 1976—2004. Thus, $\sim$ 20%—30% of our homogeneous sample of sun-like stars have mean chromospheric H+K strengths that are outside the range of the contemporary solar cycle. Seasonal variability is present that, in general, is larger in amplitude than what is observed in the modern solar cycle. Any cycle-like variability that is present in our sample of solar-type stars appears to be characterized by periods greater than $\sim$ 6 years. Finally, we estimate a mean chromospheric age for M67 in the range of 3.8—4.3 Gyr.

continued →

Accepted by ApJ (November 1, 2006 issue)
For preprints contact: giampapa@noao.edu
For preprints via ftp or WWW: astro-ph/0607313

On the CO Near-IR Band and the Line Splitting Phenomenon in the Yellow Hypergiant ρ Cassiopeiae

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We report on multi-epoch optical and near-infrared spectroscopy around the first overtone ro-vibrational band of CO in the pulsating yellow hypergiant ρ Cas, one of the most massive stars in the Galaxy and a candidate SN II progenitor. We argue that the double cores of the CO absorption lines, that have previously been attributed to separate circumstellar shells expelled during its recurrent outbursts, result in fact from a superposition of a wide absorption line and a narrow central emission line. The CO line doubling returns over subsequent pulsation cycles, where the superposed line emission assumes its largest intensity near phases of maximum light. We find that the morphology and behavior of the CO band closely resemble the remarkable "line-splitting phenomenon" also observed in optical low-excitation atomic lines. Based on radiative transport calculations we present a simplified model of the near-IR CO emission emerging from cooler atmospheric layers in the immediate vicinity of the photosphere. We speculate that the kinetic temperature minimum in our model results from a periodical pulsation-driven shock wave. We further discuss a number of alternative explanations for the origin of the ubiquitous emission line spectrum, possibly due to a quasi-chromosphere or a steady shock wave at the interface of a fast expanding wind and the ISM. We present a number of interesting spectroscopic similarities between ρ Cas and other types of cool variable supergiants such as the RV Tau and R CrB stars. We further propose a possibly common mechanism for the enigmatic outburst behavior of these luminous pulsating cool stars.

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For preprints via WWW: http://arxiv.org/abs/astro-ph/0607158

Spitzer Observations of Nearby M Dwarfs

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We present *Spitzer* IRAC and MIPS observations for a sample of eight M dwarfs: six dMe, one dM, and one sdMe star. All of our targets are found to have SEDs which are fitted within the error bars by a purely photospheric spectrum out to 24 microns. We find no evidence for IR excess. None of our targets is detected in the MIPS 70 and 160 micron bands. The estimated ages for all are >10 Myr, suggesting that enough disk dissipation has occurred within the inner several AU of the star. For four of these, Mullan et al. (1989) had reported IRAS detections at 12 micron, although the reported fluxes were below the 5- σ IRAS detection limit (~0.2 Jy). Mullan et al. also pointed out that V-K colors in dMe stars are larger than those in dM stars, possibly because of the presence of a chromosphere. Here we suggest that metallicity effects provide a better explanation of the V-K data.

For reasons of observational selection, our targets are *not* the most active flare stars known, but being dMe stars indicates the presence of a chromosphere. Scaling from Houdebine's model of the AU Mic chromosphere, we have computed the free-free infrared excesses for a range of densities. Our *Spitzer* 24 micron data shows that the chromospheres in two of our targets are less dense than in AU Mic by a factor of 10 or more. This is consistent with the fact that our sample includes the less active flare stars. Our models also indicate that the chromospheric contribution to the observed AU Mic emission at submillimeter wavelengths is only about 2%.

Accepted by ApJ (*continued*) →

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Solar Abstracts

Periodicities in Irradiance and in Other Solar Activity Indices During Cycle 23

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Magnetic fields give birth to distinctive features in different solar atmosphere regimes. In this respect time variations of the flare index, the sunspots numbers and the sunspot areas arising from different physical conditions were compared with the solar composite irradiance during the running cycle 23. The Rieger-type periodicities in these time series were calculated using the Fourier and wavelet transforms. The peaks of the wavelet power of these periodicities were appeared between the years 1999-2002. We found that the solar irradiance oscillations compared with the other's, are less significant during this running cycle. The irradiance shows non-periodic fluctuations during this time interval. The peaks of the flare index, the sunspot number and the sunspot total area were seen around 2000.4, 1999.9 and 2001.0, respectively. These periodicities appeared intermittently and were not simultaneous in different solar activity indices between the three years of the maximum phase of the solar cycle 23.

Accepted by Solar Phys.
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Observations of the Coronal Dynamics Associated with Solar Radio Spike Burst Emission

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We present the results of an analysis of multi-wavelength data for a solar radio spike burst event which was observed on 1997 November 14 by the Solar Radio Spectrometers of the Astrophysikalisches Institut Potsdam (AIP).Using radio imaging data from the Nançay Radioheliograph we are able to determine the location of the spike burst emission sites in relation to the associated flare and its coronal environment as seen in images from the *Yohkoh* Soft X-ray Telescope (SXT), Hard X-ray Telescope (HXT) and the Solar and Heliospheric Observatory (SOHO) Extreme ultraviolet Imaging Telescope (EIT). For this event we find that the spike burst emission originated high in the corona, $\sim$ 122 Mm above the soft X-ray and hard X-ray emitting regions of the associated (near-limb) flaring region. Using imaging data from SXT, HXT, and EIT we are also able to show, for the first time, the location of a solar radio spike burst in relation to the dynamics of coronal structures. We find that as an earlier flare-associated coronal mass ejection (CME) in the vicinity expanded outwards it appeared to compress the magnetic field structures at its flanks (associated with highly inclined coronal loops at the periphery of the active region). The radio spike bursts appeared at the time and in the vicinity of the compression of the coronal field. The compression presumably led to reconnection of the coronal magnetic field structures, particle acceleration and the radio spike burst emission signatures. For the specific event we analyse we find that the spike burst emission is associated with secondary flare energy release induced by an earlier flare-associated CME. These observations also provide evidence for a new category of sympathetic flaring where a large flare-associated coronal mass ejection compresses adjacent magnetic structures leading to nearby, but remote, small-scale flaring.

Accepted by A&A

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RHESSI and TRACE Observations of an M2.5 Flare: A Direct Application of the Kopp and Pneuman Model

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Context. The processes of current sheet formation and magnetic reconnection are nowadays believed to be at the basis of several solar phenomena, including erupting prominences, flares, and CMEs. However, the possibility of determining clear signatures of the occurrence of these processes in erupting active regions is still lacking in several aspects.
Aims. In this paper we analyze coronal images relevant to a system of loops involved in a very energetic flare, to search for observational signatures of current sheet formation and magnetic reconnection and compare them with what is expected from theory.
Methods. X-ray and EUV data acquired by the *Ramaty High-Energy Solar Spectroscopic Imager* (RHESSI) and the *Transition Region and Coronal Explorer* (TRACE) satellites have been used to analyze an M2.5 flare that occurred in NOAA 9901 on 16 April 2002. The evolution of the flare loops, the EUV footpoints, and the X-ray loop tops have been studied.
Results. The event shows a simple morphology in which the EUV and X-ray sources change from an X to a Y configuration; the formation of a thin, filamentary structure, compatible with what is expected from the collapse of an X-point in a current sheet, is observed; the height of the top of the observed EUV loops and the separation between the footpoints show an increase with time.
Conclusions. The study of this event provides several observational signatures, expected from theory during the formation of a current sheet and consequent reconnection, which allowed us to interpret it in the framework of the Kopp and Pneuman model.

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Torus Instability

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The expansion instability of a toroidal current ring in low-beta magnetized plasma is investigated. Qualitative agreement is obtained with experiments on spheromak expansion and with essential properties of solar coronal mass ejections, unifying the two apparently disparate classes of fast and slow coronal mass ejections.

Phys. Rev. Lett. 96, 255002, 2006

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HD 203030B: An Unusually Cool Young Sub-Stellar Companion Near the L/T Transition

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We present the discovery of a brown-dwarf companion to the 130–400 Myr-old G8 V star HD 203030. Separated by 11.″9 (487 AU in projection) from its host star, HD 203030B has an estimated mass of $0.023^{+0.008}_{-0.011} M_{\odot}$. The K-band spectral type of L7.5±0.5 places HD 203030B near the critical L/T transition in brown dwarfs, which is characterized by the rapid disappearance of dust in sub-stellar photospheres. From a comparative analysis with well-characterized field L/T transition dwarfs, we find that, despite its young age, HD 203030B has a bolometric luminosity similar to the >1 Gyr-old field dwarfs. Adopting a radius from current models of sub-stellar evolution, we hence obtain that the effective temperature of HD 203030B is only 1206^{+74}_{-116} K, markedly lower than the ≈1440 K effective temperatures of field L/T transition dwarfs. The temperature discrepancy can be resolved if either: (1) the ages of field brown dwarfs have been over-estimated by a factor of ≈1.5, leading to under-estimated radii, or (2) the lower effective temperature of HD 203030B is related to its young age, implying that the effective temperature at the L/T transition is gravity-dependent.

To appear in ApJ, Nov 10, 2006 issue

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http://arxiv.org/abs/astro-ph/0607514

Upcoming Meeting

Coronae of Stars and Accretion Discs

12 - 13 December 2006

Max-Planck-Institute for Radioastronomy, Bonn, Germany

`http://www.mpifr-bonn.mpg.de/staff/tpreibis/coronae/index.html`

Meeting Context: Coronae are an ubiquitous phenomenon among a wide variety of objects. The solar corona, the best studied case, consists of magnetic loop-like structures with an extremely complex topology confining hot plasma and relativistic particles. In combination with theoretical models, detailed observations of the dynamical interaction among these solar coronal structures provide the fundament of our understanding of coronal activity. X-ray and radio observations provide clear evidence for coronae not only, as expected, in solar-like late-type stars, but also in fully convective, very low-mass stars and even in brown dwarfs. Furthermore, young stellar objects generally show highly elevated levels of coronal activity. Coronae already exist in extremely early protostellar stages where the nuclear activity has not yet started. Finally, also accretion disks, which exist around very different classes of objects such as protostars, degenerate stellar objects, and supermassive black holes, can be surrounded by a corona; a turbulent disk dynamo can drive coronal activity, which plays an important role in disk accretion as well as the launching and collimation of outflows. Whereas significant progress in our understanding of coronal physics has been made during the last years, many aspects like the generation of magnetic fields in MHD dynamos, the heating of the coronal plasma, acceleration of particles, the complexity of coronal plasma structures and their interactions still continue to pose big challenges to observers and theoreticians.

The aim of this conference is to review the current status of the knowledge about coronae in various environments, like the Sun, stars, young stellar objects, and accretion disks. An important goal is to identify physical mechanisms that are common to all environments. Observational results as well as theoretical aspects of coronal magnetic structure and evolution will be discussed in order to spotlight existing analogies and differences.

Meeting Format: The Conference will consist of four scientific sessions. In addition to four invited review talks (30+5 min) per session, contributed papers can be presented in the form of a 5 min short-talk accompanied by a poster. The schedule is as follows:

Opening Talk: E. Rieger: Discovering a solar periodicity by chance

SESSION I: MAGNETIC RECONNECTION IN THE SUN AND STARS

1.1 Magnetic reconnection and flares – C.E. Parnell / E.R. Priest (University of St. Andrews)
1.2 Solar flares – L. Harra (Mullard Space Science Laboratory)
1.3 Preferred active longitudes in sunspot activity – S. Berdyugina (ETH Zuerich)
1.4 Stellar flaring periodicities – M. Massi (MPIfR Bonn)
1.5 Short presentations

SESSION II: SOLAR AND STELLAR CORONAE

2.1 Flux Emergenge in fast rotating stars – V. Holzwarth (University of St Andrews)
2.2 Spots on stars, Doppler Imaging – K. Strassmeier (AIP Potsdam)
2.3 X-ray and radio emission from stellar coronae – M. Güdel (Paul Scherrer Institut)
2.4 Heating the solar corona by currents – B.V. Gudiksen (University of Oslo)
2.5 Short presentations

(*continued*→)

SESSION III: YOUNG STELLAR OBJECTS

3.1 What can X-rays tell us about magnetic fields, accretion and mass loss in young stars? – T. Montmerle (Laboratoire d' Astrophysique de Grenoble)
3.2 The origin of X-ray emission from T Tauri stars – Th. Preibisch (MPIfR Bonn)
3.3 The spatial structure of coronae of T Tauri stars – M. Jardine (University of St. Andrews)
3.4 MHD aspects for star-disk-jet magnetic systems – J. Ferreira (Observatoire de Grenoble)
3.5 Short presentations

SESSION IV: ACCRETION DISCS

4.1 Accretion disc coronae in AGN/microquasars – A. Merloni (Max-Planck-Institute for Astrophysik)
4.2 Dynamos in accretion disks – A. Brandenburg (NORDITA)
4.3 Flares in accretion disk coronae – J. Malzac (Centre d'Etude Spatiale des Rayonnements)
4.4 Jet-Corona coupling – A. Lobanov (MPIfR Bonn)
4.5 Short presentations

Conference Proceedings: The conference proceedings will be published in "Memorie della Societa Astronomica Italiana" (Journal of the Italian Astronomical Society).

Scientific Organizing Committee (SOC): Manuel Güdel (Paul Scherrer Institut), Maria Massi (MPIfR, chair), Karl Menten (MPIfR), Andrea Merloni (MPIfA), Thierry Montmerle (LAOG), Thomas Preibisch (MPIfR, co-chair), Eric Priest (Un. St Andrews)

Further Information, Registration, and Abstract Submission:

Further information about the conference site and for registration and abstract submission can be found at the conference web site at `http://www.mpifr-bonn.mpg.de/staff/tpreibis/coronae/index.html` or by contacting the organizers at mmassi@mpifr-bonn.mpg.de (cc: preib@mpifr-bonn.mpg.de).

The deadline for registration and submission of abstracts is 20. September 2006. Due to space limitations, the number of participants has to be limited to 50; therefore, early registration is strongly recommended. The registration fee will be 70 Euro.

Upcoming Meeting

Structure Formation in the Universe: Galaxies, Stars, Planets

Chamonix, France

27 May – 1 June 2007

This is the *First Annoucement* of the conference *Structure Formation in the Universe*, to be held in Chamonix, France from 27 May through 1 June 2007. The aim of the conference is to bring together researchers working in the fields of planet, star and galaxy formation in order to share their expertise and to address common physical and numerical issues in the understanding of structure formation in the present and the primordial universe.

International Scientific Organizing Committee :
P. André (CEA Saclay), I. Baraffe (ENS-Lyon), P. Bodenheimer (UCSB), V. Bromm (Austin), C. Cesarsky (ESO), G. Kauffmann (MPIA Garching), R. Klessen (Heidelberg), R. Larson (Yale), C. McKee (Berkeley), M. Mayor (Geneva), P. Myers (Harvard), J. Papaloizou (Cambridge), E. Salpeter (Cornell), F. Shu (UCSD), J. Silk (Oxford)

Scientific rationale, final program and list of speakers on: **http://chamonix2007.ens-lyon.fr/**

Organizer and contact: **G. Chabrier (ENS-Lyon; chabrier@ens-lyon.fr)**

Job Opening

Research Astronomer Positions

Armagh Observatory (N. Ireland)

RESEARCH ASTRONOMER POSITIONS AT ARMAGH OBSERVATORY

Two permanent Research Astronomer positions are available from 2006 December 1. The Observatory has full access to all UK facilities and is a member of the UK SALT Consortium.

Applicants must have a PhD in an appropriate discipline and current or previous postdoctoral employment in astronomy or a related science. It is desirable that candidates have strong research interests in any branch of solar physics, solar-terrestrial physics including climate, and stellar or Galactic astrophysics, which should strengthen or complement the Observatory's existing research profile in these areas. Candidates should also have observational, theoretical, computational or modelling expertise, and experience of obtaining and/or managing grants and running an independent research programme.

Starting salary in the range 31927 – 47866 pounds (under review), depending on qualifications and experience. The positions are permanent posts subject to a normal retirement age of 65. Information about the Armagh Observatory may be obtained by consulting the web-site: http://star.arm.ac.uk/.

The closing date is 2006 September 8. Applicants should obtain an application pack from the Administrator or from the Observatory web-site, and send the completed application form together with a full curriculum vitae, statement of research interests and complete bibliography to: The Administrator, Armagh Observatory, College Hill, Armagh BT61 9DG, Northern Ireland (Tel: +44-(0)28-3752-2928; FAX: +44-(0)28-3752-7174; e-mail: lfy@arm.ac.uk). References from three referees should be sent to the Administrator by the closing date.

The advert and application pack is available on-line at the Observatory web site at; http://star.arm.ac.uk/jobs/res-ast-2006/

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.***