COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Kinematic Structure in the Young σ Orionis Association

R. D. Jeffries[1], P. F. L. Maxted[1], J. M. Oliveira[1] and Tim Naylor[2]

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We have used precise radial velocity measurements for a large number of candidate low-mass stars and brown dwarfs, to show that the young σ Ori "cluster" consists of two spatially superimposed components which are kinematically separated by $7\,\mathrm{km\,s^{-1}}$ in radial velocity, and which have different mean ages. We examine the relationship of these two kinematic groups to other populations in the Orion OB1 association and briefly discuss the consequence of mixed age samples for ongoing investigations of the formation and evolution of low-mass objects in this much-observed region.

Accepted by MNRAS

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Probing the Mass-loss History of AGB and Red Supergiant Stars from CO Rotational Line Profiles. I. Theoretical Model – Mass-loss History Unravelled in VY CMa

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Context. Mass loss plays a dominant role in the evolution of low mass stars while they are on the Asymptotic Giant Branch (AGB). The gas and dust ejected during this phase are a major source in the mass budget of the interstellar

medium. Recent studies have pointed towards the importance of variations in the mass-loss history of such objects.
Aims. By modelling the full line profile of low excitation CO lines emitted in the circumstellar envelope, we can study the mass-loss *history* of AGB stars.
Methods. We have developed a non-LTE radiative transfer code, which calculates the velocity structure and gas kinetic temperature of the envelope in a self-consistent way. The resulting structure of the envelope provides the input for the molecular line radiative calculations which are evaluated in the comoving frame. The code allows for the implementation of modulations in the mass-loss rate. This code has been benchmarked against other radiative transfer codes and is shown to perform well and efficiently.
Results. We illustrate the effects of varying mass-loss rates in case of a superwind phase. The model is applied to the well-studied case of VY CMa. We show that both the observed integrated line strengths as the spectral structure present in the observed line profiles, unambiguously demonstrate that this source underwent a phase of high mass loss ($\sim 3.2 \times 10^{-4}\,\mathrm{M}_{\odot}/\mathrm{yr}$) some 1000 yr ago. This phase took place for some 100 yr, and was preceded by a low mass-loss phase ($\sim 1 \times 10^{-6}\,\mathrm{M}_{\odot}/\mathrm{yr}$) taking some 800 yr. The current mass-loss rate is estimated to be in the order of $8 \times 10^{-5}\,\mathrm{M}_{\odot}/\mathrm{yr}$.
Conclusions In this paper, we demonstrate that both the relative strength of the CO rotational line profiles and the (non)-occurrence of spectral structure in the profile offer strong diagnostics to pinpoint the mass-loss history.

Accepted by A&A

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For preprints via ftp or WWW:

http://www.ster.kuleuven.ac.be/~leen/artikels/AGBwinds /decin_co.pdf

X-ray Variability of NGC 2516 Stars in the XMM-Newton Observations

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We present the characteristics of the X-ray variability of stars in the **cluster NGC2516** as derived from XMM-Newton/EPIC/pn data. The X-ray variations on short (hours), medium (months), and long (years) time scales have been explored. We detected 303 distinct X-ray sources by analysing six EPIC/pn observations; 194 of them are members of the cluster. Stars of all spectral types, from the early-types to the late-M dwarfs, were been detected. The Kolmogorov-Smirnov test applied to the X-ray photon time series shows that, on short time scales, only a relatively small fraction (ranging from 6% to 31% for dG and dF, respectively) of the members of NGC2516 are variable with a confidence level ≥99%; however it is possible that the fraction is small only because of the poor statistics. The time X-ray amplitude distribution functions (XAD) of a set of dF7-dK2 stars, derived on short (hours) and medium (months) time scales, seem to suggest that medium-term variations, if present, have a much smaller amplitude than those on short time scales; a similar result is also obtained for dK3-dM stars. The amplitude variations of late-type stars in NGC2516 are consistent with those of the coeval Pleiades stars. Comparing these data with those of ROSAT/PSPC, collected 7-8 years earlier, and of ROSAT/HRI, just 4-5 years earlier, we find no evidence of significant variability on the related time scales, suggesting that long-term variations due to activity cycles similar to the solar cycle are not common among young stars. Indications of spectral variability was found in one star whose spectra at three epochs were available.

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Solar Abstracts

Magnetic Confinement of the Solar Tachocline

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We have performed 3-D MHD simulations of the solar radiative interior to check whether a fossil magnetic field is able to prevent the spread of the tachocline. Starting with a purely poloidal magnetic field and a latitudinal shear imposed by the convection zone at the top of the radiation zone, we have investigated the interactions between magnetic fields, rotation and shear, using the spectral code ASH on massive parallel supercomputers. In all cases we have explored, the fossil field diffuses outward and ends up connecting with the convection zone, whose differential rotation is then imprinted at latitudes above $\approx 40^\circ$ throughout the radiative interior, according to Ferraro's law of isorotation. Rotation remains uniform in the lower latitude region which is contained within closed field lines. We find that the meridional flow cannot stop the inward progression of the differential rotation. Further, we observe the development of non-axisymmetric magnetohydrodynamic instabilities, first due to the initial poloidal configuration of the fossil field, and later to the toroidal field produced by shearing the poloidal field through the differential rotation. We do not find dynamo action as such in the radiative interior, since the mean poloidal field is not regenerated. But the instability persists during the whole evolution, while slowly decaying with the mean poloidal field; it is probably sustained by small departures from isorotation.

According to our numerical simulations, a fossil magnetic field cannot prevent the radiative spread of the tachocline, and thus it is unable to enforce uniform rotation in the radiation zone. Neither can the observed thinness of that layer be invoked as a proof for such an internal fossil magnetic field.

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Low-Mass and Substellar Abstracts

SDSS J1534+1615AB: A Novel T Dwarf Binary Found with Keck Laser Guide Star Adaptive Optics and the Potential Role of Binarity in the L/T Transition

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We have resolved the newly discovered T dwarf SDSS J153417.05+161546.1 into a 0.11″ binary using the Keck sodium laser guide star adaptive optics system. With an integrated-light near-IR spectral type of T3.5±0.5, this binary provides a new benchmark for studying the distinctive J-band brightening previously noted among early and mid-T dwarfs, using two brown dwarfs with different spectral types but having a common metallicity and age and very similar surface gravities. We estimate spectral types of T1.5±0.5 and T5.5±0.5 for the two components based on their near-IR colors, consistent with modeling the integrated-light spectrum as the blend of two components. The observed near-IR flux ratios of SDSS J1534+1615 are unique compared to all previously known substellar binaries: the component that is fainter at H and K' is brighter at J. This inversion of the near-IR fluxes is a manifestation of the J-band brightening within this individual binary system. Therefore, SDSS J1534+1615 demonstrates that the brightening can be intrinsic to ultracool photospheres (e.g., arising from cloud disruption and/or rapid increase in cloud sedimentation) and does not necessarily result from physical variations among the observed ensemble of T dwarfs (e.g., a range in masses, ages and/or metallicities). We suggest that the apparently large amplitude of the J-band brightening may be due to a high incidence of unresolved binaries and that the true amplitude of the brightening phenomenon could be more modest. This scenario would imply that truly single objects in these spectral subclasses are relatively rare, in agreement with the small effective temperature range inferred for the L/T transition.

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For preprints via WWW: http://arxiv.org/abs/astro-ph/0605037

Atomic Data Abstracts

CHIANTI - An Atomic Database for Emission Lines. VII. New data for X-rays and Other Improvements

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The CHIANTI atomic database contains atomic energy levels, wavelengths, radiative transition probabilities, and collisional excitation data for a large number of ions of astrophysical interest. CHIANTI also includes a suite of IDL routines to calculate synthetic spectra and carry out plasma diagnostics. Version 5 has been released, that includes several new features, as well as new data for many ions. The new features in CHIANTI are: the inclusion of ionization and recombination rates to individual excited levels as a means to populate atomic levels; data for $K\alpha$ and $K\beta$ emission from Fe II to Fe XXIV; new data for high-energy configurations in Fe XVII to Fe XXIII; a complete re-assessment of level energies and line identifications in the X-ray range, multi-temperature particle distributions, and photoexcitation from any user-defined radiation field. New data for ions already in the database, as well as data for ions not present in earlier versions of the database, are also included. Version 5 of CHIANTI represents a major improvement in the calculation of line emissivities and synthetic spectra in the X-ray range, and expands and improves theoretical spectra calculations in all other wavelength ranges.

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CHIANTI - An Atomic Database for Emission lines - Paper VIII: Comparison with Solar Flare Spectra from SMM/FCS

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In the present work we describe the comparison of the fluxes predicted by the latest version of the CHIANTI database (version 5.2) with the observed X-ray spectra of two solar flares from the Flat Crystal Spectrometer on board the *Solar Maximum Mission* on 1980 August 25 and 1985 July 2. The two flares were of *GOES* class M1.5 and M4.5 respectively, and were observed in the 7.47-18.97 Å wavelength range. The aim of the present work is to benchmark the CHIANTI database in this range in an effort to assess its accuracy and completeness. Very good agreement is found at all wavelengths, except for Fe XVIII and Fe XIX lines between 14.7 Å and 16.4 Å. These discrepancies are discussed. A list of lines recommended for future diagnostic studies of X-ray sources is presented.

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Upcoming Meeting

The Second International Symposium on Space Climate: Long-term Change in the Sun, and its Effects in the Heliosphere and Planet Earth

Sinaia, Romania

13 – 16 September 2006

Dear Colleagues:

The *Second International Symposium on Space Climate: Long-term Change in the Sun, and its Effects in the Heliosphere and Planet Earth* will be held in Sinaia, Romania, 13 – 16 September 2006, hosted by the Astronomical Institute of the Romanian Academy of Sciences, Bucharest, Romania.

Invited Speakers:

E. Babayev, J. Beer, P. Bencze, F. Clette, P. Charbonneau, E. Cliver, C. Demetrescu, M. Dikpati, M. Echim, A. Ferriz-Mas, J. Feynman, K. Georgieva, R. Howe, E. Ivanov, J. R. Johnson, J. Kozyra, G. Maris, N. Marsh*), K. McCracken, K. Mursula, D. Nandi, V. Obridko, E. Palle, J.-P. Rozelot, A. Ruzmaikin, W. Schmutz, S. Solanki, L. Svalgaard, H. Svensmark*), B. Tinsley, I. Usoskin, J.M. Vaquero. (* to be confirmed)

Important dates:

30 June - Abstract Submission deadline 31 July - Early Registration deadline 15 August - Third Announcement with Final Program 12 September - Travel to Sinaia 13-15 September - Scientific Sessions 16 September - Excursion to Dracula Castle

For further information, see

http://www.issc2.ro/

Welcome to Sinaia!

Sincerely Yours,

Georgeta Maris, SOC co-chair and LOC chair, Astronomical Institute, Bucharest, Romania
Kalevi Mursula, SOC co-chair, University of Oulu, Oulu, Finland

Job Opening

Ph.D. Student Fellowships

Solar System Physics

Max Planck Institute for Solar System Research (Germany)

The "International Max Planck Research School on Physical Processes in the Solar System and Beyond" at the Max Planck Institute for Solar System Research in Katlenburg-Lindau and the Universities of Braunschweig and Goettingen, Germany, offers excellent research possibilities for students to obtain a PhD degree in a 3-years graduate program.

The program covers the full range of physics inherent in the field of solar system science from geophysics and planetary science to solar physcis as well as the underlying fundamental physics. The science program is complemented by training in computational physics, space technology and project management.

High-profile space missions, outstanding projects for ground-based instruments and data analysis, as well as theoretical and extensive numerical modeling provide a wide range of research possibilities for PhD students.

Applications for the program are open to students from all countries. A prerequisite is a diploma or a master of science degree in physics or a related field, including a corresponding thesis.

The next PhD program will start in January 2007, review of application begins on 1 August 2006. Successful applicants will receive adequate financial support.

For details on the IMPRS program and the application procedure, please visit http://www.solar-system-school.de or email to info@solar-system-school.de .

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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.***