COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Buried Magnetic Flux Tubes in Giant Stars Near the "Coronal Dividing Line"

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We apply the 'solar paradigm' for stellar magnetic activity to the post-main-sequence evolution of stars in the mass range $1\,\mathrm{M}_\odot \leq \mathrm{M}_\star \leq 3\,\mathrm{M}_\odot$. The model starts from a strong toroidal magnetic field generated by a dynamo working in the overshoot layer below the convection envelope. Once a critical field strength is exceeded, an undulatory (Parker-type) instability leads to rising flux loops. Upon emergence at the stellar surface, they form bipolar magnetic regions and large-scale coronal loops. By considering the stability, dynamics, and rise of magnetic flux tubes along evolutionary sequences of stellar models, we find that the flux loops become trapped in the stellar interior when the depth of convective envelope exceeds about 80% of the stellar radius. Trapping is caused by an increase of field line curvature at the loop summit, so that eventually the magnetic tension force dominates over the buoyancy force. The magnetic loops find a stable equilibrium configuration within the convection zone and do not emerge at the stellar surface. The transition from emerging to trapped flux tubes falls in the range of spectral types G7 to K0 for luminosity class III giants, which is close to the observed "coronal dividing line" in the Hertzsprung-Russell diagram. This result is remarkably stable within large ranges of stellar parameters (mass, rotation) and flux tube parameters (field strength, magnetic flux) and depends practically exclusively on the fractional radius of the stellar radiative core. We suggest that flux tube trapping is the cause for the strong decline of stellar X-ray emission across the "coronal dividing line".

Accepted by A&A

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X-ray Emission from Young Stars in Taurus-Auriga-Perseus: Luminosity Functions and the Rotation - Activity - Age - Relation

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We report on a systematic search for X-ray emission from pre-main sequence and young main sequence stars in the Taurus-Auriga-Perseus region. Our stellar sample consists of all T Tauri stars from the Taurus-Auriga region, and all late-type stars from the Pleiades and Hyades clusters which have been observed by the *ROSAT* PSPC in pointed observations. We present the X-ray parameters for all observed stars in tables. Next to the basic results of the data analysis (such as count rates, exposure time, and off-axis angle) we give X-ray luminosities and hardness ratios for all detected stars. Upper limits are given for non-detections. Detection rates for different spectral types are compiled. We use these results to study the connection between coronal X-ray activity and stellar parameters for different subgroups of our sample. In particular we compile X-ray luminosity functions (XLF), and discuss the relations between X-ray emission and spectral type, age, and rotation, which have been disputed extensively in the past. Here, we study these questions with the largest sample so far. The XLF for classical and weak-line T Tauri stars are different, with weak-lines being the stronger X-ray emitters. Proceeding towards the main-sequence (Pleiades, Hyades) the X-ray luminosity declines for all spectral types examined (G, K, and M stars). Within an age group $L_{\rm x}$ decreases towards later spectral types, while $L_{\rm x}/L_{\rm bol}$ remains constant or even increases, reflecting the opposed influence of stellar radius, i.e. emitting area, and convection zone depth. For a given spectral type the fastest rotators show the highest X-ray luminosity. Rotation rate and X-ray emission are clearly correlated for all groups of stars with power law indices for $\lg{(L_{\rm x}/L_{\rm bol})}$ versus $\lg{P_{\rm rot}}$ of ~ -0.7 to -1.5. The study of XLF for binary stars shows that the known unresolved secondaries likely contribute a significant amount to the X-ray emission.

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ISO Observations of Symbiotic Stars: I. HM Sge

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We present ISO SWS and LWS observations of the symbiotic star HM Sge. The infrared emission longward of $\sim 5\,\mu$m is dominated by a silicate dust shell. There is a number of high ionization emission lines superimposed on the dust continuum. The ISO continuum spectra can be fitted with a single, optically thick silicate dust shell but such a model does not fit other known properties of this system, such as the observed *JHK* colours, the optical visibility of the red giant and the occurrence of a dust obscuration event. We favour a two component model in which in addition to a partial Mira dust shell, a second dust component is associated with the hot source. This second shell is located at the interface between the Mira dust shell and the dust free region carved out by the hot component. This picture corresponds closely to that deducd independently from radio observations. The two dust components are very different. The dust envelope associated with the Mira is very extended and optically thin, whereas the second dust component is geometrically rather thin but dust rich. The model not only fits the ISO data reasonably well, but is also compatible with other IR properties of HM Sge. The thin dust shell contributes strongly to the dust emission over most of the ISO range. It may be the combination of the two shells that makes a symbiotic a D type. The general agreement of the present models with ISO observations indicate that radiation (rather than collisions) as the main dust heating mechanism is sufficient.

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Solar Abstracts

Ba II 4554 Å Speckle Imaging as a Solar Doppler Diagnostic

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We present observations testing the Dopplergram capability of a narrow-band (80 mÅ) Lyot filter imaging the solar surface in the wings of the Ba II 4554 Å resonance line in combination with speckle reconstruction to obtain high angular resolution. The Ba II line is found to be an excellent tool for high-resolution Doppler mapping thanks to opacity insensitivity to temperature variations and line-width insensitivity to thermal broadening. The resulting Dopplergrams show concentrated downflows of 1.2–2.2 km s^{-1} in intergranular lanes that probably mark magnetic fluxtubes. Two-wavelength profile sampling is found to suffice for high-resolution Dopplergram construction. The filter will be installed as part of a multi-wavelength speckle imaging system on the new Dutch Open Telescope.

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The Distribution of Emission Measure, and of Heating Budget, Among the Loops in the Corona.

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The aim of this paper is to validate a methodology for connecting the emission measure of individual solar coronal loops to the integrated emission measure of the entire solar corona, and using this connection to deduce the energetic properties of the corona, and then to show how this methodology can be applied to observations of solar-like stellar coronae. The solar validation is carried out by using spatially resolved X-ray observations of the Sun obtained from the *Yohkoh* satellite. This work is a further step in our effort to place the "solar-stellar connection" on a quantitative footing. In particular, we show how this analysis procedure can be used in the context of archival *Einstein*, *ROSAT* and EUVE data, as well as Chandra and XMM Newton data, as a complementary analysis tool to existing multi-thermal component models.

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Substellar Abstracts

Keck NIRC Observations of Planetary-mass Candidate Members in σ Orionis

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We present K-band photometry and low-resolution near-infrared spectroscopy from 1.44 to 2.45 μm of isolated planetary-mass candidate members in the σ Orionis cluster found by Zapatero Osorio et al. The new data have been obtained with NIRC at the Keck I telescope. All of our targets, except for one, are confirmed as likely cluster members. Hence, we also confirm that the planetary-mass domain in the cluster is well populated. Using our deep K-band images we searched for companions to the targets in the separation range $0.3''$ to $10''$ up to a maximum faint limit of K=19.5 mag. One suspected companion seems to be an extremely red galaxy. The near-infrared colors of the σ Orionis substellar members indicate that dust grains condense and settle in their atmospheres. We estimate that the surface temperatures range from 2500 K down to 1500 K. The spectroscopic sequence covers the full range of L subclasses, and the faintest object is tentatively classified as T0. These targets provide a sequence of substellar objects of known age, distance and metallicity, which can be used as benchmark for understanding the spectral properties of ultracool dwarfs.

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For preprints via WWW: http://arXiv.org/abs/astro-ph/?0108066 or
http://www.gps.caltech.edu/ mosorio/publications.html

Infrared Photometry of Late–M, L, and T Dwarfs

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We present $ZJHKL'M'$ photometry of a sample of 58 late–M, L, a nd T dwarfs, most of which are identified from the Sloan Digital Sky Survey and the Two Micron All–Sky Survey. Near–infrared spectra and spectral classifications for most of this sample are presented in a companion paper by Geballe et al. We derive the luminosities of 18 dwarfs in the sample with known parallaxes, and the results imply that the effective temperature range for the L dwarfs in our sample is approximately 2200—1300 K and for the T dwarfs 1300—800 K. We obtained new photometric data at the United Kingdom Infrared Telescope for: 42 dwarfs at Z, 34 dwarfs at JHK, 21 dwarfs at L', as well as M' data for two L dwarfs and two T dwarfs. The M' data provide the first accurate photometry for L and T dwarfs in this bandpass — for a T2 and a T5 dwarf, we find K–M' = 1.2 and 1.6, respectively. These colors are much bluer than predicted by published models suggesting that CO may be more abundant in these objects than expected, as has been found for the T6 dwarf Gl 229B. We also find that K–L' increases monotonically through most of the M, L, and T subclasses, but it is approximately constant between types L6 and T5, restricting its usefulness as a temperature indicator. The degeneracy is probably due to the onset of CH_4 absorption at the blue edge of the L' bandpass. The JHK colors of L dwarfs show significant scatter, suggesting that the fluxes in these bandpasses are sensitive to variations in photospheric dust properties. The $H-K$ colors of the later T dwarfs also show some scatter which we suggest is due to variations in pressure–induced H_2 opacity, which is sensitive to gravity and metallicity.

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Optical Spectroscopy of Isolated Planetary Mass Objects in the σ Orionis Cluster

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We have obtained low resolution optical spectra of 15 isolated planetary mass objects (IPMOs) in the σ Orionis cluster, and derived spectral types by comparison with nearby M and L dwarfs. The spectral types are in the range late M – mid L, in agreement with our expectations based on colors and magnitudes for bona fide members. Therefore, most of these objects have masses below the deuterium burning limit. About 2/3 show Hα in emission at our spectral resolution. From our spectroscopic and photometric data, we infer that three IPMOs in this sample may be binaries with components of similar masses. These results confirm that the substellar mass function of the σ Orionis cluster, in the form dN/dM, keeps rising in the planetary domain.

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JOB OPENINGS

Postdoctoral Position
Cool Star Astrophysics
ESTEC
Noordwijk, the Netherlands

Fellowship positions are currently available in ESA's Space Science Department for working in the field of 1) X-ray astrophysics and data analysis and 2) optical high-resolution spectroscopy of cool star atmospheres.

In the field of X-ray data analysis the successful candidate is expected to work on the analysis and interpretation of X-ray data of cool stars. The current research program in the Department covers both X-ray spectroscopy of individual active stars, the study of stellar X-ray flares and the study of star-forming regions and open clusters. It is carried out mostly with data from the XMM-Newton and BeppoSAX observatories, although data from most currently flying X-ray observatories are also used. In addition to working, in collaboration with scientists from the Department, on the analysis and interpretation of the currently available data sets, the successful candidate is also expected to carry out his/her own research program by e.g. applying for observing time at currently available X-ray facilities.

In the field of optical high-resolution spectroscopy the successful candidate is expected to work on the analysis and interpretation of high-resolution spectra of cool stars, with emphasis on the atmospheric analysis of active stars and their photospheric abundances. The current research program in the Department is mostly carried out with data from ESO's telescopes. In addition to working, in collaboration with scientists from the Department, on the analysis and interpretation of the currently available data sets, the successful candidate is also expected to carry out his/her own research program by e.g. applying for observing time at currently available telescope facilities.

General information

ESA's postdoctoral Research Fellowship program is aimed at providing young scientists, holding a doctorate or the equivalent, with the means of doing research in space science and space applications. The Fellowships are open to nationals of ESA Member States and Canada (associate ESA member).

In general, there are no fixed application deadlines for Internal Fellowships. Enquiries or applications (with C.V.) can be sent at any time using the Expression of Interest Form available at `http://astro/SA-general/Vacancies/exprform_e.html`.

Applicants should cite two persons who would be prepared to provide a professional reference and provide one actual letter of reference.

Appointments depend on the availability of positions and the evolving research programmes and starting dates are agreed upon in consultation with successful candidates. Fellowships are initially awarded for a period of one year, with the possibility of an extension for a second year.

Internal Research Fellows are affiliated to the ESA Social Security Scheme and are covered by the provisions described in the ESA Staff Regulations and Rules.

Contact information

For any additional information, please contact F. Favata (`Fabio.Favata@astro.esa.int`). More general information about ESA's fellowship program is available at `http://astro/SA-general/Vacancies/appl_rf.html`.

JOB OPENINGS

Postdoctoral Research Associate
Stellar Coronal Astrophysics
JILA, Univ. of Colorado
Boulder, Colorado USA

Attention: Dr. Jeffrey L. Linsky

Applications are invited for a postdoctoral position in stellar coronal astrophysics beginning as soon as November 2001. This position in the Cool Stars Research Group will be awarded for an initial period of one year, but may be renewed upon satisfactory progress for a maximum of 3 years. Primary responsibilities will be to plan and analyze X-ray observations of stellar coronae, chromospheres and winds using data from the Chandra, XMM-Newton, HST, and FUSE satellites. Applicants should have a strong background in several of the following areas: phenomena in the outer atmospheres of late-type stars and the Sun; analysis techniques for stellar X-ray, EUV, UV, and radio data; plasma spectroscopy; modern techniques for inferring stellar surface structures; and stellar magnetic fields. Starting salary is commensurate with qualifications.

This position is part of the JILA Postdoctoral Research Associateship Program, which is more fully described in the application material. For information and application material please contact Ms. Cheryl Glenn by e-mail at glennc@jila.colorado.edu and download the application material from the JILA Website
http://jilawww.colorado.edu/www/programs/pd.html .

Please arrange for three letters of recommendation to be sent via email to Ms. Cheryl Glenn at glennc@jila.colorado.edu. This position is subject to the renewal of NASA grants. Selection for this position will occur after October 1, 2001, but the position will be open until filled. Applicants are urged to submit all material before that date. The University of Colorado at Boulder is an equal opportunity/affirmative action institution.

Questions regarding the scientific aspects of this position can be directed to Dr. Jeffrey Linsky at
jlinsky@jila.colorado.edu .

New Astronomy Textbook

The Cosmic Perspective (2nd edition)

by Jeffrey Bennett, Megan Donahue, Nicholas Schneider, & Mark Voit

The second edition of this superb general astronomy text is hot off the press and provides an up-to-date treatment of the field suitable for nonscience majors. First author Jeff Bennett is a former cool stars researcher who has now evolved off the main sequence and is pursuing a career in textbook writing.

What's New and Different? - The traditional historical sequence which begins with an overview of ancient astronomy is not followed here. Instead, the first chapters seek to provide a perspective on the cosmic distance scale and the night sky. Historical material is introduced, in context, throughout the book. The usual one-by-one planetary sequence is replaced by a section on comparative planetology. An evolutionary appraoch to the study of galaxies is presented, and there is an entire chapter on dark matter. For those wishing to emphasize physics, there are three chapters on basic relativity, gravitation and quantum mechanics.

Student Resources: The book has a companion web site (www.astronomyplace.com), a large removable poster-sized HR diagram, the Voyager SkyGazer CD ROM, and provides access to the Astronomy Tutor Center (www.aw.com/tutorcenter).

Instructor Resources: The publisher is including *for free* the full 13-part Cosmos series on DVD or VHS media to qualified adopters of the text. Also available are an Instructor's Resource Guide, test bank (paper and CD-ROM format), transparency acetates, and a Science Digital Library that includes illustrations, tables, and star charts from the book. Each chapter ends with a large selection of review questions, problems, and web projects.

Textbook Versions: In addition to the complete second edition, two separate editions covering the Solar System and Stars, Galaxies, & Cosmology are available. A Brief Edition that covers the material in less depth can also be ordered. The entire text is available on-line in XML.

Recommendation: A marvelous textbook that comes with a complete set of supplemental materials. Ya' better take a look at this!!!

Chapter Headings: 1) Our Place in the Universe 2) Discovering the Universe for Yourself S1) Celestial Timekeeping and Navigation 3) The Science of Astronomy 4) A Universe of Matter and Energy 5) Universal Motion: from Copernicus to Newton 6) Light: The Cosmic Messenger 7) Telescopes and Spacecraft 8) Formation of the Solar System 9 Planetary Geology: Earth and Other Terrestrial Worlds 10) Planetary Atmospheres: Earth and Other Terrestrial Worlds 11) Jovian Planet Systems 12) Remnants of Rock and Ice: Asteroids, Comets, and Pluto 13) Planet Earth and its Lessons on Life in the Universe S2) Space and Time S3) Spacetime and Gravity S4) Building Blocks of the Universe 14) Our Star 15) Stars 16) Star Stuff 17) The Bizarre Stellar Graveyard 18) Our Galaxy 19) Galaxies: from Here to the Horizon 20) Galaxy Evolution 21) Dark Matter and the Fate of the Universe 22) The Beginning of Time S5) Interstellar Travel and the Search for Extraterrestrial Civilizations, plus ten appendices and a glossary.

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Retail Price: Approx. $US 76 (paperback, 666 pages, check local bookstore for price)
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Submitted by Steve Skinner

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` .