COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

A Census of AGB Stars in Local Group Galaxies. III. The Dwarf Spheroidal And II

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Our photometric survey of Local Group galaxies, using a four filter technique based on the method of Wing (1971) allows the identification and subsequent characterization of their late-type stellar content. Two narrow band filters centred on molecular bands of TiO and CN allow us to distinguish between AGB stars of different chemistries [M-type (O-rich) and C-type (C-rich)]. The faint dwarf spheroidal galaxy And II, a member of the M 31 subgroup, was surveyed. From photometry in V and i as well as in the narrow band filters TiO and CN we were able to identify 7 new AGB carbon stars, to derive their mean absolute $\langle M_i \rangle$ and bolometric magnitude M_{bol}, their luminosity function, and their spatial distribution. We are unable to establish the true C/M ratio because the few M stars of And II are overwhelmed by foreground Galactic M stars.

Accepted by: A&A

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Reconsidering the Origin of the 21 micron feature: Oxides in Carbon-rich PPNe?

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The origin of the so-called '21' μm feature which is especially prominent in the spectra of some carbon-rich protoplanetary nebulae (PPNe) is the matter of a lively debate. A large number of potential band carriers have been presented and discarded within the past decade. The present paper gives an overview of the problems related to the hitherto proposed feature identifications, including the recently suggested candidate carrier silicon carbide. We also discuss the case for spectroscopically promising oxides.

SiC is shown to produce a strong resonance band at 20–21 μm if coated by a layer of silicon dioxide. At low temperatures, core-mantle particles composed of SiC and amorphous SiO_2 indeed have their strongest spectral signature at a position of 20.1 μm, which coincides with the position of the '21' μm emission band.

The optical constants of another candidate carrier that has been relatively neglected so far – iron monoxide – are proven to permit a fairly accurate reproduction of the '21' μm feature profile as well, especially when low-temperature measurements of the infrared properties of FeO are taken into account. As candidate carrier of the '21' μm emission band, FeO has the advantage of being stable against further oxidation and reduction only in a narrow range of chemical and physical conditions, coinciding with the fact that the feature, too, is detected in a small group of objects only. However, it is unclear how FeO should form or survive particularly in carbon-rich PPNe.

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For preprints via ftp or WWW: http://arxiv.org/abs/astro-ph/0408447

Solar Abstracts

G-Band Spectral Synthesis and Diagnostics of Simulated Solar Magneto-convection

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Realistic simulations of radiative magneto-convection in the solar (sub)photosphere are used for a spectral synthesis of Fraunhofer's G band, which is dominated by spectral lines from the CH molecule. It is found that the spatial pattern of integrated G-band brightness closely matches the spatial structure of magnetic flux concentrations in the convective downflow regions. The brightness contrast is mainly caused by the weakening of CH lines due to the reduced CH abundance and the resulting shift of the optical depth scale in the hot and tenuous magnetic flux concentrations. Various properties of the synthetic brightness images agree well with G-band observations. These results lends credit to the observational usage of G-band bright features as proxies for magnetic flux concentrations in the solar photosphere. However, the converse is only correct in a limited sense: only a fraction of the magnetic flux concentrations turn out to be bright in the G Band.

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Evolution of the Large-scale Magnetic Field on the Solar Surface: A Parameter Study

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Magnetic flux emerging on the Sun's surface in the form of bipolar magnetic regions is redistributed by supergranular diffusion, a meridional poleward flow and differential rotation. We perform a systematic and extensive parameter study

of the influence of various parameters on the large-scale field, in particular th e total unsigned surface flux and the flux in the polar caps, using a flux transport model. We investigate both, model parameters and source term properties. W e identify the average tilt angle of the emerging bipolar regions, the diffusion coefficient (below a critical value), the total emergent flux and, for the pol ar field, the meridional flow velocity and the cycle length as parameters with a particularly large effect. Of special interest is the influence of the overlap between succesive cycles. With increasing overlap, an increasing background field (minimum flux at cycle minimum) is built up, which is of potential relevance for secular trends of solar activity and total irradiance.

Accepted by A&A

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For preprints via ftp or WWW: http://www. linmpi.mpg.de/~baumann/downloads/paper.LargeScaleEvolution.ps

The Spectral Evolution of Impulsive Solar X-ray Flares

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The time evolution of the spectral index and the non-thermal flux in 24 impulsive solar hard X-ray flares of GOES class M was studied in RHESSI observations. The high spectral resolution allows for a clean separation of thermal and non-thermal components in the 10–30 keV range, where most of the non-thermal photons are emitted. Spectral index and flux can thus be determined with much better accuracy than before. The spectral soft-hard-soft behavior in rise-peak-decay phases is discovered not only in the general flare development, but even more pronounced in subpeaks. An empirically found power-law dependence between the spectral index and the normalization of the non-thermal flux holds during the rise and decay phases of the emission peaks. It is still present in the combined set of all flares. We find an asymmetry in this dependence between rise and decay phases of the non-thermal emission. There is no delay between flux peak and spectral index minimum. The soft-hard-soft behavior appears to be an intrinsic signature of the elementary electron acceleration process.

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For preprints via ftp or WWW: http://www.astro.phys.ethz.ch/papers/pgrigis/1367.ps

Low-Mass and Substellar Abstracts

Are Beryllium Abundances Anomalous in Stars with Giant Planets?

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In this paper we present beryllium (Be) abundances in a large sample of 41 extra-solar planet host stars, and for 29 stars without any known planetary-mass companion, spanning a large range of effective temperatures. The Be abundances were derived through spectral synthesis done in standard Local Thermodynamic Equilibrium, using spectra obtained with various instruments. The results seem to confirm that overall, planet-host stars have “normal” Be abundances, although a small, but not significant, difference might be present. This result is discussed, and we show that this difference is probably not due to any stellar “pollution” events. In other words, our results support the idea that the high-metal content of planet-host stars has, overall, a "primordial" origin. However, we also find a small subset of planet-host late-F and early-G dwarfs that might have higher than average Be abundances. The reason for the offset is not clear, and might be related either to the engulfment of planetary material, to galactic chemical evolution effects, or to stellar-mass differences for stars of similar temperature.

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The HARPS Survey for Southern Extra-solar Planets II. A 14 Earth-mass Exoplanet Around μ Arae

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In this letter we present the discovery of a very light planetary companion to the star μ Ara (HD 160691). The planet orbits its host once every 9.5 days, and induces a sinusoidal radial velocity signal with a semi-amplitude of about $4\,\mathrm{m\,s^{-1}}$. These values imply a mass of $m_2 \sin i = 14\,\mathrm{M}_\oplus$ (earth-masses). This detection represents the first discovery of a planet with a mass slightly smaller than that of Uranus, the smallest "ice giant" in our Solar System. Whether this planet can be considered an ice giant or a super-earth planet is discussed in the context of the core-accretion and migration models.

Submitted to A&A Letters

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TrES-1: The Transiting Planet of a Bright K0V Star

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We report the detection of a transiting Jupiter-sized planet orbiting a relatively bright ($V = 11.79$) K0V star. We detected the transit light-curve signature in the course of the TrES multi-site transiting planet survey, and confirmed the planetary nature of the companion via multicolor photometry and precise radial velocity measurements. We designate the planet TrES-1; its inferred mass is $0.75 \pm 0.07 M_{\mathrm{Jup}}$, its radius is $1.08^{+0.18}_{-0.04}\, R_{\mathrm{Jup}}$, and its orbital period is 3.030065 ± 0.000008 days. This planet has an orbital period similar to that of HD 209458b, but about twice as long as those of the OGLE transiting planets. Its mass is indistinguishable from that of HD 209458b, but its radius is significantly smaller and fits the theoretical models without the need for an additional source of heat deep in the atmosphere, as has been invoked by some investigators for HD 209458b.

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Theory Abstracts

Understanding the Time-dependence of Atomic Level Populations in Evolving Plasmas

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[1] High Altitude Observatory, National Center for Atmospheric Research, P.O. Box 3000, Boulder CO 80307-3000, USA The time dependence of atomic level populations in evolving plasmas is studied using an eigenfunction expansion of the non-LTE rate equations. The work aims to develop understanding without the need for, and as an aid to, numerical solutions. The discussion is mostly limited to linear systems, especially those for optically thin plasmas, but the implicitly non-linear case of non-LTE radiative transfer is briefly discussed. Eigenvalue spectra for typical atomic systems are examined using results compiled by Hearon. Diagonal dominance and sign symmetry of rate matrices show that just one eigenvalue is zero (corresponding to the equilibrium state), that the remaining eigenvalues have negative real parts, and that oscillations, if any, are necessarily damped. Gershgorin's theorems are used to show that many eigenvalues are determined by the radiative lifetimes of certain levels, because of diagonal dominance. With other properties, this demonstrates the existence of both "slow" and "fast" time scales, where the "slow" evolution is controlled by properties of meta-stable levels. It is shown that, when collisions are present, Rydberg states contribute only "fast" eigenvalues. This justifies use of the quasi-static approximation, in which atoms containing just meta-stable levels can suffice to determine the atomic evolution on time-scales long compared with typical radiative lifetimes. Analytic solutions for two and three level atoms are used to examine the basis of earlier intuitive ideas, such as the "ionizing plasma" approximation. The power and limitations of Gershgorin's theorems are examined through examples taken from the solar atmosphere. The methods should help in the planning and interpretation of both experimental and numerical experiments in which atomic evolution is important. While the examples are astrophysical, the methods and results are applicable to plasmas in general.

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Announcement

New Online Review Journal for Solar Physics and Related Fields

Living Reviews in Solar Physics

Living Reviews in Solar Physics, a purely electronic, open access, refereed journal devoted to providing the community with high quality up-to-date reviews of all aspects of solar physics and related fields (primarily the Sun-Earth and the solar-stellar connection) is now online. We begin with two substantial and interesting articles, which you are invited to browse, download and read for free:

Yuhong Fan: "Magnetic Fields in the Solar Convection Zone"

Brian E. Wood: "Astrospheres and Solar-like Stellar Winds"

An abstract of each of these articles can be found below. Further articles are in preparation and will be put online as soon as they are ready. Articles can also be accessed via NASA's ADS service. They will be kept up-to-date by periodic revisions made by the authors (hence the name *Living Reviews*). The journal can be accessed via the link http://solarphysics.livingreviews.org . There you can also order our Newsletter with which we will notify you when new or substantially updated articles are put online. I hope that you will find this new service to the community useful and will become a regular user.

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Abstracts of Recent Articles

PUB NO lrsp-2004-1 Yuhong Fan "Magnetic Fields in the Solar Convection Zone" (incl. 142 references, 19 figures and 4 movies) ACCEPTED: 30 Jun 2004 PUBLISHED: 29 Jul 2004

ABSTRACT: Recent studies of the dynamic evolution of magnetic flux tubes in the solar convection zone are reviewed with focus on emerging flux tubes responsible for the formation of solar active regions. The current prevailing picture is that active regions on the solar surface originate from strong toroidal magnetic fields generated by the solar dynamo mechanism at the thin tachocline layer at the base of the solar convection zone. Thus the magnetic fields need to traverse the entire convection zone before they reach the photosphere to form the observed solar active regions. This review discusses results with regard to the following major topics: 1. the equilibrium properties of the toroidal magnetic fields stored in the stable overshoot region at the base of the convection zone, 2. the buoyancy instability associated with the toroidal magnetic fields and the formation of buoyant magnetic flux tubes, 3. the rise of emerging flux loops through the solar convective envelope as modeled by the thin flux tube calculations which infer that the field strength of the toroidal magnetic fields at the base of the solar convection zone is significantly higher than the value in equipartition with convection, 4. the minimum twist needed for maintaining cohesion of the rising flux tubes, 5. the rise of highly twisted kink unstable flux tubes as a possible origin of δ-sunspots, 6. the evolution of buoyant magnetic flux tubes in 3D stratified convection, 7. turbulent pumping of magnetic flux by penetrative compressible convection, 8. an alternative mechanism for intensifying toroidal magnetic fields to significantly super-equipartition field strengths by conversion of the potential energy associated with the superadiabatic stratification of the solar convection zone, and finally 9. a brief overview of our current understanding of flux emergence at the surface and post-emergence evolution of the subsurface magnetic fields.

FULL ARTICLE AT: http://www.livingreviews.org/lrsp-2004-1

PUB NO lrsp-2004-2 Brian E. Wood "Astrospheres and Solar-like Stellar Winds" (incl. 156 references and 13 figures) ACCEPTED: 30 Jun 2004 PUBLISHED: 29 Jul 2004

ABSTRACT: Stellar analogs for the solar wind have proven to be frustratingly difficult to detect directly. However, these stellar winds can be studied indirectly by observing the interaction regions carved out by the collisions between these winds and the interstellar medium (ISM). These interaction regions are called "astrospheres", analogous to the "heliosphere" surrounding the Sun. The heliosphere and astrospheres contain a population of hydrogen heated by charge exchange processes that can produce enough H I Lyα absorption to be detectable in UV spectra of nearby stars from the Hubble Space Telescope (HST). The amount of astrospheric absorption is a diagnostic for the strength of the stellar wind, so these observations have provided the first measurements of solar-like stellar winds. Results from these stellar wind studies and their implications for our understanding of the solar wind are reviewed here. Of particular interest are results concerning the past history of the solar wind and its impact on planetary atmospheres.

FULL ARTICLE AT: http://www.livingreviews.org/lrsp-2004-2

Submitted by: Sami K. Solanki

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.***