COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Mg II h + k Emission Lines as Stellar Activity Indicators of Main Sequence F-K Stars

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The largest dataset of stellar activity measurements available at present is the one obtained at the Mount Wilson Observatory, where high-precision Ca II H+K fluxes have been measured from 1966 for about 2200 stars. Since the Mg II h and k lines at λ2800 Å are formed in a similar way to the Ca II H+K emission lines, they are also good indicators of chromospheric structure. The *International Ultraviolet Explorer (IUE)* provides a large database of UV spectra in the band 1150-3350 Å, from 1978 to 1995, which can also be used to study stellar activity. The main purpose of this study is to use the IUE spectra in the analysis of magnetic activity of main sequence F-K stars. Combining IUE observations of Mg II and optical spectroscopy of Ca II, the registry of activity of stars can be extended in time. We retrieved all the high-resolution spectra of F, G, and K main sequence stars observed by IUE (i.e. 1623 spectra of 259 F to K dwarf stars). We obtained the continuum surface flux near the Mg II h+k lines near λ2800 Å and the Mg II line-core surface flux from the IUE spectra. We obtained a relation between the mean continuum flux near the Mg II lines with the colour $B-V$ of the star. For a set of 117 nearly simultaneous observations of Mg II and Ca II fluxes of 21 F5 to K3 main sequence stars, we obtained a colour dependent relation between the Mount Wilson Ca II S-index and the Mg II emission line-core flux. As an application of this calibration, we computed the Mount Wilson index for all the dF to dK stars which have high resolution IUE spectra. For some of the most frequently observed main sequence stars, we analysed the Mount Wilson index S from the IUE spectra, together with the ones derived from visible spectra. We confirm the cyclic chromospheric activity of ϵ Eri (HD 22049) and β Hydri (HD 2151), and we find a magnetic cycle in α Cen B (HD 128621).

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For preprints contact: abuccino@iafe.uba.ar

For preprints via ftp or WWW: http://arxiv.org/abs/0804.1101

Analytical Theory for the Initial Mass Function: CO Clumps and Prestellar cores

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We derive an analytical theory of the prestellar core initial mass function based on an extension of the Press-Schechter statistical formalism applied in cosmology. With the same formalism, we also obtain the mass spectrum for the non self-gravitating clumps produced in supersonic flows. The mass spectrum of the self-gravitating cores reproduces very well the observed initial mass function and identifies the different mechanisms responsible for its behaviour. The theory predicts that the shape of the IMF results from two competing contributions, namely a power-law at large scales and an exponential cut-off (lognormal form) centered around the characteristic mass for gravitational collapse. The cut-off exists already in the case of pure thermal collapse, provided that the underlying density field has a lognormal distribution. Whereas pure thermal collapse produces a power-law tail steeper than the Salpeter value, $dN/d\log M \propto M^{-x}$, with $x \simeq 1.35$, this latter is recovered exactly for the (3D) value of the spectral index of the velocity power spectrum, $n \simeq 3.8$, found in observations and in numerical simulations of isothermal supersonic turbulence. Indeed, the theory predicts that $x = (n+1)/(2n-4)$ for self-gravitating structures and $x = 2 - n'/3$ for non self-gravitating structures, where n' is the power spectrum index of $\log(\rho)$. We show that, whereas supersonic turbulence promotes the formation of both massive stars and brown dwarfs, it has an overall negative impact on star formation, decreasing the star formation efficiency. This theory provides a novel theoretical foundation to understand the origin of the IMF and to infer its behaviour in different environments. It also provides a complementary approach and useful guidance to numerical simulations exploring star formation, while making testable predictions.

Accepted by ApJ

For preprints : arXiv:0805.0691v1

Solar Abstracts

Observations of Low-Latitude Coronal Plumes

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Using Fe IX/X 17.1 nm observations from the Extreme-Ultraviolet Imaging Telescope (EIT) on the Solar and Heliospheric Observatory (SOHO), we have identified many coronal plumes inside low-latitude coronal holes as they transited the solar limb during the late declining phase of cycle 23. These diffuse, linear features appear to be completely analogous to the familiar polar plumes. By tracking them as they rotate from the limb onto the disk (or vice versa), we confirm that EUV plumes seen against the disk appear as faint, diffuse blobs of emission surrounding a brighter core. When the EIT images are compared with near-simultaneous magnetograms from the SOHO Michelson Doppler Imager (MDI), the low-latitude, on-disk plumes are found to overlie regions of mixed polarity, where small bipoles are in contact with unipolar flux concentrations inside the coronal hole. The birth and decay of the plumes are shown to be closely related to the emergence of ephemeral regions, their dispersal in the supergranular flow field, and the cancellation of the minority-polarity flux against the dominant-polarity network elements. In addition to the faint polar and nonpolar plumes associated with ephemeral regions, we note the existence of two topologically similar coronal structures: the giant plume-like features that occur above active regions inside coronal holes, and the even larger scale "pseudostreamers" that separate coronal holes of the same polarity. In all three cases, the basic structure consists of open field lines of a given polarity overlying a photospheric region of the opposite polarity; ongoing interchange reconnection at the X-point separating the open field domains from the underlying doublearcade system appears to result in the steady evaporation of material from the closed into the open region.

Accepted by Solar Physics

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For preprints via ftp or WWW: http://www.springerlink.com/content/1573-093X/

Flow Instabilities of Magnetic Flux Tubes. III. Toroidal Flux Tubes

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In addition to buoyancy- and magnetic tension-driven instabilities, flux tubes are also susceptible to an instability induced by the hydrodynamic drag force. We substitute the hydrodynamic drag force with Stokes law of friction to investigate the linear stability properties of toroidal flux tubes in mechanical equilibrium. Analytical instability criteria are derived for axial symmetric perturbations and for flux rings in the equatorial plane by analysing the sequence of principal minors of the coefficient matrices of dispersion polynomials. The general case of non-equatorial flux rings is investigated numerically by considering flux tubes in the solar overshoot region. The friction-induced instability occurs when an eigenmode reverses its direction of propagation due to advection, typically from the retrograde to the prograde direction. This reversal requires a certain relative velocity difference between plasma inside the flux tube and the environment. Since for flux tubes in mechanical equilibrium the relative velocity difference is determined by the equilibrium condition, the instability criterion depends on the location and field strength of the flux ring. The friction-induced instability sets in at lower field strengths than buoyancy- and tension-driven instabilities. Its threshold is independent of the strength of friction, but the growth rates depend on the strength of the frictional coupling between flux tube and environment. Whereas buoyancy- and tension-driven instabilities depend on the magnetic field strength alone, the dependence of hydrodynamic drag on the tube diameter gives rise to an additional dependence of growth times on the magnetic flux.

Accepted by A&A

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For preprints via WWW: http://arxiv.org/abs/0804.3004

The Amplitude of Solar Oscillations Using Stellar Techniques

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The amplitudes of solar-like oscillations depend on the excitation and damping, both of which are controlled by convection. Comparing observations with theory should therefore improve our understanding of the underlying physics. However, theoretical models invariably compute oscillation amplitudes relative to the Sun, and it is therefore vital to have a good calibration of the solar amplitude using stellar techniques. We have used daytime spectra of the Sun, obtained with HARPS and UCLES, to measure the solar oscillations and made a detailed comparison with observations using the BiSON helioseismology instrument. We find that the mean solar amplitude measured using stellar techniques, averaged over one full solar cycle, is $18.7 \pm 0.7\,\mathrm{cm\,s^{-1}}$ for the strongest radial modes ($l = 0$) and $25.2 \pm 0.9\,\mathrm{cm\,s^{-1}}$ for $l = 1$. In addition, we use simulations to establish an equation that estimates the uncertainty of amplitude measurements that are made of other stars, given that the mode lifetime is known. Finally, we also give amplitudes of solar-like oscillations for three stars that we measured from a series of short observations with HARPS (γ Ser, β Aql and α For), together with revised amplitudes for five other stars for which we have previously published results (α Cen A, α Cen B, β Hyi, ν Ind and δ Pav).

Accepted by ApJ

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For preprints via ftp or WWW: http://adsabs.harvard.edu/abs/2008arXiv0804.1182K

Point Spread Functions for the Solar Optical Telescope Onboard Hinode

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The combined point spread function (PSF) of the Broadband Filter Imager (BFI) and the Solar Optical Telescope (SOT) onboard the Hinode spacecraft is investigated. Observations of the Mercury transit from November 2006 and the solar eclipse(s) from 2007 are used to determine the PSFs of SOT for the blue, green, and red continuum channels of the BFI. For each channel large grids of theoretical point spread functions are calculated by convolution of the ideal diffraction-limited PSF and Voigt profiles. These PSFs are applied to artificial images of an eclipse and a Mercury transit. The comparison of the resulting artificial intensity profiles across the terminator and the corresponding observed profiles yields a quality measure for each case. The optimum PSF for each observed image is indicated by the best fit. The observed images of the Mercury transit and the eclipses exhibit a clear proportional relation between the residual intensity and the overall light level in the telescope. In addition there is a anisotropic stray-light contribution. These two factors make it very difficult to pin down a single unique PSF that can account for all observational conditions. Nevertheless the range of possible PSF models can be limited by using additional constraints like the pre-flight measurements of the Strehl ratio. BFI/SOT operate close to the diffraction limit and have only a rather small stray-light contribution. The FWHM of the PSF is broadened by only $\sim 1\,\%$ with respect to the diffraction-limited case, while the overall Strehl ratio is ~ 0.8. In view of the large variations – best seen in the residual intensities of eclipse images – and the dependence on the overall light level and position in the FOV, a range of PSFs should be considered instead of a single PSF per wavelength. The individual PSFs of that range allow then the determination of error margins for the quantity under investigation. Nevertheless the stray-light contributions are here found to be best matched with Voigt functions with the parameters $\sigma = 0.''008$ and $\gamma = 0.''004$, $0.''005$, and $0.''006$ for the blue, green, and red continuum channels, respectively.

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JOB OPENING

Postdoctoral Researcher
Atomic Processes in Solar Physics
Armagh Observatory (N. Ireland)

Area of Emphasis: Calculation of atomic processes relevant to solar physics.

Applications are invited for a 3 year postdoctoral fellowship in Atomic Physics to be held at Armagh Observatory beginning October 2008 or as soon as possible thereafter. The PDRA's work activities will be directed towards the calculation of various atomic processes, such as density dependent ionisation, non-Maxwellian velocity distributions, etc. Such data is relevant to the interpretation and modelling of various solar transient features. The candidate will have full access to the Atomic Data and Analysis Structure (ADAS) routines.

Further information about Armagh Observatory, and in particular the current research programme, may be obtained by consulting the Observatory's web-site or via email to Gerry Doyle (jgd@arm.ac.uk). This post is funded by a grant from the UK STFC. The closing date for applications is 31 May 2008. Late applications will be considered until the position is filled.

Armagh Observatory have an excellent in-house computing facility plus access to super-computing facilities via the Irish Grid. Prospective applicants should obtain an application pack from the Administrator or it may be downloaded from http://star.arm.ac.uk/jobs/. The completed application form, together with a full curriculum vitae and bibliography should be sent to:

The Administrator, Armagh Observatory, College Hill, Armagh BT61 9DG, N. Ireland (Tel: +44-(0)28-3752-2928; FAX: +44-(0)28-3752-7174; e-mail: lfy@arm.ac.uk).

References from at least two referees should be sent to the Administrator to arrive by the initial closing date or as soon as possible thereafter.

The Armagh Observatory is an equal opportunities employer.

Upcoming Meetings

Editor's Note: The 2008 meetings listed below are of potential interest to cool stars and solar researchers. For further information see

http://www3.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/meetings/meetings.html

The First International Workshop on the UX Ori Type Stars and Related Topics
25 - 29 May 2008
Yalta, Ukraine

γ Doradus Stars in the COROT Fields
26 - 30 May 2008
University of Nice Sophia-Antipolis, Nice, France

AAS Solar Physics Div. Meeting (with AGU)
27 - 30 May 2008
Ft. Lauderdale, Florida, USA

The X-ray Universe 2008
27 - 30 May 2008
Granada, Spain

International Workshop on Solar Variability, Earth's Climate and the Space Environment
1 - 6 June 2008
Bozeman, Montana, USA

Extra-Solar Super-Earths
16 - 18 June 2008
Nantes, France

Interacting Binaries: Accretion and Synchronization
20 - 26 June 2008
Crimean Astrophysical Observatory, Crimea, Ukraine

Interpretation of Asteroseismic Data, Wroclaw HELAS Workshop
23 - 27 June 2008
Wroclaw, Poland

15th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun
21 - 25 July 2008
St Andrews, Scotland

Star Cluster Formation: From Taurus to the Antennae
Monday, 4 - 8 August 2008
University of Sheffield, UK

GONG 2008/SOHO XXI: Solar-stellar Dynamos as Revealed by Helio-and Asteroseismology
11 - 15 August 2008
Boulder, Colorado, USA

Probing Stellar Populations Out to the Distant Universe
7 - 19 September 2008
Cefalu' (Sicily), Italy

(continued →)

Upcoming Meetings (cont.)

IAU Symposium 257: Universal Heliophysical Processes
15 - 19 September 2008
University of Ioannina, Ioannina, Greece

IXth Hvar Astrophysical Colloquium : Solar Minimum Meeting
22 - 26 September 2008
Hvar, Croatia

IAU Symposium No. 258: The Ages of Stars
13 - 17 October 2008
Baltimore, Maryland USA

IAU Symposium No. 259: Cosmic Magnetic Fields: from Planets, to Stars and Galaxies
3 - 7 November 2008
Puerto Santiago, Tenerife

Magnetic Coupling between the Interior and the Atmosphere of the Sun
Tuesday, 2 - 5 December 2008
Indian Institute of Astrophysics, Bangalore, INDIA

Solar Activity During the Onset of Solar Cycle 24
Sunday, 7 - 12 December 2008
Napa, California, USA

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.***