COOLNEWS

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Stellar Abstracts

Photospheric and Chromospheric Activity in V405 And: An M Dwarf Binary with Components on the Two Sides of the Full Convection Limit

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We investigate the fast rotating ($P_{orb} = P_{rot} = 0.465d$) active dwarf binary V405 And (M0V+M5V) using photometric $BV(RI)_C$ and optical spectroscopic data. The light variation is caused by the combined effect of spottedness and binarity with a small eclipse. From the available light and radial velocity curves we estimate the system parameters. Three flare events happened during the observations: two were found in the spectroscopic data and one was observed photometrically in $BV(RI)_C$ colours. An interesting eruptive phenomenon emerged from the photometric measurements which can be interpreted as a series of post-flare eruptions lasting for at least 3 orbits (rotations) of the system, originating from trans-equatorial magnetic loops, which connect the active regions in the two hemispheres. The two components of V405 And have masses well over and below the theoretical limit of full convection. This rare property makes the binary an ideal target for observing and testing models for stellar dynamo action.

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Radiative Hydrodynamics Simulations of Red Supergiant Stars: I. Interpretation of Interferometric Observations

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Context: It has been suggested that convection in Red Supergiant (RSG) stars gives rise to large-scale granules causing observable surface inhomogeneities. This convection is also extremely vigorous, and suspected to be one of the causes of mass-loss in RSGs. It must thus be understood in details. Evidence has been accumulated that there are asymmetries in the photospheres of RSGs, but detailed studies of granulation are still lacking. Interferometric observations offer an exciting possibility to tackle this question, but they are still often interpreted using smooth symmetrical limb-darkened intensity distributions, or very simple spotted ad hoc models.
Aim: We explore the impact of the granulation on visibility curves and closure phases using the radiative transfer code OPTIM3D. We simultaneously assess how 3D simulations of convection in RSG with CO^{5}BOLD can be tested against these observations.
Methods: We use 3D radiative-hydrodynamics (RHD) simulations of convection to compute intensity maps at various wavelengths and time, from which we derive interferometric visibility amplitudes and phases. We study their behaviour with time, position angle, and wavelength, and compare them to observations of the RSG α Ori.
Results: We provide average limb-darkening coefficients for RSGs. We detail the prospects for the detection and characterization of granulation (contrast, size) on RSGs. We demonstrate that our RHD simulations provide an excellent fit to existing interferometric observation of α Ori, contrary to limb darkened disks. This confirms the existence of large convective cells on the surface of Betelgeuse.

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For preprints via ftp or WWW: http://arxiv.org/abs/0907.1860

Large Scale Circulations and Energy Transport in Contact Binaries

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A hydrodynamic model for the energy transport between the components of a contact binary is presented. Energy is transported by a large-scale, steady circulation carrying high entropy matter from the primary to secondary component. The circulation is driven by the baroclinic structure of the common envelope, which is a direct consequence of the nonuniform heating at the inner critical Roche lobes due to unequal emergent energy fluxes of the components. The mass stream flowing around the secondary is bound to the equatorial region by the Coriolis force and its width is determined primarily by the flow velocity. Its bottom is separated from the underlying secondary's convection zone by a radiative transition layer acting as an insulator. For a typically observed degree of contact the heat capacity of the stream matter is much larger than radiative losses during its flow around the secondary. As a result, its effective temperature and entropy decrease very little before it returns to the primary. The existence of the stream changes insignificantly specific entropies of both convective envelopes and sizes of the components. Substantial oversize of the secondaries, required by the Roche geometry, cannot be explained in this way. The situation can, however, be explained by assuming that the primary is a main sequence star whereas the secondary is in an advanced evolutionary stage with hydrogen depleted in its core. Such a configuration is reached past mass transfer with mass ratio reversal. Good agreement with observations is demonstrated by model calculations applied to actual W UMa-type binaries. In particular, a presence of the equatorial bulge moving with a relative velocity of 10-30 kms$^{-!}$ around both components of AW UMa is accounted for.

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Preprint available via arXiv (astro-ph): http://arxiv.org./abs/0902.1063

Red Supergiants in the Andromeda Galaxy

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[6] Geneva University, Geneva Observatory, CH-1290 Versoix, Switzerland Red supergiants are a short-lived stage in the evolution of moderately massive stars (10-25$M_{\odot}$), and as such their location in the H-R diagram provides an exacting test of stellar evolutionary models. Since massive star evolution is strongly affected by the amount of mass-loss a star suffers, and since the mass-loss rates depend upon metallicity, it is highly desirable to study the physical properties of these stars in galaxies of various metallicities. Here we identify a sample of red supergiants in M31 (the most metal-rich of the Local Group galaxies) and derive their physical properties by fitting MARCS atmosphere models to moderate resolution optical spectroscopy, and from $V-K$ photometry.

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For preprints via ftp or WWW: http://arxiv.org/abs/0907.3767

Observation and Modelling of Main Sequence Star Chromospheres. XIII. The Na I D1 & D2, and He I D3 Lines in dM1 Stars

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We investigate spectral lines of interest in dM1 stars: namely, the Na I D1 & D2, He I 5876, Ca I 6439 and Fe I 6430 lines. We study in detail the line shapes of the Na I D1 & D2 lines. We find that these lines are strong and broad in normal dM1 stars and become weaker and narrower when metallicity is low, although our sample is insufficient in order to find out an empirical correlation between these parameters.

We find correlations between the CaII resonance line mean equivalent width and vsinsi as well as between the NaI mean line core relative flux and vsini. These correlations include low activity dM1 stars, and show that the NaI mean line core flux is a good chromospheric diagnostic.

We find a good correlation between the Na I D1 line core flux and the Na I D2 line core flux. This correlation shows that the line core optical depths decrease with increasing activity level, i.e., the opposite of what was found for the Ca II lines (Houdebine & Stempels 1997). The Na I D1 & D2 mean line core flux also correlates well with the Ca II mean equivalent width, and with the H_{α} equivalent width. We also compare these correlations to the available model computations. We investigate in detail the shapes of the Na I D1 & D2 lines through the full line widths at 85%, 62% and 35% of the continuum. The significant differences from one star to another cannot be explained at this stage. Detailed modelling of the stellar photospheres will be necessary to interpret the observed differences.

The He I 5876 line is detected in only one dM1 star in our sample. We obtain activity correlations between the He I 5876 line equivalent width and the Ca II mean equivalent width, and the H_{α} equivalent width.

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Mixed Helicity in Erupting Filaments

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Erupting filaments are sometimes observed to undergo a rotation about the vertical direction as they rise. This rotation of the filament axis is generally interpreted as a conversion of twist into writhe in a kink-unstable magnetic flux rope. Consistent with this interpretation, the rotation is usually found to be clockwise (as viewed from above) if the post-eruption arcade has right-handed helicity, but counterclockwise if it has left-handed helicity. Here, we describe two non–active-region filament events recorded with the Extreme-Ultraviolet Imaging Telescope (EIT) on the *Solar and Heliospheric Observatory* (*SOHO*), in which the sense of rotation appears to be opposite to that expected from the helicity of the post-event arcade. Based on these observations, we suggest that the rotation of the filament axis is in general determined by the net helicity of the erupting system, and that the axially aligned core of the filament can have the opposite helicity sign to the surrounding field. In most cases, the surrounding field provides the main contribution to the net helicity. In the events reported here, however, the helicity associated with the filament "barbs" is opposite in sign to and dominates that of the overlying arcade.

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For preprints via ftp or WWW: http://lanl.arxiv.org/abs/0907.4446

Abstract Guidelines

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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

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