COOLNEWS

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TABLE OF CONTENTS

Stellar Abstracts

Multiwavelength Optical Observations of Chromospherically Active Binary Systems V. FF UMa (2RE J0933+624): A System With Orbital Period Variation

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This is the fifth paper in a series aimed at studying the chromospheres of active binary systems using several optical spectroscopic indicators to obtain or improve orbital solution and fundamental stellar parameters. We present here the study of FF UMa (2RE J0933+624), a recently discovered, X-ray/EUV selected, active binary with strong Hα emission. The objectives of this work are, to find orbital solutions and define stellar parameters from precise radial velocities and carry out an extensive study of the optical indicators of chromospheric activity. We obtained high resolution echelle spectroscopic observations during five observing runs from 1998 to 2004. We found radial velocities by cross correlation with radial velocity standard stars to achieve the best orbital solution. We also measured rotational velocity by cross-correlation techniques and have studied the kinematic by galactic space-velocity components (U, V, W) and Eggen criteria. Finally, we have determined the chromospheric contribution in optical spectroscopic indicators, from Ca II H & K to Ca II IRT lines, using the spectral subtraction technique. We have found that this system presents an orbital period variation, higher than previously detected in other RS CVn systems. We determined an improved orbital solution, finding a circular orbit with a period of 3.274 days. We derived the stellar parameters, confirming the subgiant nature of the primary component ($M_{\rm P} = 1.67\ M_\odot$ and $R \sin i_{\rm P} = 2.17\ R_\odot$) and obtained rotational velocities ($v \sin i$), of 33.57±0.45 km s^{-1} and 32.38±0.75 km s^{-1} for the primary and secondary components respectively. From our kinematic study, we can deduce its membership to the Castor moving group. Finally, the activity study has given us a better understanding of the possible mechanism that produce the orbital period variation. Accepted by A&A *For preprints contact*: mcz@astrax.fis.ucm.es *For preprints via ftp or WWW*: http://www.ucm.es/info/Astrof/invest/actividad/actividad_pub.html

The Radius and Mass of the Subgiant Star β Hyi from Interferometry and Asteroseismology

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We have used the Sydney University Stellar Interferometer (SUSI) to measure the angular diameter of β Hydri. This star is a nearby G2 subgiant whose mean density was recently measured with high precision using asteroseismology. We determine the radius and effective temperature of the star to be $1.814 \pm 0.017\,\mathrm{R}_{\odot}$ (0.9%) and $5872 \pm 44\,\mathrm{K}$ (0.7%) respectively. By combining this value with the mean density, as estimated from asteroseismology, we make a direct estimate of the stellar mass. We find a value of $1.07 \pm 0.03\,\mathrm{M}_{\odot}$ (2.8%), which agrees with published estimates based on fitting in the H-R diagram, but has much higher precision. These results place valuable constraints on theoretical models of β Hyi and its oscillation frequencies. Accepted by MNRAS Letters

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For preprints via ftp or WWW: http://arxiv.org/abs/0707.0333

Anti-Solar Differential Rotation on the Active K-giant σ Geminorum

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The active K1 giant σ Gem and its differential surface rotation is revisited. We refine our previous inconclusive result by recovering the spot migration pattern of this long-period RS CVn-type binary by applying the technique of "Average cross-correlation of contiguous Doppler images" (ACCORD) to a set of six Doppler images from 3.6 consecutive rotation cycles. We find an anti-solar differential rotation law with a shear of $\alpha \approx -0.022 \pm 0.006$. We also find evidence of a poleward migration trend of spots with an average velocity of $\approx$300 m s^{-1}.

Accepted by A&A

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HE 0557–4840 — Ultra-Metal-Poor and Carbon-Rich

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We report the discovery and high-resolution, high S/N, spectroscopic analysis of the ultra-metal-poor red giant HE 0557–4840, which is the third most heavy-element deficient star currently known. Its atmospheric parameters are $T_{\rm eff}$ = 4900 K, log g = 2.2, and [Fe/H]= –4.75. This brings the number of stars with [Fe/H] < –4.0 to three, and the discovery of HE 0557-4840 suggests that the metallicity distribution function of the Galactic halo does not have a "gap" between [Fe/H] = –4.0, where several stars are known, and the two most metal-poor stars, at [Fe/H]

~ -5.3. HE 0557–4840 is carbon rich – [C/Fe] = +1.6 – a property shared by all three objects with [Fe/H] < −4.0, suggesting that the well-known increase of carbon relative to iron with decreasing [Fe/H] reaches its logical conclusion – ubiquitous carbon richness – at lowest abundance. We also present abundances (nine) and limits (nine) for a further 18 elements. For species having well-measured abundances or strong upper limits, HE 0557–4840 is "normal" in comparison with the bulk of the stellar population at [Fe/H]   −4.0 – with the possible exception of Co. We discuss the implications of these results for chemical enrichment at the earliest times, in the context of single ("mixing and fallback") and two-component enrichment models. While neither offers a clear solution, the latter appears closer to the mark. Further data are required to determine the oxygen abundance and improve that of Co, and hence more strongly constrain the origin of this object.

Accepted by Astrophysical Journal

For preprints via ftp or WWW: http://xxx.lanl.gov/abs/0707.2657

Solar Abstracts

On The Mass and Energy Loading of EUV Brightpoints

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We discuss the appearance of EUV brightpoints (BPs) in the analysis of long-duration observations in the He II (304 Angstroms) passband of the Solar and Heliospheric Observatory (SOHO) Extreme-ultraviolet Imaging Telescope (EIT). The signature of the observed 304Å passband intensity fluctuations around the BPs suggest that the primary source of the mass and energy supplied to the magnetic structure is facilitated by relentless magnetoconvection-driven reconnection, forced by the magnetic evolution of the surrounding supergranules. Further, we observe that if the magnetic conditions in the supergranules surrounding the footpoints of the cool 304Å BPs are sufficient (large net imbalance with a magnetic field that closes beyond the boundaries of the cell it originates in) the magnetic topology comprising the BP will begin to reconnect with the overlying corona, increasing its visibility to hotter EUV passbands and possibly Soft X-Rays.

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For preprints via ftp or WWW: http://arxiv.org/abs/0708.0550v1/

Sporadic Long-term Variability in Radio Activity from a Brown Dwarf

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Radio activity has been observed in a large variety of stellar objects, including in the last few years, ultra-cool dwarfs. To explore the extent of long-term radio activity in ultra-cool dwarfs, we use data taken over an extended period of 9 hr from the Very Large Array of the source 2MASS J05233822-1403022 in September 2006, plus data taken in 2004. The observation taken in September 2006 failed to detect any radio activity at 8.46 GHz. A closer inspection of earlier data reveals that the source varied from a null detection on 3 May 2004, to ≈95 μJy on 17 May 2004, to 230 μJy on 18 June 2004. The lack of detection in September 2006 suggests at least a factor of ten flux variability at 8.46 GHz. Three short photometric runs did not reveal any optical variability. In addition to the observed pulsing nature of the radio flux from another ultra-cool source, the present observations suggests that ultra-cool dwarfs may not just be pulsing but can also display long-term sporadic variability in their levels of quiescent radio emission. The lack of optical photometric variability suggests an absence of large-scale spots at the time of the latest VLA observations, although small very high latitude spots combined with a low inclination could cause very low amplitude rotational modulation which may not be measurable. We discuss this large variability in the radio emission within the context of both gyrosynchrotron emission and the electron-cyclotron maser, favoring the latter mechanism.

Accepted by A&A Letters

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16–20 $M_{\rm Jup}$ RV Companion Orbiting the Brown Dwarf Candidate ChaHα8

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We report the discovery of a 16–20 $M_{\rm Jup}$ radial velocity companion around the very young (∼3 Myr) brown dwarf candidate ChaHα8 (M5.75– M6.5). Based on high-resolution echelle spectra of ChaHα8 taken between 2000 and 2007 with UVES at the VLT, a companion was detected through RV variability with a semi-amplitude of 1.6 km s^{-1}. A Kepler fit to the data yields an orbital period of the companion of 1590 days and an eccentricity of e=0.49. A companion minimum mass $M_2 \sin i$ between 16 and 20 $M_{\rm Jup}$ is derived when using model-dependent mass estimates for the primary. The mass ratio $q \equiv M_2/M_1$ might be as small as 0.2 and, with a probability of 87%, it is less than 0.4. ChaHα8 harbors most certainly the lowest mass companion detected so far in a close (∼ 1 AU) orbit around a brown dwarf or very low-mass star. From the uncertainty in the orbit solution, it cannot completely be ruled out that the companion has a mass in the planetary regime. Its discovery is in any case an important step towards RV planet detections around BDs. Further, ChaHα8 is the fourth known spectroscopic brown dwarf or very low-mass binary system with an RV orbit solution and the second known very young one.

Accepted by ApJ Letter

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A Chandra X-ray detection of the L dwarf binary Kelu-1: Simultaneous Chandra and Very Large Array observations

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Magnetic activity in ultracool dwarfs, as measured in X-rays and Hα, shows a steep decline after spectral type M7-M8. So far, no L dwarf has been detected in X-rays. In contrast, L dwarfs may have higher radio activity than M dwarfs. We observe L and T dwarfs simultaneously in X-rays and radio to determine their level of magnetic activity in the context of the general decline of magnetic activity with cooler effective temperatures. The field L dwarf binary Kelu-1 was observed simultaneously with Chandra and the Very Large Array. Kelu-1AB was detected in X-rays with $L_{\rm X} = 2.9^{+1.8}_{-1.3} \times 10^{25}$ erg/s, while it remained undetected in the radio down to a 3σ limit of $L_{\rm R} \leq 1.4 \times 10^{13}$ erg/s/Hz. We argue that, whereas the X-ray and Hα emissions decline in ultracool dwarfs with decreasing effective temperature, the radio luminosity stays (more or less) constant across M and early-L dwarfs. The radio surface flux or the luminosity may better trace magnetic activity in ultracool dwarfs than the ratio of the luminosity to the bolometric luminosity. Deeper radio observations (and at short frequencies) are required to determine if and when the cut-off in radio activity occurs in L and T dwarfs, and what kind of emission mechanism takes place in ultracool dwarfs.

Accepted by A&A Letters

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For preprints via ftp or WWW: http://arxiv.org/abs/0707.1882

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Smithsonian Astrophysical Observatory

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Attention: Dr. Nancy S. Brickhouse (nbrickhouse@cfa.harvard.edu)

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