COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

VLTI/AMBER Spectro-Interferometric Imaging of VX Sgr's Inhomogenous Outer Atmosphere

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We aim to explore the photosphere of the very cool late-type star VX Sgr and in particular the existence and characterization of molecular layers above the continuum forming photosphere.
We obtained interferometric observations with the VLTI/AMBER interferometer using the fringe tracker FINITO in the spectral domain 1.45-2.50 μm with a spectral resolution of ≈ 35 and baselines ranging from 15 to 88 meters. We perform independent image reconstruction for different wavelength bins and fit the interferometric data with a geometrical toy model. We also compare the data to 1D dynamical models of Miras atmosphere and to 3D hydrodynamical simulations of red supergiant (RSG) and asymptotic giant branch (AGB) stars.
Reconstructed images and visibilities show a strong wavelength dependence. The H-band images display two bright spots whose positions are confirmed by the geometrical toy model. The inhomogeneities are qualitatively predicted by 3D simulations. At ≈ 2.00 μm and in the region $2.35-2.50$ μm, the photosphere appears extended and the radius

is larger than in the H band. In this spectral region, the geometrical toy model locates a third bright spot outside the photosphere that can be a feature of the molecular layers. The wavelength dependence of the visibility can be qualitatively explained by 1D dynamical models of Mira atmospheres. The best-fitting photospheric models show a good match with the observed visibilities and give a photospheric diameter of $\Theta = 8.82 \pm 0.50$ mas. The H_2O molecule seems to be the dominant absorber in the molecular layers.
We show that the atmosphere of VX Sgr rather resembles Mira/AGB star model atmospheres than RSG model atmsopheres. In particular, we see molecular (water) layers that are typical for Mira stars.

Accepted by A&A

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For preprints via ftp or WWW: http://arxiv.org/abs/0911.4422

Observation and Modelling of Main-sequence Star Chromospheres IX. Two-component Model Chromospheres for Nine M1 Dwarfs

E.R. Houdebine[1] [1] 25 Rue du Dr. Laulaigne, 49670 Valanjou, France We aim to constrain the H_α, CaII H and CaII K line profiles of quiescent and active regions of nine dM1 stars of near solar metallicity: Gl 2, GJ 1010A, Gl 49, Gl 150.1B, Gl 205, Gl 229, Gl 526, G192-11A, and Gl 880.

We propose a new method for building two-component model chromospheres for dM1 stars based on simple constraints and a grid of model atmospheres developed by Houdebine & Stempels. This method is based on the measurements of the equivalent width of H_α and CaII H & K. Based on the peculiar relationship between these two equivalent widths in the model atmospheres, our solutions provide an exact match of these equivalent widths, .

We obtain two component (quiescent and active region) model chromospheres for our nine target stars. We fit the H_α, CaII H, and CaII K profiles for these stars. These models show that seven of these stars lie in the intermediate activity range between H_α maximum absorption and emission. Two stars (Gl 49 and G192-11A) are quite active with H_α emission profiles in plages. As far as the CaII emission is concerned, these two stars are almost as active as dM1e stars. Two stars (GJ 1010A and Gl 526) have lower activity levels with narrower and weaker H_α profiles. The range of activity covered by these stars is a factor of 13 in the CaII lines, from low activity to activity levels almost as high as those of dM1e stars.

Our method sometimes provides two solutions of the observed H_α equivalent width as a function of the quiescent region H_α equivalent width. For Gl 205, one of the solutions is shown to be impossible for the assumptions that we use. For Gl 49 and G192-11A, two solutions are possible; a low solution (low CaII EW) and a high solution (high CaII EW). The difference between these two solutions is mainly in the plage-filling factor. The two solutions give almost identical H_α and CaII profiles. We prefer the low solutions because the filling factors are in closer agreement with those of other stars. We find plage-filling factors typically in the range 20%-40%. We also find that it is the chromospheric pressure rather than the filling factor that increases with increasing activity.

We define a minimum theoretical H_α equivalent width as a function of the mean CaII H & K equivalent width. We show that our observations agree well with this lower limit. We also show that the properties of the chromosphere in quiescent and active regions correlate with the mean CaII H & K equivalent width. This could be useful in future studies to derive an estimate of the chromospheric properties from the observed mean CaII H & K equivalent width.

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The Electron Temperature of the Solar Transition Region as Derived from EIS and SUMER

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We use UV and EUV emission lines observed in quiet regions on the solar disk with SUMER and EIS to determine the electron temperature in solar transition region plasmas. Prominent emission lines of O IV and O VI are present in the solar spectrum and the measured intensity line ratios provide electron temperatures in the range of $\log T =$ 5.6–6.1. We find that the theoretical O IV and O VI ion formation temperatures are considerably lower than our derived temperatures. The line ratios expected from a plasma in ionisation equilibrium are larger by a factor of about 2–5 than the measured line ratios. A careful cross-calibration of SUMER and EIS has been carried out, which excludes errors in the relative calibration of the two instruments. We checked for other instrumental and observational effects, as well as line blending, and can exclude them as a possible source of the discrepancy between theoretical and observed line ratios. Using a multi-thermal quiet sun differential emission measure (DEM) changes the theoretical line ratio by up to 28% which is not sufficient as an explanation. We also explored additional excitation mechanisms. Photoexcitation from photospheric black-body radiation, self-absorption and recombination into excited levels can not be a possible solution. Adding a second Maxwellian to simulate the presence of non-thermal, high-energy electrons in the plasma distribution of velocities also did not solve the discrepancy.

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Modeling the Sun's Open Magnetic Flux and the Heliospheric Current Sheet

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By coupling a solar surface flux transport model with an extrapolation of the heliospheric field, we simulate the evolution of the Sun's open magnetic flux and the heliospheric current sheet (HCS) based on observational data of sunspot groups since 1976. The results are consistent with measurements of the interplanetary magnetic field near Earth and with the tilt angle of the HCS as derived from extrapolation of the observed solar surface field. This opens the possibility for an improved reconstruction of the Sun's open flux and the HCS into the past on the basis of empirical sunspot data.

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On the Structure of the Convective-Velocity Field in the Solar Photosphere

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An algorithm of measuring horizontal photospheric velocities, which was previously employed to process aerospace images, is adapted for the tasks of solar physics and implemented in a computational code. It differs from the standard procedure of local correlation tracking by a special choice of trial areas ("targets"), whose displacements are determined by maximizing the correlation between the original and various shifted positions of the target. Specifically, an area is chosen as a target in a certain neighborhood of each node of a predefined grid if either the contrast or the entropy of the brightness distribution reaches its maximum in this area. The horizontal velocities thus obtained are then interpolated to the positions of imaginary "corks" using the Delaunay triangulation and affine transformations specified by the deformation of the obtained triangles at the time step considered. The motion of the corks is represented by their trajectories. A superposition of flows differing in their scales, from the mesogranular to the supergranular one, can be clearly seen. "large mesogranules" with sizes of order 15 Mm are revealed. The are stellate in their shape in many cases. Areas of strong convergence of the horizontal flows are detected; this convergence is sometimes accompanied

by a helicity. Evidence is found for the possible coexistence of convection cells with different circulation directions, so-called l-type and g-type cells.

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Properties of Simulated Sunspot Umbral Dots

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Realistic 3D radiative MHD simulations reveal the magneto-convective processes underlying the formation of the photospheric fine structure of sunspots, including penumbral filaments and umbral dots. Here we provide results from a statistical analysis of simulated umbral dots and compare them with reports from high-resolution observations. A multi-level segmentation and tracking algorithm has been used to isolate the bright structures in synthetic bolometric and continuum brightness images. Areas, brightness, and lifetimes of the resulting set of umbral dots are found to be correlated: larger umbral dots tend to be brighter and live longer. The magnetic field strength and velocity structure of umbral dots on surfaces of constant optical depth in the continuum at 630 nm indicate that the strong field reduction and high velocities in the upper parts of the upflow plumes underlying umbral dots are largely hidden from spectro-polarimetric observations. The properties of the simulated umbral dots are generally consistent with the results of recent high-resolution observations. However, the observed population of small, short-lived umbral dots is not reproduced by the simulations, possibly owing to insufficient spatial resolution.

Accepted by A&A

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Upcoming Meeting

Exploring the Diversity of Planetary Systems

7 – 10 September 2010

University of Exeter (U.K.)

Organisers: Isabelle Baraffe[1], Frederic Pont [1], Suzanne Aigrain [2]

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Planetary atmospheres are complex and evolving entities, as mankind is rapidly coming to realise whilst attempting to understand, forecast and mitigate human-induced climate change. In the Solar System, our neighbours Venus and Mars provide striking examples of two endpoints of planetary evolution, runaway greenhouse and loss of atmosphere to space.

The variety of extra-solar planets brings a wider angle to the issue: from scorching hot jupiters to ocean worlds, exo-atmospheres explore many configurations unknown in the Solar System, such as iron clouds, silicate rains, extreme plate tectonics, and steam volcanoes. Exoplanetary atmospheres have recently become accessible to observations. The aim of this conference in Exeter is to bring together Earth, Solar System and Exoplanet specialists to discuss recent results and the way ahead, and put our own climate in the wider context of the trials and tribulations of planetary atmospheres.

Scientific committee:
Jonathan Lunine – University of Arizona
Peter Cox – University of Exeter
Adam Showman – University of Arizona
Christophe Sotin – Jet Propulsion Laboratory
Frédéric Pont – University of Exeter
Suzanne Aigrain – University of Oxford
Isabelle Baraffe – University of Exeter
Roger Yelle – University of Arizona
Fred Taylor – University of Oxford
Franois Forget – Université Paris 6

To pre-register, contact: exoclimes@astro.ex.ac.uk

For more information, see: http://www.exeter.ac.uk/exoclimes/

Postdoctoral & Research Positions
Star and Planet Formation
Ecole Normale Supérieure de Lyon (France)

Several postdoc and more senior research associate positions (2 to 5 years) will be open in the Theoretical Astrophysics group of Ecole Normale Supérieure de Lyon (ENS-Lyon), France; Head Gilles Chabrier (chabrier AT ens-lyon.fr) in star and planet formation.

The positions can start as soon as June 1st, 2010.

For more information, see below:

http://members.aas.org/JobReg/JobDetailPage.cfm?JobID=26192

http://members.aas.org/JobReg/JobDetailPage.cfm?JobID=26193

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.***