COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

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Stellar Abstracts

Searching for Signatures of Planet Formation in Stars with Circumstellar Debris Discs

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Context: Tentative correlations between the presence of dusty circumstellar debris discs and low-mass planets have been recently presented. In parallel, detailed chemical abundance studies have reported different trends between samples of planet and non-planet hosts. Whether these chemical differences are indeed related to the presence of planets is still strongly debated. Aims: We aim to test whether solar-type stars with debris discs show any chemical peculiarity that could be related to the planet formation process. Methods: We determine in a homogeneous way the metallicity, [Fe/H], and abundances of individual elements of a sample of 251 stars including stars with known debris discs, stars harbouring simultaneously debris discs and planets, stars hosting exclusively planets, and a comparison sample of stars without known discs nor planets. High resolution échelle spectra (R∼ 57000) from 2-3 m class telescopes are used. Our methodology includes the calculation of the fundamental stellar parameters ($T_{\rm eff}$, $\log g$, microturbulent velocity, and metallicity) by applying the iron ionisation and equilibrium conditions to several isolated Fe I and Fe II lines, as well as, individual abundances of C, O, Na, Mg, Al, Si, S, Ca, Sc, Sc, Ti, V, Cr, Mn, Co, Ni, Cu, and Zn. Results: No significant differences have been found in metallicity, individual abundances or abundance-condensation temperature trends between stars with debris discs and stars with neither debris nor planets. Stars with debris discs

and planets have the same metallicity behaviour as stars hosting planets, and they also show a similar $<$[X/Fe]$>$-T_C trend. Different behaviour in the $<$[X/Fe]$>$-T_C trends is found between the samples of stars without planets and the samples of planet hosts. In particular, when considering only refractory elements, negative slopes are shown in cool giant planet hosts, whilst positive ones are shown in stars hosting low-mass planets. The statistical significance of the derived slopes is however low, a fact that can be due to the wide range of stellar parameters of our samples. Stars hosting exclusively close-in giant planets behave in a different way, showing higher metallicities and positive $<$[X/Fe]$>$-T_C slope. A search for correlations between the $<$[X/Fe]$>$-T_C slopes and the stellar properties reveals a moderate but significant correlation with the stellar radius and as well as a weak correlation with the stellar age, which remain even if Galactic chemical evolution effects are considered. No correlation between the $<$[X/Fe]$>$-T_C slopes and the disc/planet properties are found. Conclusions: The fact that stars with debris discs and stars with low-mass planets do not show neither metal enhancement nor a different $<$[X/Fe]$>$-T_C trend might indicate a correlation between the presence of debris discs and the presence of low-mass planets. We extend results from previous works based mainly in solar analogues which reported differences in the $<$[X/Fe]$>$-T_C trends between planet hosts and non hosts to a wider range of parameters. However, these differences tend to be present only when the star hosts a cool distant planet and not in stars hosting exclusively low-mass planets. The interpretation of these differences as a signature of planetary formation should be considered with caution since moderate correlations between the T_C slopes with the stellar radius and the stellar age are found, suggesting that an evolutionary effect might be at work.

Accepted by A&A

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For preprints via ftp or WWW: http://arxiv.org/abs/1502.07100

CARMENES Input Catalogue of M Dwarfs I. Low-resolution Spectroscopy with CAFOS

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Context. CARMENES is a stabilised, high-resolution, double-channel spectrograph at the 3.5 m Calar Alto telescope. It is optimally designed for radial-velocity surveys of M dwarfs with potentially habitable Earth-mass planets. Aims. We prepare a list of the brightest, single M dwarfs in each spectral subtype observable from the northern hemisphere, from which we will select the best planet-hunting targets for CARMENES. Methods. In this first paper on the preparation of our input catalogue, we compiled a large amount of public data and collected low-resolution optical spectroscopy with CAFOS at the 2.2 m Calar Alto telescope for 753 stars. We derived accurate spectral types using a dense grid of standard stars, a double least-squares minimisation technique, and 31 spectral indices previously defined by other authors. Additionally, we quantified surface gravity, metallicity, and chromospheric activity for all the stars in our sample. Results. We calculated spectral types for all 753 stars, of which 305 are new and 448 are revised. We measured pseudo-equivalent widths of Hα for all the stars in our sample, concluded that chromospheric activity does not affect spectral typing from our indices, and tabulated 49 stars that had been reported to be young stars in open clusters, moving groups, and stellar associations. Of the 753 stars, two are new subdwarf candidates, three are T Tauri stars, 25 are giants, 44 are K dwarfs, and 679 are M dwarfs. Many of the 261 investigated dwarfs in the range M4.0–8.0 V are among the brightest stars known in their spectral subtype. Conclusions. This collection of low-resolution spectroscopic data serves as a candidate target list for the CARMENES survey and can be highly valuable for other radial-velocity surveys of M dwarfs and for studies of cool dwarfs in the solar neighbourhood.

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For preprints via WWW: http://arxiv.org/abs/1502.07580

Dynamics of Rotation in M dwarfs: Indications for a Change in the Dynamo Regime in Stars at the Onset of Complete Convection

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We have measured v sin i with high precision for a sample of dM3 stars (86 targets). We detected rotation in 82 stars (73 dM3 stars, and 9 dM3e stars). We compare our measurements of v sin i for all the stars in our dM0, dM2, dM3 and dM4 samples to those from other authors. We find a good agreement down to v sin i values of less than 1 km s1. The mean of the differences between measurements is only 0.42 km s1.

We find that the distribution of P/sini for our dM3 stars is different from the distribution of P/sini among our samples of dM2 and dM4 stars. The mean rotation rate for the dM3 stars (excluding dM3e and sdM3 stars) is significantly slower (25.8 days) than for dM2 (14.4 days) and dM4 stars (11.4 days). Analogous behavior also emerges among the faster rotators (dMe stars): we find that a longer rotation period also occurs at spectral sub-type dM3e. Our data suggest that, as regards the rotational properties of lower main sequence stars, spectral sub-type dM3 stands out as exhibiting unusual slow rotation compared to that of adjoining sub-types. Our data lead us to suggest that the unusual rotational properties of M3 dwarfs may represent a signature of the transition to complete convection (TTCC).

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New Evolutionary Models for Pre-main Sequence and Main Sequence Low-mass Stars Down to the Hydrogen-burning Limit

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We present new models for low-mass stars down to the hydrogen-burning limit that consistently couple atmosphere and interior structures, thereby superseding the widely used BCAH98 models. The new models include updated molecular linelists and solar abundances, as well as atmospheric convection parameters calibrated on 2D/3D radiative hydrodynamics simulations. Comparison of these models with observations in various colour-magnitude diagrams for various ages shows significant improvement over previous generations of models. The new models can solve flaws that are present in the previous ones, such as the prediction of optical colours that are too blue compared to M dwarf observations. They can also reproduce the four components of the young quadruple system LkCa 3 in a colour-magnitude diagram with one single isochrone, in contrast to any presently existing model. In this paper we also highlight the need for consistency when comparing models and observations, with the necessity of using evolutionary models and colours based on the same atmospheric structures.

Accepted by A&A

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RESIK Solar X-ray Flare Element Abundances on a Non-isothermal Assumption

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Solar X-ray spectra from the RESIK crystal spectrometer on the *CORONAS-F* spacecraft (spectral range $3.3-6.1$ Å) are analyzed for thirty-three flares using a method to derive abundances of Si, S, Ar, and K, emission lines of which feature prominently in the spectra. For each spectrum, the method first optimizes element abundances then derives the differential emission measure as a function of temperature based on a procedure given by Sylwester et al. and Withbroe. This contrasts with our previous analyses of RESIK spectra in which an isothermal assumption was used. The revised abundances (on a logarithmic scale with $A(\mathrm{H}) = 12$) averaged for all the flares in the analysis are $A(\mathrm{Si}) = 7.53 \pm 0.08$ (previously 7.89 ± 0.13), $A(\mathrm{S}) = 6.91 \pm 0.07$ (7.16 ± 0.17), $A(\mathrm{Ar}) = 6.47 \pm 0.08$ (6.45 ± 0.07), and $A(\mathrm{K}) = 5.73 \pm 0.19$ (5.86 ± 0.20), with little evidence for time variations of abundances within the evolution of each flare. Our previous estimates of the Ar and K flare abundances are thus confirmed by this analysis but those for Si and S are reduced. This suggests the flare abundances of Si and Ar are very close to the photospheric abundance or solar proxies, while S is significantly less than photospheric and the K abundance is much higher than photospheric. These estimates differ to some extent from those in which a single enhancement factor applies to elements with first ionization potential less than 10 eV.

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Solar Flare Element Abundances from the Solar Assembly for X-rays (SAX) on MESSENGER

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X-ray spectra in the range $1.5-8.5$ keV have been analyzed for 526 large flares detected with the Solar Assembly for X-rays (SAX) on the Mercury *MESSENGER* spacecraft between 2007 and 2013. For each flare, the temperature and emission measure of the emitting plasma were determined from the spectrum of the continuum. In addition, with the SAX energy resolution of 0.6 keV (FWHM) at 6 keV, the intensities of the clearly resolved Fe-line complex at 6.7 keV and the Ca-line complex at 3.9 keV were determined, along with those of unresolved line complexes from S, Si, and Ar at lower energies. Comparisons of these line intensities with theoretical spectra allow the abundances of these elements relative to hydrogen to be derived, with uncertainties due to instrument calibration and the unknown temperature distribution of the emitting plasma. While significant deviations are found for the abundances of Fe and Ca from flare to flare, the abundances averaged over all flares are found to be enhanced over photospheric values by factors of 1.66 ± 0.34 (Fe), 3.89 ± 0.76 (Ca), 1.23 ± 0.45 (S), 1.64 ± 0.66 (Si), and 2.48 ± 0.90 (Ar). These factors differ from previous reported values for Fe and Si at least. They suggest a more complex relation of abundance enhancement with the first ionization potential (FIP) of the element than previously considered, with the possibility that fractionation occurs in flares for elements with a FIP of less than $\sim$7 eV rather than $\sim$ 10 eV.

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Upcoming Meeting

Brightness Variations of the Sun and Sun-like Stars

XXIX IAU General Assembly Focus Meeting

5 - 6 August 2015

Honolulu, Hawaii

SECOND ANNOUNCEMENT

Dear Colleagues:

The XXIX IAU General Assembly will be held August 3-14, 2015 in Honolulu, Hawaii. We invite contributions to the Focus Meeting 13 *Brightness Variations of the Sun and Sun-like Stars* scheduled for August 5-6, 2015.

Key Topics: The Focus meeting will address the following key topics:

1. Measurements of solar irradiance variability . 2. Stellar variability on rotational time scales; Kepler and Corot measurements. 3. Stellar variability on activity cycle time scales; ground based observations. 4. Physical mechanisms and models of solar and stellar brightness variability. 5. The photometric signature of magnetic activity: darker or brighter? 6. Is the Sun a solar-type variable? 7. Constraining dynamo models using solar and stellar variability records. 8. Influence of solar and stellar variability on Earth and other planets. 9. Stellar variability as a limiting factor for detectability of extra-solar planets.

Agenda: Session 1:Observing solar and stellar variability Session 2:The solar-stellar connection Session 3:Modelling solar and stellar variability Session 4:The impact of solar and stellar variability on their environment

Invited speakers confirmed to date include Suzanne Aigrain, Gibor Basri, Fabienne Bastien, Benjamin Beeck, Paul Charbonneau, Rim Fares, Edward Guinan,Heidi Korhonen,Dibyendu Nandi,Steven Saar,Sami Solanki, Tom Woods.

Scientific Organizing Committee: Gibor Basri (co-chair, USA), Arnab Rai Choudhuri (India), Jie Jiang (China), Philip Judge (co-chair, USA), Greg Kopp (USA), Natalie Krivova (co-chair, Germany), Stephen Marsden (Australia), Katalin Olah (Hungary), Pascal Petit (France), Alexander Shapiro (co-chair, Germany), Yvonne Unruh (United Kingdom)

The deadline for abstract submission is **March 18, 2015**.

Please visit **astronomy2015.org/abstracts** for abstract submission and further information.

The official website of the Focus meeting is **astronomy2015.org/focus_meeting_13** .
More information can be found at **www2.mps.mpg.de/projects/sun-climate/iau_fm13.html** .

Job Opening

Two Postdoctoral & Two Ph.D Positions
Evolved Stars & Physical Chemistry
Leuven University (Belgium)

Interdisciplinary project on the stellar winds around evolved stars at the Leuven University in Belgium funded by the ERC-CoG_2014 grant AEROSOL (PI. L. Decin).

The project
At the Leuven University (Belgium), we seek candidates for two post-doctoral and two PhD research positions, ready to play a key role in a new interdisciplinary project focusing on stellar winds around evolved (low-mass) stars. The candidates will interact closely with a team consisting of astrophysicists, chemists, and computational mathematicians, as the goal of the project is to boost our understanding of the physics and chemistry characterizing these stellar winds. The project builds upon novel data (including ALMA, Herschel, etc.), detailed theoretical wind models, and targeted laboratory experiments (see
`http://fys.kuleuven.be/ster/Projects/aerosol/aerosol`).

Institute of Astronomy
The Institute of Astronomy of the Leuven University is a young and active research group of some 50 scientists, engineers and administrative staff (http://www.ster.kuleuven.be). The institute is involved in several international networks and research projects, involving telescopes at international observatories and space missions. The institute is also responsible for the organisation of the Master in Astronomy & Astrophysics of the Faculty of Science at the Leuven University. The institute has a long tradition in the observational and theoretical studies of the late stages of evolution of low and intermediate mass stars.

For the ERC-CoG AEROSOL project of Prof. L. Decin, we seek one post-doc and one PhD candidate to work on the reduction, analysis and (radiative transfer) modeling of a whole suit of observations ranging from the UV to mm wavelength regime with the aim to retrieve the geometrical, thermodynamical and chemical structures of stellar winds. The post-doc preferentially has experience with infrared and (sub)millimeter observations and has in any case sufficient experience in implementing and exploiting radiative transfer models. The post-doc will also be allowed to carry out (part-time) his/her own research in collaboration with affiliated group members. The successful candidates will have access to recently obtained and granted observational data, advanced radiative transfer and forward chemistry modeling tools and will have the possibility to develop their own (hydro)simulations.

Physical Chemistry
As part of this project, one post-doc and one PhD position is open in the research group of Prof. S. Carl in the field of experimental gas-phase reaction kinetics in the Department of Chemistry, division of Quantum and Physical chemistry, beginning preferably on 1st October 2015. The experimental work will be carried out in the modern and fully-equipped new research laboratories of the Department of Chemistry, opening in mid 2015.

The experimental research concerns the determination of rate coefficients and product distributions of elementary gas-phase reactions involving key reactive species (Si- and S-bearing species and HCCO radicals) in stellar winds for which data is currently lacking. Specifically, several advanced laser-spectroscopic and chemiluminescence techniques will be employed by the PhD student to follow photolytically-generated reactive species in real time in a novel temperature-graded reaction vessel ($200-900$ K) coupled with cavity-ringdown/Fourier-transform infrared spectroscopy to elucidate reaction product channels. The post-doc will concentrate on the construction and exploitation of a novel low-temperature Laval-nozzle apparatus with the aim to obtain the rates of the same gas-phase reactions at temperatures below 200 K.

Candidates should have an interest in physical chemistry, high-resolution laser spectroscopy, and technical experimentation. The group currently enjoys and encourages further close collaboration with researches in the department employing high-level quantum chemical calculations on species related to this project. (*continued* →)

The position

At the Leuven University, the candidates will join the Institute for Astronomy (Prof. L. Decin) or the Physical Chemistry section (Prof. S. Carl). The interdisciplinary project is carried out in collaboration with Prof. T. Millar (Belfast University) and Prof. J. Nuth (NASA, Greenbelt). The four candidates will interact closely with the other team members at the Institute of Astronomy and Department of Chemistry. At the Leuven University, we have access to parallel computing facilities, to be exploited extensively in this project.

Contract

The PhD candidates will be employed for a 2+2 (after positive evaluation) period at the Institute of Astronomy or a 2+1 period at the Department of Chemistry. The initial contract for the post-doc positions runs over 2 years and could be prolonged with another year after positive evaluation. The salary will be commensurate to the standard scale for PhD and post-doctoral researchers at the Leuven University. The preferred starting date is between 1 October 2015 and 1 December 2015, but will be adapted to the selected candidate's availability. Candidates are thus requested to indicate their preferred starting date in the application.

Interested?

The successful post-doc candidates must have a PhD degree in astrophysics or chemistry, while the PhD candidates must have obtained a master degree in (astro)physics, mathematics or chemistry. The application must include

- A Curriculum Vitae (including publication list).
- A statement of research interests and future plans (maximum 3 pages).
- A letter detailing your specific qualifications for the position and your career/educational goals (maximum 1 page).
- Two letters of recommendation from professors well acquainted with your academic achievements. The letters are to be submitted separately to the address mentioned below.

DEADLINE for the application: 1 May 2015

More information can be obtained by contacting

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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 bimonthly call for abstracts will be issued. 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.***