COOLNEWS

A RESEARCH NEWSLETTER DEDICATED TO COOL STARS AND THE SUN

No. 191 — May-June 2014 Editor: Steve Skinner (coolnews@jila.colorado.edu)

TABLE OF CONTENTS

Coolnews on the Web

The current and previous issues of *Coolnews* are available on the following web page in pdf, postscript, and Latex format: **http://casa.colorado.edu/~skinners/coolnews.html**

Stellar Abstracts

Reliable Probabilistic Determination of Membership in Stellar Kinematic Groups in the Young Disk

A. Klutsch[1,2], R. Freire Ferrero[3], P. Guillout[3], A. Frasca[1], E. Marilli[1] and D. Montes[2]

[1] INAF - Osservatorio Astrofisico di Catania, via S. Sofia, 78, 95123 Catania, Italy
[2] Departmento de Astrofísica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain
[3] Observatoire Astronomique, Université de Strasbourg & CNRS, UMR 7550, 11 rue de l'université, 67000 Strasbourg, France

Over the last century, the overdensities in the velocity distributions of nearby stars were attributed to stellar kinematic groups or moving groups. Although their reality was initially questioned, their existence is now supported by a confluence of evidence.

To pursue investigations, quantitative methods should be clearly defined to identify new stars belonging to these groups. Here, we present two probabilistic methods to determine the likelihood of kinematic membership for possible candidates to five of the known young stellar kinematic groups – namely, Pleiades, IC 2391, Castor, Ursa Major, and Hyades – in which all are younger than 650 Myr.

We tried different methods to handle kinematic data of their known members. We succeeded to develop two independent procedures that are able to identify new candidates of these five stellar stream. We tested the robustness of our two approaches by means of extensive Monte-Carlo simulations.

Our methods are consistent with each other in more than 90% of cases and for almost all the stellar kinematic groups under scrutiny. The IC 2391 supercluster is an exception. Applying our statistical methods to a large sample of young

low-mass stars, we confirmed almost all the likely members and good candidates of these stellar streams. We also proposed 39 additional candidates based on the agreement and the high likelihood of age and kinematic membership.

These probabilistic methods are very powerful to reliably identify new candidate members of young stellar kinematic groups. However, the kinematic criteria alone are not sufficient to distinguish between coeval stars that are evaporated from open clusters and other field stars trapped by dynamical processes generated by galactic perturbations. The identification of stars belonging to the remnant of a past star-forming event can be possible with the help of additional information, such as indicators of chromospheric activity, age proxies (lithium abundance), and chemical composition.

Accepted by A&A

For preprints contact: alexis.klutsch@oact.inaf.it

For preprints via WWW: http://www.aanda.org/articles/aa/pdf/forth/aa22575-13.pdf

Spectrum of Hot Methane in Astronomical Objects Using a Comprehensive Computed Line List

Sergei N. Yurchenko[1], Jonathan Tennyson[1], Jeremy Bailey[2], Morgan D. J. Hollis[1] and Giovanna Tinetti[1]

[1] Department of Physics and Astronomy, University College London, London WC1E 6BT, United Kingdom
[2] of Physics, University of New South Wales, Sydney, NSW 2052, Australia

Hot methane spectra are important in environments ranging from flames to the atmospheres of cool stars and exoplanets. A new spectroscopic line list, 10to10, for 12CH4 containing almost 10 billion transitions is presented. This comprehensive line list covers a broad spectroscopic range and is applicable for temperatures up to 1,500 K. Previous methane data are incomplete, leading to underestimated opacities at short wavelengths and elevated temperatures. Use of 10to10 in models of the bright T4.5 brown dwarf 2MASS 0559-14 leads to significantly better agreement with observations and in studies of the hot Jupiter exoplanet HD 189733b leads to up to a 20-fold increase in methane abundance. It is demonstrated that proper inclusion of the huge increase in hot transitions which are important at elevated temperatures is crucial for accurate characterizations of atmospheres of brown dwarfs and exoplanets, especially when observed in the near-infrared.

Accepted by: Proc. Nat. Acad. Sci., 111, 93799383 (2014)

For preprints contact: j.tennyson@ucl.ac.uk

Absolute Properties of the Eclipsing Binary V501 Herculis

Claud H. Sandberg Lacy[1] and Francis C. Fekel[2]

[1] Physics Department, University of Arkansas, Fayetteville, AR 72701
[2] Center of Excellence in Information Systems, Tennessee State University, Nashville, TN 37209

V501 Her is a well detached G3 eclipsing binary star with a period of 8.597687 days for which we have determined very accurate light and radial-velocity curves by using robotic telescopes. Results of these data indicate that the component stars have masses of 1.269 ± 0.004 and 1.211 ± 0.003 solar masses, radii of 2.001 ± 0.003 and 1.511 ± 0.003 solar radii, and temperatures of 5683 ± 100K and 5720 ± 100K, respectively. Comparison with the Yonsei-Yale series of evolutionary models results in good agreement at an age of about 5.1 Gyr for a somewhat metal rich composition. Those models indicate that the more massive, larger, slightly cooler star is just beyond core hydrogen exhaustion while the less massive, smaller, slightly hotter star has not quite reached core hydrogen exhaustion. The orbit is not yet circularized, and both components are rotating at or near their pseudosynchronous velocities. The distance to the system is 450 ± 30 pc.

Accepted by AJ

For preprints contact: fekel@evans.tsuniv.edu

Stellar Activity Masquerading as Planets in the Habitable Zone of the M Dwarf Gliese 581

Paul Robertson[1,2], Suvrath Mahadevan[1,2,3], Michael Endl[4], and Arpita Roy[1,2,3]

[1] Department of Astronomy and Astrophysics, The Pennsylvania State University
[2] Center for Exoplanets & Habitable Worlds, The Pennsylvania State University
[3] The Penn State Astrobiology Research Center, The Pennsylvania State University
[4] McDonald Observatory, The University of Texas at Austin

The M dwarf Gliese 581 is believed to host four planets, including one (GJ 581d) near the habitable zone that could possibly support liquid water on its surface if it is a rocky planet. The detection of another habitable-zone planet–GJ 581g–is disputed, as its significance depends on the eccentricity assumed for d. Analyzing stellar activity using the Hα line, we measure a stellar rotation period of 130 ± 2 days and a correlation for Hα modulation with radial velocity. Correcting for activity greatly diminishes the signal of GJ 581d (to 1.5σ), while significantly boosting the signals of the other known super-Earth planets. GJ 581d does not exist, but is an artifact of stellar activity which, when incompletely corrected, causes the false detection of planet g.

Published in Science Express, arXiv:1407.1049

For preprints contact: pmr19@psu.edu

Near Infrared Spectroscopy of M Dwarfs. I. CO Molecule as an Abundance Indicator of Carbon

Takashi Tsuji[1] and Tadashi Nakajima[2]

[1] Institute of Astronomy, The University of Tokyo, 3-21-1 Osawa, Mitaka-shi, Tokyo, 181-0015 Japan
[2] National Astronomial Observatory of Japan, 3-21-1 Osawa, Mitaka-shi, Tokyo, 181-8588 Japan

Based on the near infrared spectra of 42 M dwarfs, carbon abundances are determined from the ro-vibrational lines of CO 2-0 band. We apply $T_{\rm eff}$ values based on the angular diameters (15 objects) and on the infrared flux method (2 objects) or apply a simple new method using a $\log T_{\rm eff}$ (by the angular diameters and by the infrared flux method) – $M_{3.4}$ (the absolute magnitude at $3.4\,\mu$m based on the $WISE$ $W1$ flux and the Hipparcos parallax) relation to estimate $T_{\rm eff}$ values of objects for which angular diameters are unknown (25 objects). Also, we discuss briefly the HR diagram of low mass stars.

On the observed spectrum of M dwarf, the continuum is depressed by the numerous weak lines of H_2O and only the depressed continuum or the pseudo-continuum can be seen. On the theoretical spectrum of M dwarfs, the true continuum can be evaluated easily but we find that the pseudo-continuum can also be evaluated accurately thanks to the recent H_2O line database. Then quantitative analysis of the spectrum of M dwarf can be done by referring to the pseudo-continua both on the observed and theoretical spectra. Since the basic principle of the spectroscopic analysis should be the same whether the true- or pseudo-continuum is referred to, the difficulty related to the continuum in cool stars can in principle be overcome by the analysis referring to the pseudo-continuum instead of the true-continuum. Although this procedure can easily be applied to the spectral synthesis method, we propose a simple method of analyzing EWs by taking the effect of the contamination of H_2O on CO lines into account: We measure the EWs of the CO blends (i.e., not necessarily limited to a single line) including H_2O as contamination and analyze them by the theoretical EWs evaluated from the synthetic spectrum including the effect of H_2O contamination as well.

In dense and cool photospheres of M dwarfs, almost all the carbon atoms are in stable CO molecules which remain almost unchanged for the changes of the physical condition in the photospheres. For this reason, the numerous CO lines can be excellent abundance indicators of carbon, and carbon abundances in late-type stars can best be determined in M dwarfs rather than in solar type stars. This somewhat unexpected advantage of M dwarfs in abundance analysis has not necesarily been recognized very well so far, but we determine carbon abundances rather easily to be log C/H between -3.9 and -3.1 in 42 M dwarfs. The resulting C/Fe ratios for most M dwarfs are nearly constant at about the solar value based on the classical high carbon abundance rather than on the recently revised lower value. This result implies that the solar carbon abundance is atypical for its metallicity among the stellar objects in the solar neighborhood if the downward revised solar carbon abundance is correct.

Accepted by PASJ

For preprints contact: ttsuji@ioa.s.u-tokyo.ac.jp

For preprints via WWW: arXiv.1407.5829

Synthetic Stellar Photometry. I-General Considerations and New Transformations for Broad-band Systems.

Luca Casagrande[1], Don A. VandenBerg[2]

[1] Research School of Astronomy and Astrophysics, The Australian National University, Australia
[2] Department of Physics & Astronomy, University of Victoria, Canada

After a pedagogical introduction to the main concepts of synthetic photometry, colours and bolometric corrections in the Johnson-Cousins, 2MASS, and HST-ACS/WFC3 photometric systems are generated from MARCS synthetic fluxes for various [Fe/H] and [α/Fe] combinations, and virtually any value of $E(B-V) \leq 0.7$. The successes and failures of model fluxes in reproducing the observed magnitudes are highlighted. Overall, extant synthetic fluxes predict quite realistic broad-band colours and bolometric corrections, especially at optical and longer wavelengths: further improvements of the predictions for the blue and ultraviolet spectral regions await the use of hydrodynamic models where the microturbulent velocity is not treated as a free parameter. We show how the morphology of the colour-magnitude diagram (CMD) changes for different values of [Fe/H] and [α/Fe]; in particular,how suitable colour combinations can easily discriminate between red giant branch and lower main sequence populations with different [α/Fe], due to the concomitant loops and swings in the CMD. We also provide computer programs to produce tables of synthetic bolometric corrections as well as routines to interpolate in them. These colour–$T_{\rm eff}$–metallicity relations may be used to convert isochrones for different chemical compositions to various bandpasses assuming observed reddening values, thus bypassing the standard assumption of a constant colour excess for stars of different spectral type. We also show how such an assumption can lead to significant systematic errors. The MARCS transformations presented in this study promise to provide important constraints on our understanding of the multiple stellar populations found in globular clusters (e.g., the colours of lower main sequence stars are predicted to depend strongly on [α/Fe]) and of those located towards/in the Galactic Bulge.

Accepted by MNRAS

For preprints contact: luca.casagrande@anu.edu.au

For preprints via ftp or WWW: http://arxiv.org/abs/1407.6095
Tables and programs to generate synthetic colours and bolometric corrections at http://tinyurl.com/SSPcodes

Solar Abstracts

Coronal Hole Oscillations as Inferred from SDO/AIA Data

Hegde, M.[1 2], Hiremath, K. M.[1] and Doddamani, Vijayakumar H.[2]

[1] Indian Institute of Astrophysics, Bangalore, India 560034
[2] Department of Physics, Bangalore University, Bangalore 560056

Coronal Holes (CH) are large regions on the solar corona with low density plasma that have unipolar magnetic structures connected to interplanetary space. Apart from global oscillations of the Sun as a whole, other active regions of Sun also oscillate in different periods. Purpose of this study is to investigate whether a large-scale structure like coronal hole oscillates or not. Idea of this study is to examine if large-scale oscillations (rather than small spatial scales) of the coronal hole exist or not. So, with high temporal resolution (12 sec) of about two hours duration, data of a coronal hole structure in 171$\mathring{A}$, 193$\mathring{A}$ and 211$\mathring{A}$ taken from SDO/AIA images is considered for examination of oscillations. After estimating the total DN counts of a whole coronal hole structure in three wavelength bands, the resulting time series are subjected to FFT and wavelet analysis. Significant periods in all the three wavelength bands are detected that are mainly concentrated around 500 sec as a fundamental mode and its odd (167, 100, 71, 56, 46, 39, 33, 29, 26, 24 seconds) harmonics. Computed phases in all the three wavelengths band are estimated to be constant.

Published in Advances in Space Research. 2014, Vol.54, p.272

For preprints contact: manjunath@iiap.res.in

Slow Rise and Partial Eruption of a Double-Decker Filament. II. A Double Flux Rope Model

Bernhard Kliem[1], Tibor Török[2], Viacheslav S. Titov[2], Roberto Lionello[2], Jon A. Linker[2], Rui Liu[3], Chang Liu[4], and Haimin Wang[4]

[1] Institute of Physics and Astronomy, University of Potsdam, Karl-Liebknecht-Str. 24, 14476 Potsdam, Germany
[2] Predictive Science, Inc., San Diego, CA 92121, USA
[3] CAS Key Laboratory of Geospace Environment, University of Science and Technology of China, Hefei 230026, China
[4] Space Weather Research Laboratory, Center for Solar-Terrestrial Research, NJIT, Newark, NJ 07102, USA

Force-free equilibria containing two vertically arranged magnetic flux ropes of like chirality and current direction are considered as a model for split filaments/prominences and filament-sigmoid systems. Such equilibria are constructed analytically through an extension of the methods developed in Titov & Démoulin (1999) and numerically through an evolutionary sequence including shear flows, flux emergence, and flux cancellation in the photospheric boundary. It is demonstrated that the analytical equilibria are stable if an external toroidal (shear) field component exceeding a threshold value is included. If this component decreases sufficiently, then both flux ropes turn unstable for conditions typical of solar active regions, with the lower rope typically becoming unstable first. Either both flux ropes erupt upward, or only the upper rope erupts while the lower rope reconnects with the ambient flux low in the corona and is destroyed. However, for shear field strengths staying somewhat above the threshold value, the configuration also admits evolutions which lead to partial eruptions with only the upper flux rope becoming unstable and the lower one remaining in place. This can be triggered by a transfer of flux and current from the lower to the upper rope, as suggested by the observations of a split filament in Paper I (Liu et al. 2012). It can also result from tether-cutting reconnection with the ambient flux at the X-type structure between the flux ropes, which similarly influences their stability properties in opposite ways. This is demonstrated for the numerically constructed equilibrium.

Accepted by ApJ

For preprints contact: bkliem@uni-potsdam.de

For preprints via WWW: arXiv:1407:2272

Catastrophe Versus Instability for the Eruption of a Toroidal Solar Magnetic Flux Rope

B. Kliem[1,2], J. Lin[1], T. G. Forbes[3], E. R. Priest[4], and T. Török[3]

[1] Yunnan Observatories, Chinese Academy of Sciences, Kunming 650011, China
[2] Institute of Physics and Astronomy, University of Potsdam, Potsdam 14476, Germany
[3] Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham, New Hampshire 03824, USA
[4] School of Mathematics and Statistics, University of St Andrews, North Haugh, St Andrews KY16 9SS, UK
[5] Predictive Science Inc., 9990 Mesa Rim Rd., Ste 170, San Diego, CA 92121, USA

The onset of a solar eruption is formulated here as either a magnetic catastrophe or as an instability. Both start with the same equation of force balance governing the underlying equilibria. Using a toroidal flux rope in an external bipolar or quadrupolar field as a model for the current-carrying flux, we demonstrate the occurrence of a fold catastrophe by loss of equilibrium for several representative evolutionary sequences in the stable domain of parameter space. We verify that this catastrophe and the torus instability occur at the same point; they are thus equivalent descriptions for the onset condition of solar eruptions.

Accepted by ApJ 789, 46, 2014

For preprints contact: bkliem@uni-potsdam.de

For preprints via WWW: arXiv:1404.5922

Coronal Magnetic Reconnection Driven by CME Expansion—The 2011 June 7 Event

L. van Driel-Gesztelyi[1,2,3], D. Baker[1], T. Török[4], E. Pariat[2], L. M. Green[1], D. R. Williams[1], J. Carlyle[1,5], G. Valori[2], P. Démoulin[2], B. Kliem[1,6,7], D. M. Long[1], S. A. Matthews[1], and J.-M. Malherbe[2]

[1] University College London, Mullard Space Science Laboratory, Holmbury St Mary, Dorking, Surrey, RH5 6NT, UK
[2] Observatoire de Paris, LESIA, UMR 8109 (CNRS), Meudon-Principal Cedex, France

[3] Konkoly Observatory of the Hungarian Academy of Sciences, Budapest, Hungary
[4] Predictive Science Inc. 9990 Mesa Rim Rd., Ste 170, San Diego, CA 92121, U.S.A.
[5] Max-Planck Institut für Sonnensystemforschung, 37191 Katlenburg-Lindau, Germany
[6] Institut für Physik und Astronomie, Universität Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany
[7] Yunnan Observatories, Chinese Academy of Sciences, Kunming, Yunnan 650011, China

Coronal mass ejections (CMEs) erupt and expand in a magnetically structured solar corona. Various indirect observational pieces of evidence have shown that the magnetic field of CMEs reconnects with surrounding magnetic fields, forming, e.g., dimming regions distant from the CME source regions. Analyzing Solar Dynamics Observatory (SDO) observations of the eruption from AR 11226 on 2011 June 7, we present the first direct evidence of coronal magnetic reconnection between the fields of two adjacent active regions during a CME. The observations are presented jointly with a data-constrained numerical simulation, demonstrating the formation/intensification of current sheets along a hyperbolic flux tube at the interface between the CME and the neighboring AR 11227. Reconnection resulted in the formation of new magnetic connections between the erupting magnetic structure from AR 11226 and the neighboring active region AR 11227 about 200 Mm from the eruption site. The onset of reconnection first becomes apparent in the SDO/AIA images when filament plasma, originally contained within the erupting flux rope, is redirected toward remote areas in AR 11227, tracing the change of large-scale magnetic connectivity. The location of the coronal reconnection region becomes bright and directly observable at SDO/AIA wavelengths, owing to the presence of down-flowing cool, dense (10^{10} cm^{-3}) filament plasma in its vicinity. The high-density plasma around the reconnection region is heated to coronal temperatures, presumably by slow-mode shocks and Coulomb collisions. These results provide the first direct observational evidence that CMEs reconnect with surrounding magnetic structures, leading to a large-scale reconfiguration of the coronal magnetic field.

Published by ApJ 788, 85, 2014

For preprints contact: Lidia.vanDriel@obspm.fr

For preprints via WWW: arXiv:1406.3153

The Evolution of Writhe in Kink-unstable Flux Ropes and Erupting Filaments

T. Török[1], B. Kliem[2], M. A. Berger[3], M. G. Linton[4], P. Démoulin[5], and L van Driel-Gesztelyi[5,6,7]

[1] Predictive Science Inc., 9990 Mesa Rim Rd., Ste 170, San Diego, CA 92121, USA
[2] Institut für Physik und Astronomie, Universität Potsdam, 14476 Potsdam, Germany
[3] University of Exeter, SECAM, Exeter, EX4 4QE, UK
[4] U.S. Naval Research Lab, 4555 Overlook Ave., SW Washington, DC 20375, USA
[5] LESIA, Observatoire de Paris, CNRS, UPMC, Univ. Paris Diderot, 5 place Jules Janssen, 92190 Meudon, France
[6] University College London, Mullard Space Science Laboratory, Holmbury St Mary, Dorking, Surrey, RH5 6NT, UK
[7] Konkoly Observatory of the Hungarian Academy of Sciences, Budapest, Hungary

The helical kink instability of a twisted magnetic flux tube has been suggested as a trigger mechanism for solar filament eruptions and coronal mass ejections (CMEs). In order to investigate if estimations of the pre-emptive twist can be obtained from observations of writhe in such events, we quantitatively analyze the conversion of twist into writhe in the course of the instability, using numerical simulations. We consider the line tied, cylindrically symmetric Gold–Hoyle flux rope model and measure the writhe using the formulae by Berger and Prior which express the quantity as a single integral in space. We find that the amount of twist converted into writhe does not simply scale with the initial flux rope twist, but depends mainly on the growth rates of the instability eigenmodes of higher longitudinal order than the basic mode. The saturation levels of the writhe, as well as the shapes of the kinked flux ropes, are very similar for considerable ranges of initial flux rope twists, which essentially precludes estimations of pre-eruptive twist from measurements of writhe. However, our simulations suggest an upper twist limit of $\sim 6\pi$ for the majority of filaments prior to their eruption.

Accepted by: Plasma Phys. Control. Fusion 56, 064012 (Open Access); DOI:10.1088/0741-3335/56/6/06401

For preprints contact: tibor@predsci.com

For preprints via WWW: arXiv:1403.1565

Doubts About the Crucial Role of the Rising-tube Mechanism in the Formation of Sunspot Groups

A. V. Getling[1], R. Ishikawa[2] and A. A. Buchnev[3]

[1] Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, 119991 Russia
[2] Hinode Science Center, National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo, 181-8588 Japan
[3] Institute of Computational Mathematics and Mathematical Geophysics, Novosibirsk, 630090 Russia

Some preliminary processing results are presented for a dataset obtained with the Solar Optical Telescope on the *Hinode* satellite. The idea of the project is to record, nearly simultaneously, the full velocity and magnetic-field vectors in growing active regions and sunspot groups at a photospheric level. Our ultimate aim is to elaborate observational criteria to distinguish between the manifestations of two mechanisms of sunspot-group formation — the rising of an Ω-shaped flux tube of a strong magnetic field and the in situ amplification and structuring of magnetic field by convection (the convective mechanism is briefly described).

Observations of a young bipolar subregion developing within AR 11313 were carried out on 9–10 October 2011. During each 2-h observational session, 5576-Å filtergrams and Dopplergrams were obtained at a time cadence of 2 min, and one or two 32-min-long spectropolarimetric fast-mode scans were done. Based on the series of filtergrams, the trajectories of corks are computed, using a technique similar to but more reliable than local correlation tracking (LCT), and compared with the magnetic maps. At this stage of the investigation, only the vertical magnetic field and the horizontal flows are used for a qualitative analysis.

According to our preliminary findings, the velocity pattern in the growing active region has nothing to do with a spreading flow on the scale of the entire bipolar region, which could be expected if a tube of strong magnetic field emerged. No violent spreading flows on the scale of the entire growing magnetic region can be identified. Instead, normal mesogranular and supergranular flows are preserved. Signs of small-scale structuring of the magnetic field can be detected in the area where new spots develop, and signs of the presence of separatrices between the magnetic polarities can be found, such that the surface flows converge to but not diverge from these separatrix curves. The observed scenario of evolution seems to agree with Bumba's inference that the development of an active region does not entail the destruction of the existing convective-velocity field. The convective mechanism appears to be better compatible with observations than the rising-tube mechanism.

In the umbras of the well-developed sunspots, flows converging to the umbra centres are revealed. Spreading streams are present around these spots.

Accepted by Adv. Space Res.

For preprints contact: A.Getling@mail.ru

For preprints via WWW: arXiv:1401.8077

Stratification-induced Scale Splitting in Convection

O. V. Shcheritsa[1], A. V. Getling[2] and O. S. Mazhorova[1]

[1] Keldysh Institute of Applied Mathematics, Moscow, 125047 Russia
[2] Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, 119991 Russia

The coexistence of motions on various scales is a remarkable feature of solar convection, which should be taken into account in analyses of the dynamics of magnetic fields. Therefore, it is important to investigate the factors responsible for the observed multiscale structure of solar convection. In this study, an attempt is made to understand how the scales of convective motions are affected by the particularities of the static temperature stratification of a fluid layer. To this end, simple models are considered. The equations of two-dimensional thermal convection are solved numerically for a plane horizontal fluid layer heated from below, in an extended Boussinesq approximation that admits thermal-diffusivity variations. These variations specify the stratification of the layer. The static temperature gradient in a thin sublayer near the upper surface of the layer is assumed to be many times larger than in the remainder of the layer. In some cases, distributed heat sinks are assumed to produce a stably stratified region overlying the convective layer. Manifestations of the scale-splitting effect are noted, which depend on the boundary conditions and stratification; it becomes more pronounced with the increase of the Rayleigh number. Small-scale convection cells are advected by larger-scale flows. In particular, the phase trajectories of fluid particles indicate the presence of complex attractors, which reflect the multiscale structure of the flow. The effect of the stably stratified upper sublayer on the flow scales

is also considered.

Submitted to Adv. Space Res.

For preprints contact: A.Getling@mail.ru

For preprints via WWW: arXiv:1401.8137

Low-Mass and Substellar Abstracts

Revision of Earth-sized Kepler Planet Candidate Properties with High Resolution Imaging by *Hubble Space Telescope*

Kimberly M. Star[1,2], Ronald L. Gilliland[1,2], Jason T. Wright[1,2] and David R. Ciardi[3]

[1] Department of Astronomy & Astrophysics, The Pennsylvania State University, 525 Davey Lab, University Park, PA 16802

[2] Center for Exoplanets and Habitable Worlds, The Pennsylvania State University, University Park, PA 16802

[3] NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

We present the results of our *Hubble Space Telescope* program and describe how our image analysis methods were used to re-evaluate the habitability of some of the most interesting *Kepler* planet candidates. Our program observed 22 KOI hosts, several of which were found to be multiple star systems unresolved by *Kepler*. We use our high-resolution imaging to provide a conversion to the *Kepler* photometric bandpass (Kp) from the F555W and F775W filters on WFC3/UVIS, and spatially resolve the stellar multiplicity of Kepler-296, KOI-2626, and KOI-3049. The binary system Kepler-296 has a projected separation of $0.217''$ (80 AU); KOI-2626 is a triple star system with a projected separation of $0.201''$ (70 AU) between the primary and secondary components and $0.161''$ (55 AU) between the primary and tertiary components; and the binary system KOI-3049 has a projected separation of $0.464''$ (225 AU). Using theoretical isochrones from the latest Victoria-Regina Stellar Models, we performed hierarchical fitting using our derived photometry and the synthetic photometry from the isochrones. We find that the individual components of the three systems range from mid-K dwarf to mid-M dwarf spectral types. We solved for the planetary properties in the three systems directly from the stellar and published transit parameters and from empirically derived relations. We find that the planets range in size from $\sim 1.2\,\mathrm{R}_\oplus$ to $\sim 4\,\mathrm{R}_\oplus$, placing them in the Super Earth/mini-Neptune regime. As a result of the stellar multiplicity, we find that some planets previously in the Habitable Zone are, in fact, not, and that other planets may be in the HZ depending on their assumed stellar host.

Submitted to ApJ

For preprints contact: kms648@psu.edu

For preprints via WWW: arXiv:1407.1057

Cross-Listed Abstracts (Pre-Main Sequence Stars)

Editor's Note: The abstracts below are being cross-listed with the *Star Formation Newsletter*.

Accretion Discs as Regulators of Stellar Angular Momentum Evolution in the ONC and Taurus-Auriga

Claire L. Davies[1], Scott G. Gregory[1] and Jane S. Greaves[1]

[1] SUPA School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, Fife KY16 9SS U.K.

In light of recent substantial updates to spectral type estimations and newly established intrinsic colours, effective temperatures, and bolometric corrections for pre-main sequence (PMS) stars, we re-address the theory of accretion-disc regulated stellar angular momentum (AM) evolution. We report on the compilation of a consistent sample of fully convective stars within two of the most well-studied and youngest, nearby regions of star formation: the Orion Nebula Cluster (ONC) and Taurus-Auriga. We calculate the average specific stellar AM ($j_\star$) assuming solid body rotation, using surface rotation periods gathered from the literature and new estimates of stellar radii and ages. We use published Spitzer IRAC fluxes to classify our stars as Class II or Class III and compare their $j_\star$ evolution. Our results suggest that disc dispersal is a rapid process that occurs at a variety of ages. We find a consistent $j_\star$ reduction rate between the Class II and Class III PMS stars which we interpret as indicating a period of accretion disc-regulated AM evolution followed by near-constant AM evolution once the disc has dissipated. Furthermore, assuming our observed spread in stellar ages is real, we find the removal rate of $j_\star$ during the Class II phase is more rapid than expected by contraction at constant stellar rotation rate. A much more efficient process of AM removal must exist, most likely in the form of an accretion-driven stellar wind or other outflow from the star-disc interaction region or extended disc surface.

Accepted by MNRAS

For preprints contact: cd54@st-andrews.ac.uk

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.***