ExoPlanet News
An Electronic Newsletter

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Editors: Andrew J. Norton
Glenn J. White
Department of Physical Sciences, The Open University, Milton Keynes MK7 6AA, UK
exoplanet@open.ac.uk, http://exoplanet.open.ac.uk/

Contents

1 Editorial **2**

2 Abstracts of refereed papers **2**

– Experimental investigation of the nebular formation of chondrule rims and the formation of chondrite parent bodies *Beitz et al.* . . . 2
– SOAP. A tool for the fast computation of photometry and radial velocity induced by stellar spots *Boisse, Bonfils & Santos* . . . 3
– Cosmochemical Consequences of Particle Trajectories During FU Orionis Outbursts by the Early Sun *Boss et al.* . . . 4
– Rapid dynamical chaos in an exoplanetary system *Deck et al.* . . . 4
– Planets Around Low-Mass Stars (PALMS). I. A Substellar Companion to the Young M Dwarf 1RXS J235133.3+312720 *Bowler et al.* . . . 5
– Planets Around Low-Mass Stars (PALMS). II. A Low-Mass Companion to the Young M Dwarf GJ 3629 Separated By $0\farcs2$ *Bowler et al.* . . . 6
– Kepler-36: A pair of planets with neighboring orbits and dissimilar densities *Carter, Agol et al.* . . . 7
– Distinguishing Between Stellar and Planetary Companions With Phase Monitoring *Kane & Gelino* . . 8
– Remnant gas in evolved circumstellar disks: Herschel PACS observations of 10–100 Myr old disk systems *Geers et al.* . . . 9
– Rapid growth of gas-giant cores by pebble accretion *Lambrechts & Johansen* . . . 9
– Star-planet magnetic interaction and activity in late-type stars with close-in planets *Lanza* . . . 10
– How not to build Tatooine: the difficulty of in situ formation of circumbinary planets Kepler 16b, Kepler 34b and Kepler 35b *Paardekooper et al.* . . . 10
– Temporal variations in the evaporating atmosphere of the exoplanet HD 189733b *Lecavelier des Etangs et al.* . . . 11
– An Independent Planet Search In The *Kepler* Dataset. I. A hundred new candidates and revised KOIs *Ofir & Dreizler* . . . 12
– ExELS: an exoplanet legacy science proposal for the ESA *Euclid* mission I. Cold exoplanets *Penny et al.* . . . 13
– The International Deep Planet Survey I. The frequency of wide-orbit massive planets around A-stars *Vigan et al.* . . . 15
– ExoMol: molecular line lists for exoplanet and other atmospheres *Tennyson & Yurchenko* . . . 16
– The rovibrational spectrum of BeH, MgH and CaH at high temperatures in the $X\,^2\Sigma^+$ state: a theoretical study *Yadin et al.* . . . 16
– The PTF Orion Project: a Possible Planet Transiting a T-Tauri Star *van Eyken et al.* . . . 17
– Herschel imaging of 61 Vir: implications for the prevalence of debris in low-mass planetary systems *Wyatt et al.* . . . 18

1 EDITORIAL 2

3 Conference announcements **18**
– EChO Open Science Workshop *ESA-ESTEC* 18

4 As seen on astro-ph **19**

1 Editorial

Welcome to the fifty first edition of ExoPlanet News. This month's newsletter contains a great selection of abstracts reporting the latest discoveries in the field of exoplanet science.
We will take a short break over the (northern hemisphere) summer, so the next edition of the newsletter is planned for the beginning of September 2012. Please send anything relevant to exoplanet@open.ac.uk, and it will appear then. Remember that past editions of this newsletter, submission templates and other information can be found at the ExoPlanet News website: http://exoplanet.open.ac.uk.

Best wishes
Andrew Norton & Glenn White
The Open University

2 Abstracts of refereed papers

Experimental investigation of the nebular formation of chondrule rims and the formation of chondrite parent bodies

E. Beitz[1]*, J. Blum*[1]*, R. Mathieu*[2]*, A. Pack*[2]*, D.C. Hezel*[3]

[1] Inst. for Geophysics and Extraterrestrial Physics, Technical University Braunschweig, Mendelssohnstr. 3, D-38106 Braunschweig, Germany
[2] Geoscience Center, University Göttingen Goldschmidtstr. 1, D-37077 Göttingen, Germany
[3] Natural History Museum, Department of Mineralogy, Cromwell Road, SW7 5BD London, UK

Geochimica et Cosmochimica Acta, Published online (DOI:10.1016/j.gca.2012.04.059)

We developed an experimental setup to test the hypothesis that accretionary rims around chondrules formed in the solar nebula by accretion of dust on the surfaces of hot chondrules.Our experimentalmethod allows us to form dust rims around chondrule analogs while levitated in an inert-gas flow.We used micrometer-sized powdered San Carlos olivine to accrete individual dust particles onto the chondrule analogs at room temperature (20 °C) and at 1100 °C. The resulting dust rims were analyzed by means of two different techniques: non-destructivemicro computer tomography, and scanning electron microscopy. Both methods give very similar results for the dust rim structure and a mean dust rim porosity of 60% for the hot coated samples, demonstrating that both methods are equally well suited for sample analysis. The chondrule analogs bulk composition has no measurable impact on the accretion efficiency of the dust.Wemeasured the chemical composition of chondrule analog and dust rim to check whether elemental exchange between the two components occurred. Such a reaction zone was not found; thus, we can experimentally confirm the sharp border between chondrules and dust rims described in the literature. We adopted a simple model to derive the degree of post-accretionary compaction for different carbonaceous chondrites.Moreover, we measured the rim porosity of a fragment of Murchison meteorite, analyzed it with micro-CT and found rim porosities with this technique that are comparable to those described in the literature.

Download/Website: `http://dx.doi.org/10.1016/j.gca.2012.04.059`

Contact: `e.beitz@tu-braunschweig.de`

SOAP. A tool for the fast computation of photometry and radial velocity induced by stellar spots

I. Boisse[1], *X. Bonfils*[2], *N.C. Santos*[1,3]

[1] Centro de Astrofísica, Universidade do Porto, Rua das Estrelas, 4150-762 Porto, Portugal
[2] Université Joseph Fourier CNRS, Laboratoire d'Astrophysique de Grenoble, BP 53, 38041 Grenoble Cedex 9, France
[3] Departamento de Fisica e Astronomia, Faculdade de Ciências, Universidade do Porto, Portugal

Astronomy & Astrophysics, in press (arXiv: 1206.5493)

We define and put at disposal SOAP, *Spot Oscillation And Planet*, a software tool that simulates the effect of stellar spots and plages on radial velocimetry and photometry. This paper describes the tool release and provides instructions for its use. We present detailed tests to assess its performance and to validate the suitability of the code with previous computations and real data. We characterize the variations of the radial velocity, line bisector, and photometric amplitude as a function of the main variables: projected stellar rotational velocity, filling factor of the spot, resolution of the spectrograph, linear limb-darkening coefficient, latitude of the spot, and inclination of the star. Finally, we model the spot distributions on the active stars HD166435, TW Hya and HD189733 that reproduces the observations. We show that the software is remarkably fast allowing several evolutions in its capabilities that could be done to study the next challenges in the exoplanetary field connected with the stellar variability.

Download/Website: `http://www.astro.up.pt/soap`

Contact: `Isabelle.Boisse@astro.up.pt`

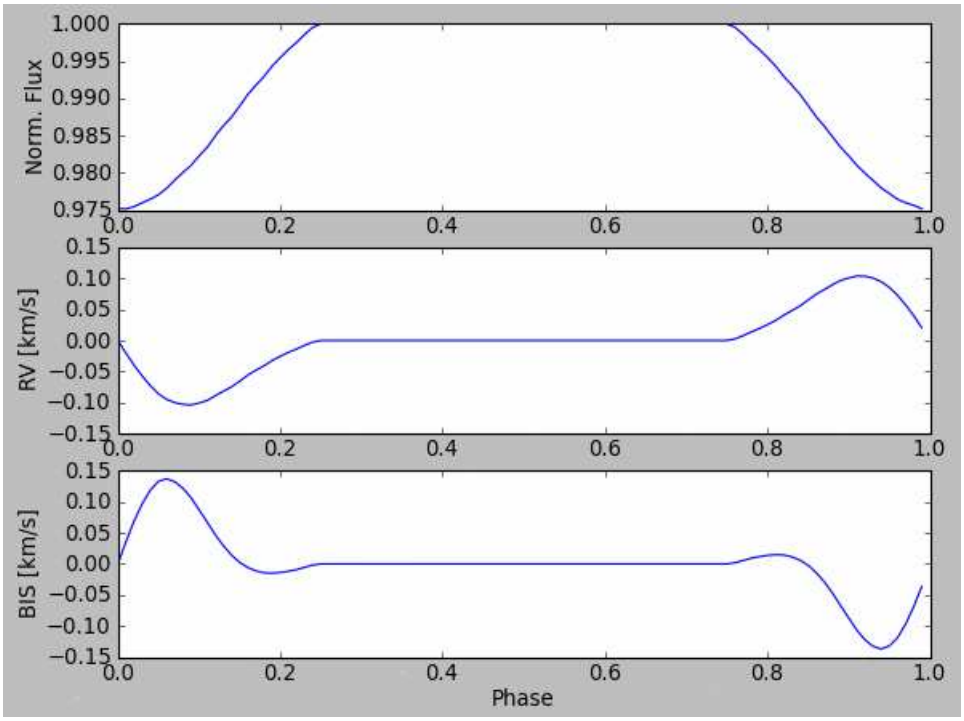

Figure 1: (Boisse et al.) Figure generated by SOAP (optional) showing as a function of the stellar rotational phase the photometry, the RV and the BIS (from *top* to *bottom panel*). As a default parameter, the first spot is in front of the line of sight at phase 0.

Cosmochemical Consequences of Particle Trajectories During FU Orionis Outbursts by the Early Sun

Alan P. Boss[1]*, Conel M. O'D. Alexander*[1]*, Morris Podolak*[2]
[1] DTM, Carnegie Institution, Washington, DC, USA
[2] Tel Aviv University, Ramat, Tel Aviv, Israel

Earth and Planetary Science Letters, in press

The solar nebula is thought to have undergone a number of episodes of FU Orionis outbursts during its early evolution. We present here the first calculations of the trajectories of particles in a marginally gravitationally unstable solar nebula during an FU Orionis outburst, which show that 0.1 to 10 cm-sized particles traverse radial distances of 10 AU or more, inward and outward, in less than 200 yrs, exposing the particles to temperatures from $\sim$ 60 K to $\sim$ 1500 K. Such trajectories can thus account for the discovery of refractory particles in comets. Refractory particles should acquire Wark-Lovering-like rims as they leave the highest temperature regions of the disk, and these rims should have significant variations in their stable oxygen isotope ratios. Particles are likely to be heavily modified or destroyed if they pass within 1 AU of the Sun, and so are only likely to survive if they formed in the final few FU Orionis outbursts, or were transported to the outer reaches of the solar system. Calcium, aluminum-rich inclusions (CAIs) from primitive meteorites are the oldest known solar system objects and have a very narrow age range. Most CAIs may have formed at the end of the FU Orionis outbursts phase, with an age range reflecting the period between the last few outbursts.

Download/Website: `http://www.dtm.ciw.edu/users/boss/ftp/cosmochemical.pdf`

Contact: `boss@dtm.ciw.edu`

Rapid dynamical chaos in an exoplanetary system

K. M. Deck[1]*, M. J. Holman*[2]*, E. Agol*[3]*, J. A. Carter*[2,4]*, J. J. Lissauer*[5]*, D. Ragozzine*[2]*, J. N. Winn*[1]
[1] Department of Physics and Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139
[2] Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138
[3] Department of Astronomy, Box 351580, University of Washington, Seattle, WA 98195
[4] Hubble Fellow
[5] NASA Ames Research Center, Moffet Field, CA 94035

Astrophysical Journal Letters, in press (arXiv:1206.4695)

We report on the long-term dynamical evolution of the two-planet Kepler-36 system, which we studied through numerical integrations of initial conditions that are consistent with observations of the system. The orbits are chaotic with a Lyapunov time of only $\sim$10 years. The chaos is a consequence of a particular set of orbital resonances, with the inner planet orbiting 34 times for every 29 orbits of the outer planet. The rapidity of the chaos is due to the interaction of the 29:34 resonance with the nearby first order 6:7 resonance, in contrast to the usual case in which secular terms in the Hamiltonian play a dominant role. Only one contiguous region of phase space, accounting for $\sim 4.5\%$ of the sample of initial conditions studied, corresponds to planetary orbits that do not show large scale orbital instabilities on the timescale of our integrations ($\sim$ 200 million years). The long-lived subset of the allowed initial conditions are those that satisfy the Hill stability criterion by the largest margin. Any successful theory for the formation of this system will need to account for why its current state is so close to unstable regions of phase space.

Download/Website: `http://arxiv.org/abs/1206.4695`

Contact: `kdeck@mit.edu`

Planets Around Low-Mass Stars (PALMS). I. A Substellar Companion to the Young M Dwarf 1RXS J235133.3+312720

Brendan P. Bowler,[1], *Michael C. Liu,*[1], *Evgenya L. Shkolnik,*[2], *Trent J. Dupuy,*[3,4], *Lucas A. Cieza,*[1,5], *Adam L. Kraus,*[1,4], *Motohide Tamura*[6]

[1] Institute for Astronomy, University of Hawai'i; 2680 Woodlawn Drive, Honolulu, HI 96822, USA
[2] Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff, AZ 86001
[3] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138
[4] Hubble Fellow
[5] Sagan Fellow
[6] National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

Astrophysical Journal, in press

We report the discovery of a brown dwarf companion to the young M dwarf 1RXS J235133.3+312720 as part of a high contrast imaging search for planets around nearby young low-mass stars with Keck-II/NIRC2 and Subaru/HiCIAO. The 2.″4 (∼120 AU) pair is confirmed to be comoving from two epochs of high resolution imaging. Follow-up low- and moderate-resolution near-infrared spectroscopy of 1RXS J2351+3127 B with IRTF/SpeX and Keck-II/OSIRIS reveals a spectral type of L0$^{+2}_{-1}$. The M2 primary star 1RXS J2351+3127 A exhibits X-ray and UV activity levels comparable to young moving group members with ages of ∼10-100 Myr. UVW kinematics based the measured radial velocity of the primary and the system's photometric distance (50 ± 10 pc) indicate it is likely a member of the ∼50–150 Myr AB Dor moving group. The near-infrared spectrum of 1RXS J2351+3127 B does not exhibit obvious signs of youth, but its H-band morphology shows subtle hints of intermediate surface gravity. The spectrum is also an excellent match to the ∼200 Myr M9 brown dwarf LP 944-20. Assuming an age of 50–150 Myr, evolutionary models imply a mass of 32 ± 6 M_J for the companion, making 1RXS J2351+3127 B the second lowest-mass member of the AB Dor moving group after the L4 companion CD–35 2722 B and one of the few benchmark brown dwarfs known at young ages.

Download/Website: `http://adsabs.harvard.edu/abs/2012arXiv1205.2084B`

Contact: `bpbowler@ifa.hawaii.edu`

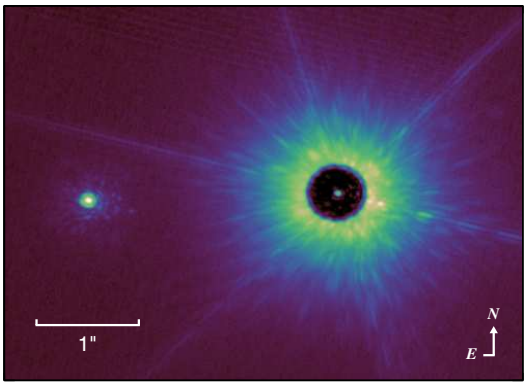

Figure 2: (Bowler et al.) Keck/NIRC2 coadded H-band image of 1RXS J2351+3127 AB. The primary is positioned behind the 0.″6 diameter translucent coronagraph with the companion located to its east.

Planets Around Low-Mass Stars (PALMS). II. A Low-Mass Companion to the Young M Dwarf GJ 3629 Separated By 0.″2

Brendan P. Bowler,[1]*, Michael C. Liu,*[1]*, Evgenya L. Shkolnik,*[2]*, Motohide Tamura*[3]

[1] Institute for Astronomy, University of Hawai'i; 2680 Woodlawn Drive, Honolulu, HI 96822, USA
[2] Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff, AZ 86001
[3] National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

Astrophysical Journal, in press

We present the discovery of a 0.″2 companion to the young M dwarf GJ 3629 as part of our high contrast adaptive optics imaging search for giant planets around low-mass stars with the Keck-II and Subaru telescopes. Two epochs of imaging confirm the pair is co-moving and reveal signs of orbital motion. The primary exhibits saturated X-ray emission, which together with its UV photometry from $GALEX$ point to an age younger than $\sim$300 Myr. At these ages the companion lies below the hydrogen burning limit with a model-dependent mass of 46 ± 16 $M_{\rm Jup}$ based on the system's photometric distance of 22 ± 3 pc. Resolved $YJHK$ photometry of the pair indicates a spectral type of M7 $\pm$ 2 for GJ 3629 B. With a projected separation of 4.4 ± 0.6 AU and an estimated orbital period of 21 ± 5 yr, GJ 3629 AB is likely to yield a dynamical mass in the next several years, making it one of only a handful of brown dwarfs to have a measured mass and an age constrained from the stellar primary.

Download/Website: `http://adsabs.harvard.edu/abs/2012arXiv1206.3307B`

Contact: `bpbowler@ifa.hawaii.edu`

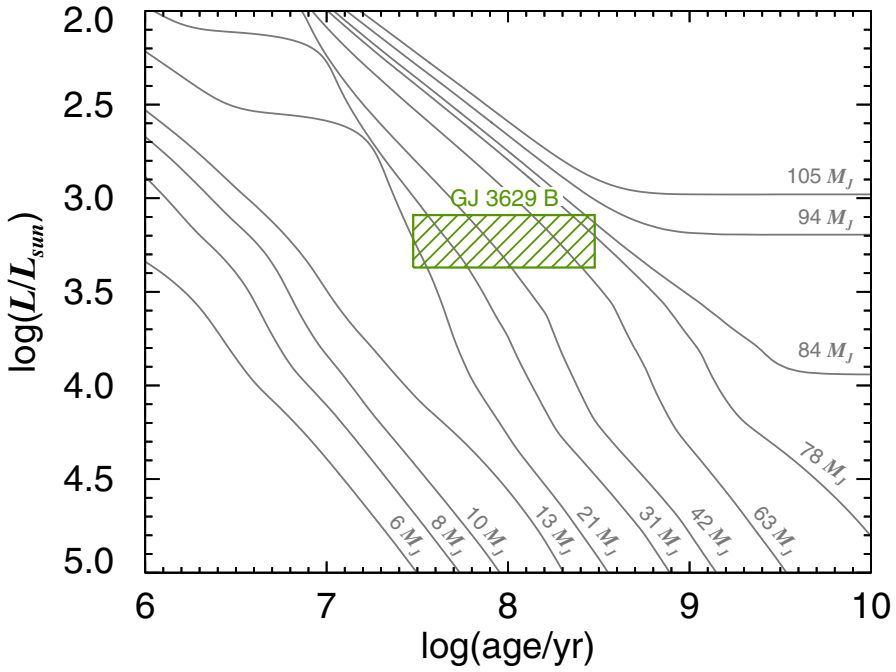

Figure 3: (Bowler et al.) Mass estimate for GJ 3629 B based on the evolutionary models of Burrows et al. (1997). The green region shows the model predictions for the age (25–300 Myr) and estimated distance (22 ± 3 pc) of the primary, which yields 46 ± 16 $M_{\rm Jup}$ for GJ 3629 B. This is well below the hydrogen burning limit ($\sim$78 $M_{\rm Jup}$)

Kepler-36: A pair of planets with neighboring orbits and dissimilar densities

J.A. Carter[1,24], *E. Agol*[2,24], *W.J. Chaplin*[3], *Sarbani Basu*[4], *Timothy R. Bedding*[5], *Lars A. Buchhave*[6,7], *Jørgen Christensen-Dalsgaard*[8], *Katherine M. Deck*[9], *Yvonne Elsworth*[3], *Daniel C. Fabrycky*[10], *Eric B. Ford*[11], *Jonathan J. Fortney*[12], *Steven J. Hale*[3], *Rasmus Handberg*[8], *Saskia Hekker*[13,3], *Matthew J. Holman*[14], *Daniel Huber*[15], *Christopher Karoff*[8], *Steven D. Kawaler*[16], *Hans Kjeldsen*[8], *Jack J. Lissauer*[15], *Eric D. Lopez*[12], *Mikkel N. Lund*[8], *Mia Lundkvist*[8], *Travis S. Metcalfe*[17], *Andrea Miglio*[3], *Leslie A. Rogers*[9], *Dennis Stello*[5], *William J. Borucki*[15], *Steve Bryson*[15], *Jessie L. Christiansen*[18], *William D. Cochran*[19], *John C. Geary*[14], *Ronald L. Gilliland*[20], *Michael R. Haas*[15], *Jennifer Hall*[21], *Andrew W. Howard*[22], *Jon M. Jenkins*[18], *Todd Klaus*[21], *David G. Koch*[15], *David W. Latham*[14], *Phillip J. MacQueen*[19], *Dimitar Sasselov*[14], *Jason H. Steffen*[23], *Joseph D. Twicken*[18], *Joshua N. Winn*[9]

[1] Hubble Fellow, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[2] Department of Astronomy, Box 351580, University of Washington, Seattle, WA 98195, USA
[3] School of Physics and Astronomy, University of Birmingham, Edgbaston, B15 2TT, UK
[4] Department and Astronomy, Yale University, New Haven, CT, 06520, USA
[5] Sydney Institute for Astronomy, School of Physics, University of Sydney, Sydney, Australia
[6] Niels Bohr Institute, Copenhagen University, DK-2100 Copenhagen, Denmark
[7] Centre for Star and Planet Formation, Natural History Museum of Denmark, University of Copenhagen, DK-1350 Copenhagen, Denmark
[8] SAC, Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, DK-8000 Aarhus C, Denmark
[9] MIT, Physics Department and Kavli Institute for Astrophysics and Space Research, 77 Massachusetts Avenue, Cambridge, MA 02139, USA
[10] Hubble Fellow, Department of Astronomy and Astrophysics, University of California, Santa Cruz, CA 95064
[11] Department of Astronomy, University of Florida, Gainesville, FL 32611-2055, USA
[12] Department of Astronomy and Astrophysics, University of California, Santa Cruz, CA 95064
[13] Astronomical Institute 'Anton Pannekoek', University of Amsterdam, The Netherlands
[14] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[15] NASA Ames Research Center, Moffett Field, CA 94035, USA
[16] Department of Physics and Astronomy, Iowa State University, Ames, IA, 50011, USA
[17] White Dwarf Research Corporation, Boulder, CO, 80301, USA
[18] SETI Institute/NASA Ames Research Center, Moffett Field, CA 94035
[19] McDonald Observatory, University of Texas at Austin, Austin, TX, 78712, USA
[20] Center for Exoplanets and Habitable Worlds, The Pennsylvania State University, University Park, PA, 16802, USA
[21] Orbital Science Corporation/NASA Ames Research Center, Moffett Field, CA 94035
[22] Department of Astronomy, University of California, Berkeley, CA, 94720, USA
[23] Fermilab Center for Particle Astrophysics, P.O. Box 500, Batavia IL 60510, USA
[24] These authors contributed equally to this work.

Science, published online in Science Express, 21 June 2012 (2012arXiv1206.4718C)

In the solar system, the planets' compositions vary with orbital distance, with rocky planets in close orbits and lower-density gas giants in wider orbits. The detection of close-in giant planets around other stars was the first clue that this pattern is not universal and that planets' orbits can change substantially after their formation. Here, we report another violation of the orbit-composition pattern: two planets orbiting the same star with orbital distances differing by only 10% and densities differing by a factor of 8. One planet is likely a rocky "super-Earth," whereas the other is more akin to Neptune. These planets are 20 times more closely spaced and have a larger density contrast than any adjacent pair of planets in the solar system.

Download/Website: `Science DOI: 10.1126/science.1223269`

Contact: `jacarter@cfa.harvard.edu, agol@astro.washington.edu`

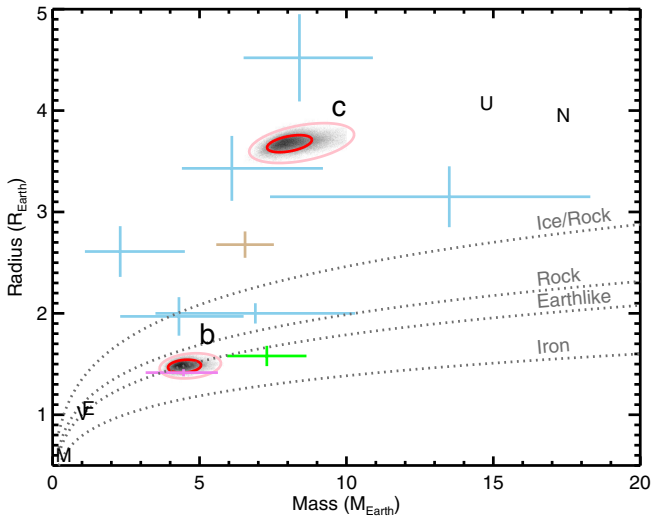

Figure 4: (Carter, Agol et al.) Mass-radius diagram for small planets. Constraints for Kepler-36b and c are shown as two-dimensional joint probability densities and confidence contours (68% and 95%). Other exoplanets are shown for comparison: blue – the planets in Kepler-11 (Lissauer et al. 2011), pink – Kepler-18b (Cochran et al. 2011), gray – Kepler-20 b and c (Gautier et al. 2012), brown – GJ 1214b (Charbonneau et al. 2009), violet – CoRoT-7b (Hatzes et al. 2011), green – Kepler-10b (Batalha et al. 2011), orange – 55 Cnc e (Winn et al. 2011). Solar System planets are plotted using the first letter of their names (excluding Mercury). The curves represent theoretical models for planets of a given composition. Dotted curves are models of terrestrial bodies [those lacking a significant gas envelope (Fortney et al. 2007)], with "Ice/Rock" – 50% ice and rock (silicates) by mass, "Rock" – 100% rock, "Earth-like" – 33% iron, 67% rock, "Iron" – 100% iron. Dashed curves are for planets with Earth-like solid cores surrounded with H/He envelopes with 5% or 10% of the total mass. The dash-dotted curve is for an Earth-like core and a water layer, in equal parts mass, surrounded by H/He envelope with 1.6% of the total mass.

Distinguishing Between Stellar and Planetary Companions With Phase Monitoring

Stephen R. Kane & Dawn M. Gelino

NASA Exoplanet Science Institute, Caltech, MS 100-22, 770 South Wilson Avenue, Pasadena, CA 91125, USA

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1205.5812)

Exoplanets which are detected using the radial velocity technique have a well-known ambiguity of their true mass, caused by the unknown inclination of the planetary orbit with respect to the plane of the sky. Constraints on the inclination are aided by astrometric follow-up in rare cases or, in ideal situations, through subsequent detection of a planetary transit. As the predicted inclination decreases, the mass of the companion increases leading to a change in the predicted properties. Here we investigate the changes in the mass, radius, and atmospheric properties as the inclination pushes the companion from the planetary into the brown dwarf and finally low-mass star regimes. We determine the resulting detectable photometric signatures in the predicted phase variation as the companion changes properties and becomes self-luminous. We apply this to the HD 114762 and HD 162020 systems for which the minimum masses of the known companions places them at the deuterium-burning limit.

Download/Website: `http://arxiv.org/abs/1205.5812`

Contact: `skane@ipac.caltech.edu, dawn@ipac.caltech.edu`

Remnant gas in evolved circumstellar disks: Herschel PACS observations of 10–100 Myr old disk systems

Vincent C. Geers[1], *Uma Gorti*[2,3], *Michael R. Meyer*[1], *Eric Mamajek*[4,5], *Arnold O. Benz*[1], *David Hollenbach*[3]

[1] ETH Zurich, Institute for Astronomy, Wolfgang-Pauli-strasse 27, 8093 Zurich, Switzerland
[2] NASA Ames Research Center, Moffett Field, CA 94035, USA
[3] SETI Institute, 189 Bernardo Ave., Mountain View, CA 94043, USA
[4] University of Rochester, Department of Physics & Astronomy, Rochester, NY 14627-0171, USA
[5] Current address: Cerro-Tololo Inter-American Observatory, Casilla 603, La Serena, Chile

Astrophysical Journal, in press (arXiv: 1206.1044)

We present *Herschel* PACS spectroscopy of the [OI] 63 μm gas-line for three circumstellar disk systems showing signs of significant disk evolution and/or planet formation: HR 8799, HD 377 and RX J1852.3-3700. [OI] is undetected toward HR 8799 and HD 377 with 3σ upper limits of 6.8×10^{-18} W m^{-2} and 9.9×10^{-18} W m^{-2} respectively. We find an [OI] detection for RX J1852.3-3700 at $12.3 \pm 1.8 \times 10^{-18}$ W m^{-2}. We use thermo-chemical disk models to model the gas emission, using constraints on the [OI] 63 μm, and ancillary data to derive gas mass upper limits and constrain gas-to-dust ratios. For HD 377 and HR 8799, we find 3 σ upper limits on the gas mass of 0.1–20 $M_\oplus$. For RX J1852.3-3700, we find two distinct disk scenarios that could explain the detection of [OI] 63 μm and CO(2–1) upper limits reported from the literature: (i) a large disk with gas co-located with the dust (16–500 AU), resulting in a large tenuous disk with ~ 16 $M_\oplus$ of gas, or (ii) an optically thick gas disk, truncated at ~ 70 AU, with a gas mass of 150 $M_\oplus$. We discuss the implications of these results for the formation and evolution of planets in these three systems.

Download/Website: `http://arxiv.org/abs/1206.1044`

Contact: `vcgeers@phys.ethz.ch`

Rapid growth of gas-giant cores by pebble accretion

M. Lambrechts, A. Johansen
Lund University, Box 43, 22100 Lund, Sweden

Astronomy & Astrophysics, in press (arXiv:1205.3030)

The observed lifetimes of gaseous protoplanetary discs place strong constraints on gas and ice giant formation in the core accretion scenario. The approximately 10-Earth-mass solid core responsible for the attraction of the gaseous envelope has to form before gas dissipation in the protoplanetary disc is completed within 1-10 million years. Building up the core by collisions between km-sized planetesimals fails to meet this time-scale constraint, especially at wide stellar separations. Nonetheless, gas-giant planets are detected by direct imaging at wide orbital distances. In this paper, we numerically study the growth of cores by the accretion of cm-sized pebbles loosely coupled to the gas. We measure the accretion rate onto seed masses ranging from a large planetesimal to a fully grown 10-Earth-mass core and test different particle sizes. The numerical results are in good agreement with our analytic expressions, indicating the existence of two accretion regimes, one set by the azimuthal and radial particle drift for the lower seed masses and the other, for higher masses, by the velocity at the edge of the Hill sphere. In the former, the optimally accreted particle size increases with core mass, while in the latter the optimal size is centimeters, independent of core mass. We discuss the implications for rapid core growth of gas-giant and ice-giant cores. We conclude that pebble accretion can resolve the long-standing core accretion time-scale conflict. This requires a near-unity dust-to-gas ratio in the midplane, particle growth to mm and cm and the formation of massive planetesimals or low radial pressure support. The core growth time-scale is shortened by a factor 30–1,000 at 5 AU and by a factor 100–10,000 at 50 AU, compared to the gravitationally focused accretion of, respectively, low-scale-height planetesimal fragments or standard km-sized planetesimals.

Download/Website: `http://arxiv.org/abs/1205.3030`

Contact: `michiel@astro.lu.se`

Star-planet magnetic interaction and activity in late-type stars with close-in planets

A. F. Lanza
INAF-Osservatorio Astrofisico di Catania, Via S. Sofia, 78, 95123 Catania, Italy

Astronomy & Astrophysics, in press (arXiv:1206.5893)

Late-type stars interact with their close-in planets through their coronal magnetic fields. We introduce a theory for the interaction between the stellar and planetary fields focussing on the processes that release magnetic energy in the stellar coronae. We consider the energy dissipated by the reconnection between the stellar and planetary magnetic fields as well as that made available by the modulation of the magnetic helicity of the coronal field produced by the orbital motion of the planet. We estimate the powers released by both processes in the case of axisymmetric and non-axisymmetric, linear and non-linear force-free coronal fields finding that they scale as $v_{\rm rel}B_{\rm s}^{4/3}B_{\rm p}^{2/3}R_{\rm p}^2$, where $v_{\rm rel}$ is the relative velocity between the stellar and planetary fields, $B_{\rm s}$ the mean stellar surface field, $B_{\rm p}$ the planetary field at the poles, and $R_{\rm p}$ the radius of the planet. A chromospheric hot spot or a flaring activity phased to the orbital motion of the planet are found only when the stellar field is axisymmetric. In the case of a non-axisymmetric field, the time modulation of the energy release is multiperiodic and can be easily confused with the intrinsic stellar variability. We apply our theory to the systems with some reported evidence of star-planet magnetic interaction finding a dissipated power at least one order of magnitude smaller than that emitted by the chromospheric hot spots. The phase lags between the planets and the hot spots are reproduced by our models in all the cases except for υ And. In conclusion, the chromospheric hot spots rotating in phase with the planets cannot be explained by the energy dissipation produced by the interaction between stellar and planetary fields as considered by our models and require a different mechanism.

Download/Website: `http://arxiv.org/abs/1206.5893`

Contact: `nuccio.lanza@oact.inaf.it`

How not to build Tatooine: the difficulty of in situ formation of circumbinary planets Kepler 16b, Kepler 34b and Kepler 35b

S.-J. Paardekooper[1]*, Z.M. Leinhardt*[2]*, P. Thebault*[3] *, C. Baruteau*[1]
[1] DAMTP, University of Cambridge, Wilberforce Road, Cambridge CB3 0WA, UK
[2] School of Physics, University of Bristol, H.H. Wills Physics Laboratory, Tyndall Avenue, Bristol BS8 1TL, UK
[3] Observatoire de Paris, F-92195 Meudon Principal Cedex, France

Astrophysical Journal Letters, in press (arXiv:1206.3484)

We study planetesimal evolution in circumbinary disks, focusing on the three systems Kepler 16, 34 and 35 where planets have been discovered recently. We show that for circumbinary planetesimals, in addition to secular forcing, eccentricities evolve on a dynamical timescale, which leads to orbital crossings even in the presence of gas drag. This makes the current locations of the circumbinary Kepler planets hostile to planetesimal accretion. We then present results from simulations including planetesimal formation and dust accretion, and show that even in the most favourable case of 100% efficient dust accretion, in situ growth starting from planetesimals smaller than ~ 10 km is difficult for Kepler 16b, Kepler 34b and Kepler 35b. These planets were likely assembled further out in the disk, and migrated inward to their current location.

Download/Website: `http://arxiv.org/abs/1206.3484`

Contact: `S.Paardekooper@damtp.cam.ac.uk`

Temporal variations in the evaporating atmosphere of the exoplanet HD 189733b

A. Lecavelier des Etangs[1,2], V. Bourrier[1,2], P. J. Wheatley[3], H. Dupuy[1,2], D. Ehrenreich[4], A. Vidal-Madjar[1,2], G. Hébrard[1,2], G. E. Ballester[5], J.-M. Désert[6], R. Ferlet[1,2], D. K. Sing[7]

[1] CNRS, UMR 7095, Institut d'astrophysique de Paris, 98bis boulevard Arago, F-75014 Paris, France
[2] UPMC Univ. Paris 6, UMR 7095, Institut d'Astrophysique de Paris, 98bis boulevard Arago, F-75014 Paris, France
[3] Department of Physics, University of Warwick, Coventry CV4 7AL, UK
[4] UJF-Grenoble 1/CNRS-INSU, Institut de Planétologie et d'Astrophysique de Grenoble (IPAG), Grenoble, France
[5] Lunar and Planetary Laboratory, University of Arizona, 1541 E. University Blvd., Tucson, AZ 85721-0063, USA
[6] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[7] Astrophysics Group, School of Physics, University of Exeter, Stocker Road, Exeter EX4 4QL, UK

Astronomy & Astrophysics Letters, 543, L4 (2012) (arXiv:1206.6274)

Atmospheric escape has been detected from the exoplanet HD 209458b through transit observations of the hydrogen Lyman-α line. Here we present spectrally resolved Lyman-α transit observations of the exoplanet HD 189733b at two different epochs. These HST/STIS observations show for the first time, that there are significant temporal variations in the physical conditions of an evaporating planetary atmosphere. While atmospheric hydrogen is not detected in the first epoch observations, it is observed at the second epoch, producing a transit absorption depth of 14.4±3.6% between velocities of -230 to -140 km s^{-1}. Contrary to HD 209458b, these high velocities cannot arise from radiation pressure alone and require an additional acceleration mechanism, such as interactions with stellar wind protons. The observed absorption can be explained by an atmospheric escape rate of neutral hydrogen atoms of about 10^9 g s^{-1}, a stellar wind with a velocity of 190 km s^{-1} and a temperature of $\sim 10^5$ K.
An X-ray flare from the active star seen with Swift/XRT 8 hours before the second-epoch observation supports the idea that the observed changes within the upper atmosphere of the planet can be caused by variations in the stellar wind properties, or by variations in the stellar energy input to the planetary escaping gas (or a mix of the two effects). These observations provide the first indication of interaction between the exoplanet's atmosphere and stellar variations.

Contact: lecaveli@iap.fr

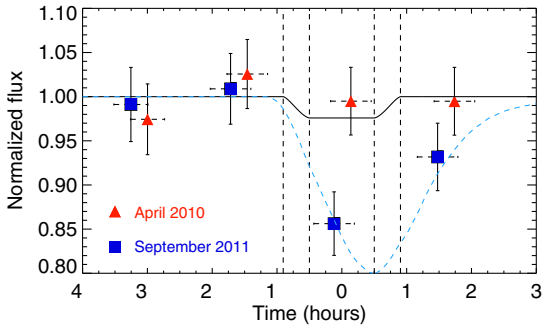

Figure 5: (Lecavalier des Etangs et al.) Plot of the flux between -230 and -140 km s^{-1} in the blue wing of the Lyman-α line as a function of time relative to the center of the planetary transit. Vertical dashed lines show the beginning and end of ingress and egress of the transit. The red triangular symbols are for the 2010 observations, while the blue square symbols correspond to observations of 2011. Horizontal error bars centered on the symbols show the duration of the exposures in each HST orbit. The time-tagged data allow independent sub-exposures to be extracted within each HST orbit (not shown here), resulting in the same transit signal within error bars. The light curve of the planet's transit at optical wavelengths is displayed as a solid black line. The blue dashed line shows the calculated flux using the numerical simulation with an EUV ionizing flux 5 times the solar value, a stellar wind of protons with a temperature $T \sim 10^5$ K, a velocity $v \sim 190$ km s^{-1} and density $n \sim 3 \times 10^3$ cm^{-3} together with an atmospheric escape rate of 10^9 g s^{-1}.

An Independent Planet Search In The *Kepler* Dataset. I. A hundred new candidates and revised KOIs

A. Ofir, S. Dreizler
Institut für Astrophysik, Georg-August-Universität, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Astronomy & Astrophysics submitted, astro-ph/1206.5347

Aims. We start a project to re-analyze the entire public *Kepler* dataset, searching for planetary transits using a different processing pipeline than the one used by the *Kepler* Mission
Methods. The SARS pipeline was tried and tested extensively by processing the entire CoRoT mission data. In this first paper of the series we use this pipeline to search for (additional) planetary transits only in a small subset of stars - the *Kepler* Objects of Interest (KOIs), which are already known to include at least one promising planet candidate.
Results. Despite the fact that KOIs represent less than 1% of the *Kepler* dataset we are able to significantly update the overall statistics of planetary multiplicity: we find 84 new transit signals on 64 systems on these light curves only, nearly doubling the number of transit signals in these systems. 41 of the systems were singly-transiting systems that are now multiply-transiting, significantly reducing the chances of false positive in them. Notable among the new discoveries are KOI 435 as a new 6-candidate systems (where only *Kepler*-11 was known before), KOI 277 which includes two candidates in a 6:7 period commensurability and with anti-correlated TTVs all but validating the system, KOIs 719 and 1574 that have small planet candiates ($1.29R_\oplus$ and $2.05R_\oplus$ respectively) in the habitable zone of their host star, and KOI 1843 that exhibits the shortest period (4.25hr) and among the smallest ($0.68R_\oplus$) of all planet candidates. We are also able to completely reject 11 KOIs as eclipsing binaries based on photometry alone, update the ephemeris for five KOIs and otherwise discuss a number of other objects, bringing the total of new signals and revised KOIs in this study to over a hundred. We discuss sub-optimal fitting of multi-transiting systems by the *Kepler* Mission that does not take Kepler's third law into account, causing the error on the d/R_* parameter to be overestimated by 3.8 (median factor). Interestingly a large fraction, about $\sim 1/3$, of the newly detected candiates participate in period commensurabilities.
Conclusions. Our results strengthen previous analyzes of the multi-transiting ensemble, and only stress the great importance of this dataset. Nevertheless, we conclude that despite the phenomenal success of the *Kepler* mission, parallel analysis of the data by multiple teams is required to make full use of the data.

Contact: avivofir@astro.physik.uni-goettinge.de

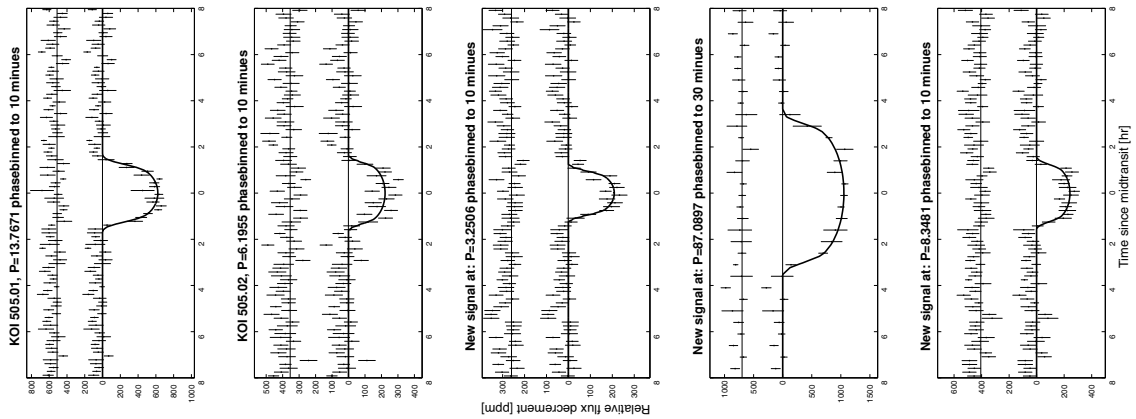

Figure 6: (Ofir et al.) The five transit-like signals detected in the light curve of KOI 505, of them two (topmost) were previously known and three are newly discovered.

ExELS: an exoplanet legacy science proposal for the ESA *Euclid* mission I. Cold exoplanets

M. T. Penny[1,2,3], *E. Kerins*[1,2], *N. Rattenbury*[2], *J.-P. Beaulieu*[1,4], *A. C. Robin*[5], *S. Mao*[1,2,6], *V. Batista*[1,3], *S. Calchi Novati*[1,7,8], *A. Cassan*[1,4], *I. McDonald*[1,2], *J. B. Marquette*[1,4], *P. Tisserand*[1,10], *M. R. Zapatero Osorio*[1,11]

[1] The *Euclid* Exoplanet Science Working Group
[2] Jodrell Bank Centre for Astrophysics, School of Physics & Astronomy, University of Manchester, Oxford Road, Manchester M13 9PL, UK
[3] Department of Astronomy, Ohio State University, 140 W. 18th Ave., Columbus, OH 43210, USA
[4] Institut dAstrophysique de Paris, Université Pierre et Marie Curie, CNRS UMR7095, 98bis Boulevard Arago, 75014 Paris, France
[5] Institut Utinam, CNRS UMR6213, Université de Franche-Comté, Observatoire de Besançon, Besançon, France
[6] National Astronomical Observatories, Chinese Academy of Sciences, A20 Datun Road, Chaoyang District, Beijing 100012, China
[7] Dipartimento di Fisica E. R. Caianiello, Università di Salerno, Via Ponte don Melillo, 84084 Fisciano (SA), Italy
[8] Istituto Internazionale per gli Alti Studi Scientifici (IIASS), Vietri Sul Mare (SA), Italy
[9] IRAP, CNRS - Universit de Toulouse, 14 av. E. Belin, F-31400 Toulouse, France
[10] Research School of Astronomy and Astrophysics, Australian National University, Cotter Rd, Weston Creek, ACT, 2611, Australia
[11] Centro de Astrobiología (CSIC-INTA), Crta. Ajalvir km 4, E-28850 Torrejón de Ardoz, Madrid, Spain

Monthly Notices of the Royal Astronomical Society, submitted (arXiv:1206.5296)

The *Euclid* mission is the second M-class mission of the ESA Cosmic Vision programme, with the principal science goal of studying dark energy through observations of weak lensing and baryon acoustic oscillations. *Euclid* is also expected to undertake additional Legacy Science programmes. One such proposal is the Exoplanet *Euclid* Legacy Survey (ExELS) which will be the first survey able to measure the abundance of exoplanets down to Earth mass for host separations from $\sim$1 AU out to the free-floating (unbound) regime. The cold and free-floating exoplanet regimes represent a crucial discovery space for testing planet formation theories. ExELS will use the gravitational microlensing technique and will detect over 400 microlensing events per month over 1.6 deg^2 of the Galactic bulge. We assess how many of these events will have detectable planetary signatures using a detailed multi-wavelength microlensing simulator – the Manchester-Besançon microLensing Simulator (MaBμLS, pronounced *may*-buls) – which incorporates the Besançon Galactic model with 3D extinction. MaBμLS is the first theoretical simulation of microlensing to treat the effects of point spread function (PSF) blending self-consistently with the underlying Galactic model. We use MaBμLS, together with current numerical models for the *Euclid* PSFs, to explore a number of designs and de-scope options for ExELS, including the two current spacecraft designs, the exoplanet yield as a function of filter choice, and the effect of systematic photometry errors. Using conservative extrapolations of current empirical exoplanet mass functions determined from ground-based microlensing and radial velocity surveys, ExELS can expect to detect a few hundred cold exoplanets around mainly G, K and M-type stellar hosts, including $\sim$19 Earth-mass planets and $\sim$3 Mars-mass planets for an observing programme totalling 10 months. ExELS will be capable of measuring the cold exoplanet mass function down to Earth mass or below, with orbital separations ranging from $\sim$1 AU out to infinity (i.e. the free-floating regime). Recent ground-based microlensing measurements indicate a significant population of free-floating Jupiters, in which case ExELS will detect hundreds of free-floating planets. ExELS will also be sensitive to hot exoplanets and sub-stellar companions through their transit signatures and this is explored in a companion paper.

Download/Website: `http://arxiv.org/abs/1206.5296`

Contact: `Eamonn.Kerins@manchester.ac.uk`

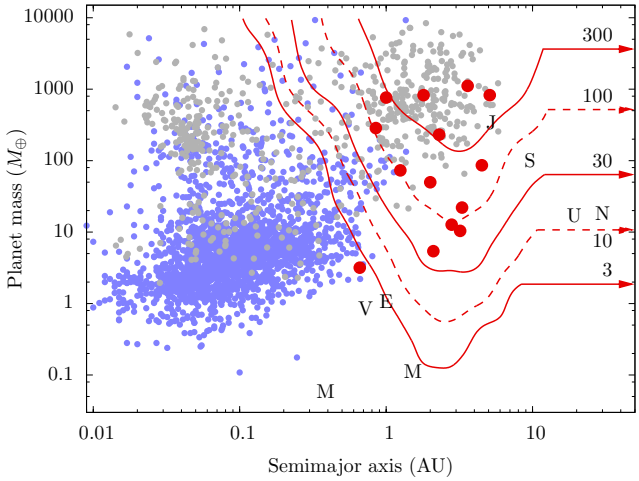

Figure 7: (Penny et al.) Red contours show the expected yield of a 300-day ExELS survey, plotted against planet mass and semimajor axis, assuming there is one planet per star at each point in the planet mass–semimajor axis plane. Horizontal arrows are plotted when the expected yield of free-floating planets of that mass exceeds the yield of bound planets (assuming one free-floating planet per star). The grey points show planets listed by the Exoplanets Orbits Database, and light blue points show candidate planets from the Kepler mission. The red points show planets detected via microlensing.

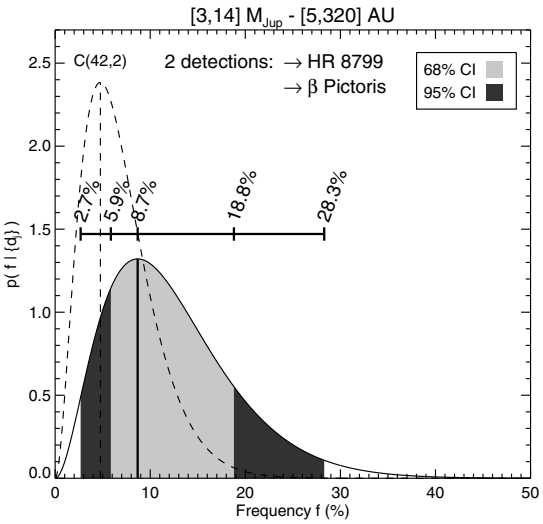

Figure 8: (Vigan et al.) Probability density of the giant planetary systems frequency f given the observations as a function of f, in the semimajor axis interval 5–320 AU and mass interval 3–14 M_{Jup}, for two detections around HR 8799 and β Pic, and with confidence levels of 68% (light grey area) and 95% (dark grey area). The dashed lines gives the binomial distributions for two detections out of 42 targets, which represent the ideal case where the observations would be sensitive to *all* planets in the range 5–320 AU and 3–14 M_{Jup}.

The International Deep Planet Survey I. The frequency of wide-orbit massive planets around A-stars

A. Vigan[1], *J. Patience*[1,2], *C. Marois*[3], *M. Bonavita*[4], *R. J. De Rosa*[1,2], *B. Macintosh*[5], *I. Song*[6], *R. Doyon*[7], *B. Zuckerman*[8], *D. Lafrenière*[7], *T. Barman*[9]

[1] Astrophysics group, School of Physics, University of Exeter, Stocker Road, Exeter EX4 4QL, United Kingdom
[2] Arizona State University, School of Earth and Space Exploration, PO Box 871404, Tempe, AZ 85287-1404, USA
[3] National Research Council of Canada, 5071 West Saanich Road, Victoria, British Columbia V9E 2E7, Canada
[4] Department of Astronomy, University of Toronto, Toronto, ON, Canada
[5] Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, California 94550, USA
[6] University of Georgia, Department of Physics and Astronomy, 240 Physics, Athens, GA 30602, USA
[7] Département de Physique, Université de Montréal, C.P. 6128, Succursale Centre-ville, Montréal, QC H3C 3J7, Canada
[8] Department of Physics and Astronomy, University of California, Los Angeles, CA 90095, USA
[9] Lowell Observatory, 1400 West Mars Hill Road, Flagstaff, AZ 86001, USA

Astronomy & Astrophysics, in press (arXiv:1206.4048)

Breakthrough direct detections of planetary companions orbiting A-type stars confirm the existence of massive planets at relatively large separations, but dedicated surveys are required to estimate the frequency of similar planetary systems. To measure the first estimation of the giant exoplanetary systems frequency at large orbital separation around A-stars, we have conducted a deep-imaging survey of young (8–400 Myr), nearby (19–84 pc) A- and F-stars to search for substellar companions in the $\sim$10–300 AU range. The sample of 42 stars combines all A-stars observed in previous AO planet search surveys reported in the literature with new AO observations from VLT/NaCo and Gemini/NIRI. It represents an initial subset of the International Deep Planet Survey (IDPS) sample of stars covering M- to B-stars. The data were obtained with diffraction-limited observations in H- and $K_{\rm s}$-band combined with angular differential imaging to suppress the speckle noise of the central stars, resulting in typical 5σ detection limits in magnitude difference of 12 mag at $1''$, 14 mag at $2''$ and 16 mag at $5''$ which is sufficient to detect massive planets. A detailed statistical analysis of the survey results is performed using Monte Carlo simulations. Considering the planet detections, we estimate the fraction of A-stars having at least one massive planet (3–14 $\mathrm{M_{Jup}}$) in the range 5–320 AU to be inside 5.9–18.8% at 68% confidence, assuming a flat distribution for the mass of the planets. By comparison, the brown dwarf (15–75 $\mathrm{M_{Jup}}$) frequency for the sample is 2.0–8.9% at 68% confidence in the range 5–320 AU. Assuming power law distributions for the mass and semimajor axis of the planet population, the AO data are consistent with a declining number of massive planets with increasing orbital radius which is distinct from the rising slope inferred from radial velocity (RV) surveys around evolved A-stars and suggests that the peak of the massive planet population around A-stars may occur at separations between the ranges probed by existing RV and AO observations. Finally, we report the discovery of three new close M-star companions to HIP 104365 and HIP 42334.

Download/Website: `http://arxiv.org/abs/1206.4048`

Contact: `arthur@astro.ex.ac.uk`

ExoMol: molecular line lists for exoplanet and other atmospheres

J. Tennyson, S. N. Yurchenko
Department of Physics and Astronomy, University College London, WC1E 6BT London, UK

Monthly Notices of the Royal Astronomical Society, in press/published (ArXiv:1204.0124)

The discovery of extrasolar planets is one of the major scientific advances of the last two decades. Hundreds of planets have now been detected and astronomers are beginning to characterise their composition and physical characteristics. To do this requires a huge quantity of spectroscopic data most of which is not available from laboratory studies. The ExoMol project will offer a comprehensive solution to this problem by providing spectroscopic data on all the molecular transitions of importance in the atmospheres of exoplanets. These data will be widely applicable to other problems and will be used for studies on cool stars, brown dwarfs and circumstellar environments. This paper lays out the scientific foundations of this project and reviews previous work in this area.
A mixture of first principles and empirically-tuned quantum mechanical methods will be used to compute comprehensive and very large rotation-vibration and rotation-vibration-electronic (rovibronic) line lists. Methodologies will be developed for treating larger molecules such as methane and nitric acid. ExoMol will rely on these developments and the use of state-of-the-art computing.

Download/Website: `http://http://uk.arxiv.org/abs/1204.0124`

Contact: `j.tennyson@ucl.ac.uk`

The rovibrational spectrum of BeH, MgH and CaH at high temperatures in the $X\,^2\Sigma^+$ state: a theoretical study

Benjamin Yadin, Thomas Veness, Pierandrea Conti, Christian Hill, Sergei N. Yurchenko, Jonathan Tennyson
Department of Physics and Astronomy, University College London, WC1E 6BT London, UK

Monthly Notices of the Royal Astronomical Society, in press/published (ArXiv:1204.0137)

Accurate line lists for three molecules, BeH, MgH and CaH, in their ground electronic states are presented. These line lists are suitable for temperatures relevant to exoplanetary atmospheres and cool stars (up to 2000K). A combination of empirical and *ab initio* methods is used. The rovibrational energy levels of BeH, MgH and CaH are computed using the programs Level and DPotFit in conjunction with 'spectroscopic' potential energy curves (PECs). The PEC of BeH is taken from the literature, while the PECs of CaH and MgH are generated by fitting to the experimental transition energy levels. Both spin-rotation interactions (except for BeH, for which it is negligible) and non-adiabatic corrections are explicitly taken into account. Accurate line intensities are generated using newly computed *ab initio* dipole moment curves for each molecule using high levels of theory. Full line lists of rotation-vibration transitions for ^{9}BeH, ^{24}MgH, ^{25}MgH, ^{26}MgH and ^{40}CaH are made available in an electronic form as supplementary data to this article and at http://www.exomol.com.

Download/Website: `http://uk.arxiv.org/abs/1204.0137`

Contact: `j.tennyson@ucl.ac.uk`

The PTF Orion Project: a Possible Planet Transiting a T-Tauri Star

J. C. van Eyken[1], D. R. Ciardi[1], K. von Braun[1], S. R. Kane[1], P. Plavchan[1], C. F. Bender[2,3], T. M. Brown[4], J. R. Crepp[5], B. J. Fulton[4], A. W. Howard[6], S. B. Howell[7], S. Mahadevan[2,3], G. W. Marcy[6], A. Shporer[4], P. Szkody[8], R. L. Akeson[1], C. A. Beichman[1], A. F. Boden[9], D. M. Gelino[1], D. W. Hoard[10], S. V. Ramírez[1], L. M. Rebull[10], J. R. Stauffer[10], J. S. Bloom[6], S. Bradley Cenko[6], M. M. Kasliwal[5], S. R. Kulkarni[5], N. M. Law[11], P. E. Nugent[12], E. O. Ofek[13], D. Poznanski[14], R. M. Quimby[15], R. Walters[5], C. J. Grillmair[10], R. Laher[10], D. B. Levitan[16], B. Sesar[5], J. A. Surace[10]

[1] NASA Exoplanet Science Institute, California Institute of Technology, 770 South Wilson Avenue, M/S 100-22, Pasadena, CA, 91125, USA
[2] Department of Astronomy & Astrophysics, The Pennsylvania State University, University Park, PA 16802, USA
[3] Center for Exoplanets and Habitable Worlds, The Pennsylvania State University, University Park, PA 16802, USA
[4] Las Cumbres Observatory Global Telescope, Goleta, CA 93117, USA
[5] Cahill Center for Astrophysics, California Institute of Technology, Pasadena, CA, 91125, USA
[6] Department of Astronomy, University of California, Berkeley, CA 94720-3411, USA
[7] NASA Ames Research Center, M/S 244-30, Moffett Field, CA 94035, USA
[8] Department of Astronomy, University of Washington, Box 351580, Seattle, WA 98195, USA
[9] Caltech Optical Observatories, California Institute of Technology, Pasadena, CA 91125, USA
[10] Spitzer Science Center, M/S 220-6, California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA 91125, USA
[11] Dunlap Institute for Astronomy and Astrophysics, University of Toronto, 50 St. George Street, Toronto M5S 3H4, Ontario, Canada
[12] Computational Cosmology Center, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, USA
[13] Benoziyo Center for Astrophysics, Weizmann Institute of Science, 76100 Rehovot, Israel
[14] School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel
[15] IPMU, University of Tokyo, Kashiwanoha 5-1-5, Kashiwa-shi, Chiba, Japan
[16] Division of Physics, Mathematics and Astronomy, California Institute of Technology, Pasadena, CA 91125, USA

Astrophysical Journal, in press (arXiv:1206.1510)

We report observations of a possible young transiting planet orbiting a previously known weak-lined T-Tauri star in the 7–10 Myr-old Orion-OB1a/25-Ori region. The candidate was found as part of the Palomar Transient Factory (PTF) Orion project. It has a photometric transit period of 0.448413 ± 0.000040 days, and appears in both 2009 and 2010 PTF data. Follow-up low-precision radial velocity observations and adaptive-optics imaging suggest that the star is not an eclipsing binary, and that it is unlikely that a background source is blended with the target and mimicking the observed transit. Radial-velocity observations with the Hobby-Eberly and Keck telescopes yield a radial velocity that has the same period as the photometric event, but is offset in phase from the transit center by ≈ -0.22 periods. The amplitude (half range) of the radial velocity variations is $2.4\,\mathrm{km\,s^{-1}}$ and is comparable with the expected radial velocity amplitude that stellar spots could induce. The radial velocity curve is likely dominated by stellar spot modulation and provides an upper limit to the projected companion mass of $M_\mathrm{p} \sin i_\mathrm{orb} \lesssim 4.8 \pm 1.2\,M_\mathrm{Jup}$; when combined with the orbital inclination, i_orb, of the candidate planet from modeling of the transit lightcurve, we find an upper limit on the mass of the planetary candidate of $M_\mathrm{p} \lesssim 5.5 \pm 1.4\,M_\mathrm{Jup}$. This limit implies that the planet is orbiting close to, if not inside, its Roche limiting orbital radius, so that it may be undergoing active mass loss and evaporating.

Download/Website: `http://arxiv.org/abs/1206.1510`

Contact: `vaneyken@ipac.caltech.edu, ciardi@ipac.caltech.edu`

Herschel imaging of 61 Vir: implications for the prevalence of debris in low-mass planetary systems

M. C. Wyatt[1]*, G. Kennedy*[1]*, B. Sibthorpe*[2]*, A. Moro-Martín*[3]*, J.-F. Lestrade*[4]*, R. J. Ivison*[2]*, B. Matthews*[5]*, S. Udry*[6]*, J. S. Greaves*[7]*, P. Kalas*[8,9]*, S. Lawler*[10]*, K. Y. L. Su*[11]*, G. H. Rieke*[11]*, M. Booth*[12,5]*, G. Bryden*[13]*, J. Horner*[14]*, J. J. Kavelaars*[5]*, D. Wilner*[15]

[1] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK
[2] UK Astronomy Technology Centre, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, UK
[3] Centro de Astrobiología (CSIC-INTA), 28850 Torrejón de Ardoz, Madrid, Spain
[4] Observatoire de Paris, 77 Avenue Denfert Rochereau, 75014, Paris, France
[5] Herzberg Institute of Astrophysics, 5072 West Saanich Road, Victoria V9E 2E7, BC, Canada
[6] Observatoire de l'Université de Genève, 51 Ch. des Maillettes, CH-1290 Versoix, Switzerland
[7] Scottish Universities Physics Alliance, University of St. Andrews, North Haugh, St Andrews KY16 9SS, UK
[8] Department of Astromomy, University of California, 601 Campbell Hall, Berkeley, CA 94720, USA
[9] SETI Institute, 515 North Whisman Road, Mountain View, CA 94043, USA
[10] University of British Columbia, Physics and Astronomy, 6244 Agricultural Road, Vancouver, BC V6T 1Z1, Canada
[11] Steward Observatory, University of Arizona, Tucson, AZ 85721, USA
[12] Department of Physics & Astronomy, University of Victoria, 3800 Finnerty Rd, Victoria, BC, V8P 5C2, Canada
[13] Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA
[14] Department of Astrophysics and Optics, School of Physics, University of New South Wales, Sydney 2052, Australia
[15] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1206.2370)

This paper describes Herschel observations of the nearby (8.5pc) G5V multi-exoplanet host star 61 Vir at 70, 100, 160, 250, 350 and 500 μm carried out as part of the DEBRIS survey. These observations reveal emission that is significantly extended out to a distance of $>$ 15arcsec with a morphology that can be fitted by a nearly edge-on (77° inclination) radially broad (from 30AU out to at least 100AU) debris disk of fractional luminosity 2.7×10^{-5}, with two additional (presumably unrelated) sources nearby that become more prominent at longer wavelengths. Chance alignment with a background object seen at 1.4GHz provides potential for confusion, however the star's 1.4arcsec/year proper motion allows archival Spitzer 70μm images to confirm that what we are interpreting as *disk* emission really is circumstellar. Although the exact shape of the disk's inner edge is not well constrained, the region inside 30AU must be significantly depleted in planetesimals. This is readily explained if there are additional planets outside those already known (i.e., in the 0.5-30AU region), but is also consistent with collisional erosion. We also find tentative evidence that the presence of detectable debris around nearby stars correlates with the presence of the lowest mass planets that are detectable in current radial velocity surveys. Out of an unbiased sample of the nearest 60 G stars, 11 are known to have planets, of which 6 (including 61 Vir) have planets that are all less massive than Saturn, and 4 of these have evidence for debris. The debris toward one of these planet-hosts (HD20794) is reported here for the first time. This fraction (4/6) is higher than that expected for nearby field stars (15%), and implies that systems that form low-mass planets are also able to retain bright debris disks. We suggest that this correlation could arise because such planetary systems are dynamically stable and include regions that are populated with planetesimals in the formation process where the planetesimals can remain unperturbed over Gyr timescales.

Download/Website: `http://arxiv.org/abs/1206.2370`

Contact: `wyatt@ast.cam.ac.uk`

3 Conference announcements

EChO Open Science Workshop

ESA-EChO Science Team
ESA

ESA-ESTEC, the Netherlands, Jan. 15-17, 2013

Dear colleague,

We kindly invite you to attend EChO2013, an open conference about the EChO (Exoplanet Characterisation Observatory) M3 mission candidate to be held at ESA-ESTEC on January 15-17, 2013. This international conference will provide an update on the status of EChO. The conference will be open to all the scientific, technical and industrial community, to encourage feedback in advance of the ESA Cosmic Vision review process. EChO is a mission dedicated to the observation of the atmospheres of planets around nearby stars. Those planets will span a range of masses –from gas giants to super-Earths–, stellar companions and temperatures –from hot to habitable. EChO will investigate their composition, and chemical/physical properties through repeated, simultaneous, multi-wavelength spectroscopic observations. The registration will soon be open on this website:

http://www.echo2013.net/

The two and half day meeting will start with the presentations of ESA EChO Study Team and Science Team. Presentations from the EChO consortia and contributed talks from the community will follow.

The ESA-EChO Science Team

Download/Website: `http://www.echo2013.net/`

4 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during June 2012. If you see any that we missed, please let us know and we'll include them in the next issue.

astro-ph/1206.0334: **Outcomes and Duration of Tidal Evolution in a Star-Planet-Moon System** by *Takashi Sasaki, Jason W. Barnes, David P. O'Brien*

astro-ph/1206.0349: **Comparative study of manufacturing techniques for coronagraphic binary pupil masks: masks on substrates and free-standing masks** by *Keigo Enya, Kanae Haze, Takayuki Kotani et al.*

astro-ph/1206.0558: **Can Ground-based Telescopes Detect The Oxygen 1.27 Micron Absorption Feature as a Biomarker in Exoplanets ?** by *Hajime Kawahara, Taro Matsuo, Michihiro Takami et al.*

astro-ph/1206.0601: **SOPHIE velocimetry of Kepler transit candidates VI. A false positive rate of 35% for Kepler close-in giant exoplanet candidates** by *A. Santerne, R. F. Diaz, C. Moutou et al.*

astro-ph/1206.0746: **On the detectability of star-planet interaction** by *Brendan P. Miller, Elena Gallo, Jason T. Wright et al.*

astro-ph/1206.0774: **Infrared Eclipses of the Strongly Irradiated Planet WASP-33b, and Oscillations of its Host Star** by *Drake Deming, Jonathan D. Fraine, Pedro V. Sada et al.*

astro-ph/1206.1021: **Atmospheres from very low-mass stars to extrasolar planets** by *France Allard, Derek Homeier et al.*

astro-ph/1206.1177: **WASP-78b and WASP-79b: Two highly-bloated hot Jupiter-mass exoplanets orbiting F-type stars in Eridanus** by *B. Smalley, D.R. Anderson, A. Collier-Cameron et al.*
astro-ph/1206.1212: **The timing precision of transit light-curves** by *H.J. Deeg, M. Seidel et al.*
astro-ph/1206.1215: **High-Resolution Near-Infrared Polarimetry of a Circumstellar Disk around UX Tau A** by *Ryoko Tanii, Yoichi Itoh, Tomoyuki Kudo et al.*
astro-ph/1206.1235: **Minimizing follow-up for space-based transit surveys using full lightcurve analysis** by *S.V. Nefs, I.A.G. Snellen, E.J.W. de Mooij*
astro-ph/1206.1343: **Does the innermost occurrence distribution measure tidal dissipation, reveal a flow of giant planets, or both?** by *S. F. Taylor*
astro-ph/1206.1391: **HATSouth: a global network of fully automated identical wide-field telescopes** by *G. A. Bakos, Z. Csubry, K. Penev et al.*
astro-ph/1206.1485: **STEREO observations of long period variables** by *K. T. Wraight, D. Bewsher, Glenn J. White et al.*
astro-ph/1206.1510: **The PTF Orion Project: a Possible Planet Transiting a T-Tauri Star** by *Julian C. van Eyken, David R. Ciardi, Kaspar von Braun et al.*
astro-ph/1206.1524: **HATS-1b: The First Transiting Planet Discovered by the HATSouth Survey** by *K. Penev, G. A. Bakos, D. Bayliss et al.*
astro-ph/1206.1568: **An Efficient Automated Validation Procedure for Exoplanet Transit Candidates** by *Timothy D. Morton*
astro-ph/1206.1592: **KELT-2Ab: A Hot Jupiter Transiting the Bright (V=8.77) Primary Star of a Binary System** by *Thomas G. Beatty, Joshua Pepper, Robert J. Siverd et al.*
astro-ph/1206.1729: **Photometric transit search for planets around cool stars from the western Italian Alps: A pilot study** by *P. Giacobbe, M. Damasso, A. Sozzetti et al.*
astro-ph/1206.2078: **Hubble Space Telescope Observations of the HD 202628 Debris Disk** by *John E. Krist, Karl R. Stapelfeldt, Geoffrey Bryden et al.*
astro-ph/1206.2165: **Multi-object spectroscopy of stars in the CoRoT fields II: The stellar population of the CoRoT fields IRa01, LRa01, LRa02, and LRa06** by *E. W. Guenther, D. Gandolfi, D. Sebastian et al.*
astro-ph/1206.2370: **Herschel imaging of 61 Vir: implications for the prevalence of debris in low-mass planetary systems** by *M. C. Wyatt, G. Kennedy, B. Sibthorpe et al.*
astro-ph/1206.2996: **Speckle Control with a remapped-pupil PIAA-coronagraph** by *Frantz Martinache, Olivier Guyon, Christophe Clergeon et al.*
astro-ph/1206.3154: **Observing planet-disk interaction in debris disks** by *Steve Ertel, Sebastian Wolf, Jens Rodmann*
astro-ph/1206.3303: **Characterization of exoplanets from their formation II: The planetary mass-radius relationship** by *C. Mordasini, Y. Alibert, C. Georgy et al.*
astro-ph/1206.3363: **Thermo-Resistive Instability of Hot Planetary Atmospheres** by *Kristen Menou*
astro-ph/1206.3585: **z'-band Ground-Based Detection of the Secondary Eclipse of WASP-19b** by *J. R. Burton, C. A. Watson, S. P. Littlefair et al.*
astro-ph/1206.3723: **DC Circuit Powered by Orbital Motion: Magnetic Interactions in Compact Object Binaries and Exoplanetary Systems** by *Dong Lai*
astro-ph/1206.3729: **ACME Stellar Spectra. I. Absolutely Calibrated, Mostly Empirical Flux Densities of 55 Cancri and its Transiting Planet** by *Ian J. M. Crossfield*
astro-ph/1206.4037: **Doppler tomography of transiting exoplanets: A prograde, low-inclined orbit for the hot Jupiter CoRoT-11b** by *Davide Gandolfi, Andrew Collier Cameron, Michael Endl et al.*
astro-ph/1206.4048: **The International Deep Planet Survey I. The frequency of wide-orbit massive planets around A-stars** by *A. Vigan, J. Patience, C. Marois et al.*
astro-ph/1206.4088: **Design of mirrors and apodization functions in phase-induced amplitude apodization (PIAA) systems** by *E. Cady*
astro-ph/1206.4190: **Debris from terrestrial planet formation: the Moon-forming collision** by *Alan P. Jackson,*

Mark C. Wyatt

astro-ph/1206.4305: **Precision Near Infrared Photometry For Exoplanet Transit Observations - I : Ensemble Spot Photometry for An All-Sky Survey** by *C*. Clanton, C. Beichman, G. Vasishtet al.

astro-ph/1206.4344: **Glancing views of the Earth. From a lunar eclipse to an exoplanetary transit** by *A. Garca Munoz, M. R. Zapatero Osorio, R. Barrena et al.*

astro-ph/1206.4688: **Keck/NIRC2 Imaging of the Warped, Asymmetric Debris Disk around HD 32297** by *Thayne Currie, Timothy J. Rodigas, John Debes et al.*

astro-ph/1206.4694: **Disrupting Primordial Planet Signatures: The Close Encounter of Two Single-Planet Exosystems in the Galactic Disc** by *Dimitri Veras, Nickolas Moeckel*

astro-ph/1206.4695: **Rapid dynamical chaos in an exoplanetary system** by *Katherine M. Deck, Matthew J. Holman, Eric Agol et al.*

astro-ph/1206.4715: **Transit Detection in the MEarth Survey of Nearby M Dwarfs: Bridging the Clean-First, Search-Later Divide** by *Zachory K. Berta, Jonathan Irwin, David Charbonneau et al.*

astro-ph/1206.4718: **Kepler-36: A Pair of Planets with Neighboring Orbits and Dissimilar Densities** by *Joshua A. Carter, Eric Agol, William J. Chaplin et al.*

astro-ph/1206.4875: **Stellar scattering and the origin of the planet around gamma-cephei-A** by *Javier Marti, Cristian Beauge*

astro-ph/1206.5296: **ExELS: an exoplanet legacy science proposal for the ESA Euclid mission I. Cold exoplanets** by *M*.T. Penny, E. Kerins, N. Rattenburyet al.

astro-ph/1206.5307: **A hot Uranus transiting the nearby M dwarf GJ3470. Detected with HARPS velocimetry. Captured in transit with TRAPPIST photometry** by *X. Bonfils, M. Gillon, S. Udry et al.*

astro-ph/1206.5347: **An Independent Planet Search In The Kepler Dataset. I. A hundred new candidates and revised KOIs** by *Aviv Ofir, Stefan Dreizler*

astro-ph/1206.5493: **SOAP. A tool for the fast computation of photometry and radial velocity induced by stellar spots** by *I. Boisse, X. Bonfils, N.C. Santos*

astro-ph/1206.5519: **2MASSJ035523.51+113337.4: A Young, Dusty, Nearby, Isolated Brown Dwarf Resembling A Giant Exoplanet** by *Jacqueline K. Faherty, Emily L. Rice, Kelle L. Cruz et al.*

astro-ph/1206.5579: **The Photoeccentric Effect and Proto Hot Jupiters II. KOI-1474.01, an eccentric planet perturbed by an unseen companion** by *Rebekah I. Dawson, John Asher Johnson, Timothy D. Morton et al.*

astro-ph/1206.5798: **EXOFAST: A fast exoplanetary fitting suite in IDL** by *Jason Eastman, B. Scott Gaudi, Eric Agol*

astro-ph/1206.5820: **Search for giant planets in M67 I. Overview** by *L. Pasquini, A. Brucalassi, M. T. Ruiz et al.*

astro-ph/1206.5887: **On the Evolution and Survival of Protoplanets Embedded in a Protoplanetary Disk** by *Allona Vazan, Ravit Helled*

astro-ph/1206.5887: **On the Evolution and Survival of Protoplanets Embedded in a Protoplanetary Disk** by *Allona Vazan, Ravit Helled*

astro-ph/1206.5893: **Star-planet magnetic interaction and activity in late-type stars with close-in planets** by *A. F. Lanza*

astro-ph/1206.6103: **Characterization of exoplanets from their formation I: Models of combined planet formation and evolution** by *C. Mordasini, Y. Alibert, H. Klahr et al.*

astro-ph/1206.6105: **Obliquities of Hot Jupiter host stars: Evidence for tidal interactions and primordial misalignments** by *Simon Albrecht, Joshua N. Winn, John A. Johnson et al.*

astro-ph/1206.6109: **The signature of orbital motion from the dayside of the planet tau Bootis b** by *M. Brogi, I.A.G. Snellen, R.J. de Kok et al.*

astro-ph/1206.6197: **Weighing The Non-Transiting Hot Jupiter Tau BOO b** by *Florian Rodler, Mercedes Lopez-Morales, Ignasi Ribas*

astro-ph/1206.6235: **Parameters of 20 newly detected eclipsing binaries from the Kepler database** by *Dinko P. Dimitrov, Diana P. Kjurkchieva, Veselka S. Radeva et al.*

astro-ph/1206.6274: **Temporal variations in the evaporating atmosphere of the exoplanet HD 189733b** by *A. Lecavelier des Etangs, V. Bourrier, P.J. Wheatley et al.*

astro-ph/1206.6276: **The Penn State-Torun Centre for Astronomy Planet Search stars. I. Spectroscopic analysis of 348 red giants** by *P. Zielinski, A. Niedzielski, A. Wolszczan et al.*

astro-ph/1206.6334: **Morphology of the very inclined debris disk around HD 32297** by *Anthony Boccaletti, Jean-Charles Augereau, Anne-Marie Lagrange et al.*

astro-ph/1206.6353: **On the Age and Binarity of Fomalhaut** by *Eric E. Mamajek*

astro-ph/1206.6619: **Narrow Band Halpha Photometry of the Super-Earth GJ 1214b with GTC/OSIRIS Tunable Filters** by *F. Murgas, E. Palle, A. Cabrera-Lavers, K. D. Colon et al.*

astro-ph/1206.6709: **The DWARF project: Eclipsing binaries - precise clocks to discover exoplanets** by *T. Pribulla, M. Vanko, M. Ammler - von Eiff et al.*

astro-ph/1206.6887: **3.6 and 4.5 Micron Phase Curves and Evidence for Non-Equilibrium Chemistry in the Atmosphere of Extrasolar Planet HD 189733b** by *Heather A. Knutson, Nikole Lewis, Jonathan J. Fortney et al.*

astro-ph/1206.7118: **A planetary system with gas giants and super-Earths around the nearby M dwarf GJ 676A. Optimizing data analysis techniques for the detection of multi-planetary systems** by *Guillem Anglada-Escude, Mikko Tuomi*