ExoPlanet News
An Electronic Newsletter

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

Contents

1 Editorial

Here is the 80th edition of ExoPlanet News with the usual selection of excellent papers, conference announcements and reports, and some job adverts too. I will be on leave at the beginning of next month, so the next edition of the newsletter will be in early September.
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. Although note that my updates to the website only become live over-night. So if you want to get the newsletter as soon as it is ready, please subscribe and get it by email on the day it's released.

Best wishes
Andrew Norton
The Open University

2 Abstracts of refereed papers

Vetting $Kepler$ planet candidates in the sub-Jovian desert with multi-band photometry

K. D. Colón[1]*, R. C. Morehead*[2,3]*, E. B. Ford*[2,3]

[1] Department of Physics, Lehigh University, 16 Memorial Drive East, Bethlehem, PA, USA
[2] Department of Astronomy and Astrophysics, The Pennsylvania State University, 525 Davey Laboratory, State College, PA, USA
[3] Center for Exoplanets & Habitable Worlds, The Pennsylvania State University, 525 Davey Laboratory, State College, PA, USA

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1506.07057)

We present new multi-band transit photometry of three small ($R_p \lesssim 6\ R_\oplus$), short-period ($P \lesssim 6$ days) $Kepler$ planet candidates acquired with the Gran Telescopio Canarias. These observations supplement the results presented in Colón & Ford (2011) and Colón et al. (2012), where we used multicolor transit photometry of five $Kepler$ planet candidates to search for wavelength-dependent transit depths and either validate planet candidates or identify eclipsing binary false positives within our sample. In those previous studies, we provided evidence that three targets were false positives and two targets were planets. Here, we present observations that provide evidence supporting a planetary nature for KOI 439.01 and KOI 732.01, and we find that KOI 531.01, a 6 $R_\oplus$ planet candidate around an M dwarf, is likely a false positive. We also present a discussion of the purported "sub-Jovian desert" in the orbital period-planet radius plane, which cannot be easily explained by observational bias. Both KOI 439.01 and KOI 732.01 are likely planets located within the so-called desert and should be investigated with further follow-up observations. As only ∼30 of the ∼3600 currently active $Kepler$ planet candidates are located within the sub-Jovian desert, it will be interesting to see if these candidates also survive the vetting process and fill in the gap in the period-radius plane. Confirming planets in this regime will be important for understanding planetary migration and evolution processes, and we urge additional follow-up observations of these planet candidates to confirm their nature.

Download/Website: `http://arxiv.org/abs/1506.07057`

Contact: `knicole.colon@gmail.com`

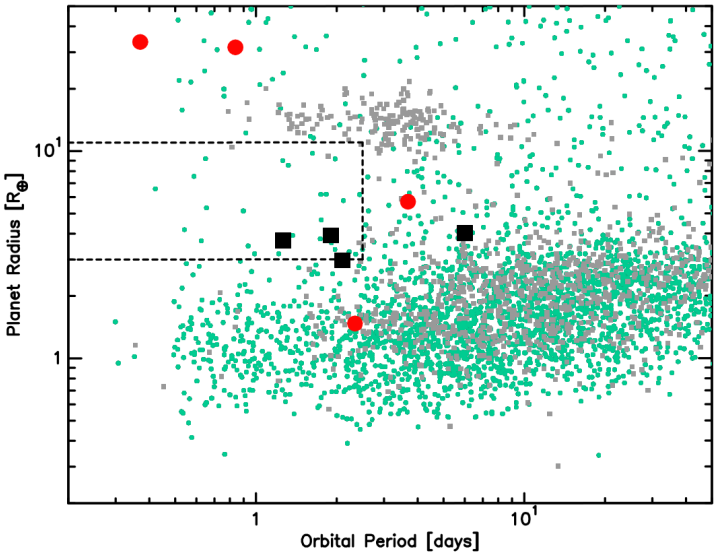

Figure 1: (Colón, Morehead & Ford) Planet radius versus orbital period for all confirmed transiting planets (from both ground-based surveys and $Kepler$; gray squares) and for active $Kepler$ planet candidates (green circles). The black squares mark the locations of the four KOIs we support as planets, while the red circles mark the four KOIs that we identified as false positives. We consider KOI 439.01 and 732.01 to be planets and KOI 531.01 to be a false positive in this context. The parameters for confirmed planets were taken from The Exoplanet Orbit Database at exoplanets.org on 2014 July 31. The region marked by dashed black lines indicates the regime of the so-called sub-Jovian desert (for $R_p \sim 3{-}11$ $R_\oplus$ and $P < 2.5$ days). While we initially selected KOIs with radii less than 6 $R_\oplus$, updated stellar parameters from Huber et al. (2014) and light curve models from the $Kepler$ team yielded new planet radii of 33.63 and 31.69 $R_\oplus$ for the false positives KOI 1187.01 and 225.01 (the two shortest period KOIs we observed, the latter of which is notably still included in the archive as a planet candidate).

Observations of exoplanets in time-evolving habitable zones of pre-main-sequence M dwarfs

F. Tian[1,2]

[1] Ministry of Education Key Laboratory for Earth System Modeling, Center for Earth System Science, Tsinghua University, Beijing 100084, China

[2] Joint Center for Global Change Studies (JCGCS), Beijing 100875, China

Icarus, in press

It is recently proposed that planets in the habitable zones (HZ) of pre-main-sequence (PMS) M dwarfs are good targets for the detection of habitable environments. In this note we show that future ground-based telescopes will be able to observe planets in time-evolving HZ of PMS M dwarfs with duration 10–100 Myrs. Based on X-ray measurements, there are > 18 M0 – M4 PMS stars within 10 pc, the characterization of potentially habitable exoplanets around which could provide highly valuable information regarding the evolution of habitable environments. There are tens of M dwarfs within 10 pc with X-ray to total luminosity ratios similar to that of the young Sun, the observations of potential planets around which could significantly improve our understanding of the physical states of early Solar System rocky planets

Contact: tianfengco@126.com

The formation of the Galilean moons and Titan in the Grand Tack scenario

R. Heller[1,2,3]*, G.-D. Marleau*[4,5]*, and R. Pudritz*[1,2]

[1] Origins Institute, McMaster University, 1280 Main Street West, Hamilton (ON) L8S 4M1, CAN
[2] Department of Physics & Astronomy, McMaster University, CAN
[3] Postdoctoral Fellow, Canadian Astrobiology Training Program
[4] Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, GER
[5] Member of the International Max Planck Research School

Astronomy & Astrophysics Letters, in press (arXiv:1506.01024)

In the "Grand Tack" (GT) scenario for the young solar system, Jupiter formed beyond 3.5 AU from the Sun and migrated as close as 1.5 AU until it encountered an orbital resonance with Saturn. Both planets then supposedly migrated outward for several 10^5 yr, with Jupiter ending up at $\approx$ 5 AU. The initial conditions of the GT and the timing between Jupiter's migration and the formation of the Galilean satellites remain unexplored. We study the formation of Ganymede and Callisto, both of which consist of $\approx$ 50 % H_2O and rock, respectively, in the GT scenario. We examine why they lack dense atmospheres, while Titan is surrounded by a thick N_2 envelope. We model an axially symmetric circumplanetary disk (CPD) in hydrostatic equilibrium around Jupiter. The CPD is warmed by viscous heating, Jupiter's luminosity, accretional heating, and the Sun. The position of the H_2O ice line in the CPD, which is crucial for the formation of massive moons, is computed at various solar distances. We assess the loss of Galilean atmospheres due to high-energy radiation from the young Sun. Ganymede and Callisto cannot have accreted their H_2O during Jupiter's supposed GT, because its CPD (if still active) was too warm to host ices and much smaller than Ganymede's contemporary orbit. From a thermal perspective, the Galilean moons might have had significant atmospheres, but these would probably have been eroded during the GT in $< 10^5$ yr by solar XUV radiation. Jupiter and the Galilean moons formed beyond 4.5 ± 0.5 AU and *prior* to the proposed GT. Thereafter, Jupiter's CPD would have been dry, and delayed accretion of planetesimals should have created water-rich Io and Europa. While Galilean atmospheres would have been lost during the GT, Titan would have formed after Saturn's own tack, because Saturn still accreted substantially for $\approx 10^6$ yr after its closest solar approach, ending up at about 7 AU.

Download/Website: `http://arxiv.org/abs/1506.01024`

Contact: `rheller@physics.mcmaster.ca`

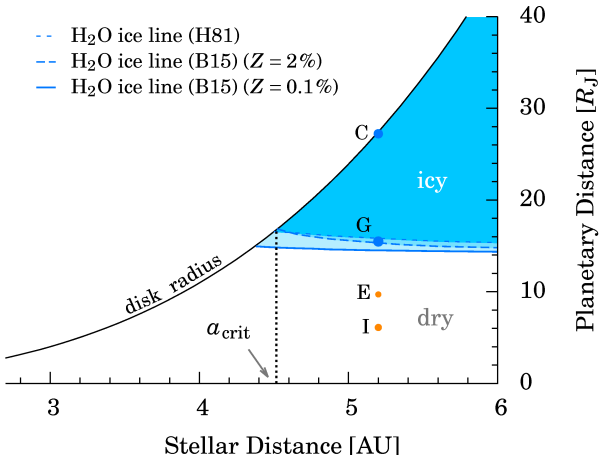

Figure 2: (Heller, Marleau, & Pudritz) Radial distance of Jupiter's H_2O ice line (roughly horizontal lines) and centrifugal disk radius (curved solid line) during its final accretion phase. Inside about 4.5 AU from the Sun, Jupiter's disk does not contain an H_2O ice line in any of the circumstellar disk models (Hayashi 1981; Bitsch et al. 2015; see legend). Locations of the Galilean moons are indicated by symbols at 5.2 AU. Symbol sizes scale with the physical radii of the moons (orange: rocky, blue: icy composition).

Magnetic fields in gaps surrounding giant protoplanets

S. L. Keith[1,2] *& M. Wardle*[1]

[1] Department of Physics & Astronomy and Research Centre in Astronomy, Astrophysics & Astrophotonics, Macquarie University, NSW 2109, Australia
[2] Jodrell Bank Centre for Astrophysics, School of Physics and Astronomy, The University of Manchester, Manchester, M13 9PL, United Kingdom

Monthly Notices of the Royal Astronomical Society, published (arXiv:1505.02158)

Giant protoplanets evacuate a gap in their host protoplanetary disc, which gas must cross before it can be accreted. A magnetic field is likely carried into the gap, potentially influencing the flow. Gap crossing has been simulated with varying degrees of attention to field evolution (pure hydrodynamical, ideal, and resistive MHD), but as yet there has been no detailed assessment of the role of the field accounting for all three key non-ideal MHD effects: Ohmic resistivity, ambipolar diffusion, and Hall drift. We present a detailed investigation of gap magnetic field structure as determined by non-ideal effects. We assess susceptibility to turbulence induced by the magnetorotational instability, and angular momentum loss from large-scale fields. As full non-ideal simulations are computationally expensive, we take an a posteriori approach, estimating MHD quantities from the pure hydrodynamical gap crossing simulation by Tanigawa, Ohtsuki & Machida. We calculate the ionisation fraction and estimate field strength and geometry to determine the strength of non-ideal effects. We find that the protoplanetary disc field would be easily drawn into the gap and circumplanetary disc. Hall drift dominates, so that much of the gap is conditionally MRI unstable depending on the alignment of the field and disc rotation axes. Field alignment also influences the strong toroidal field component permeating the gap. Large-scale magnetic forces are small in the circumplanetary disc, indicating they cannot drive accretion there. However, turbulence will be key during satellite growth as it affects critical disc features, such as the location of the ice line.

Download/Website: `http://arxiv.org/abs/1505.02158`

Contact: `sarah.keith3@students.mq.edu.au`

Numerically Predicted Indirect Signatures of Terrestrial Planet Formation

Z. M. Leinhardt, J. Dobinson, P. J. Carter, S. Lines
School of Physics, University of Bristol, Bristol, UK

The Astrophysical Journal, published (2015ApJ...806...23L)

The intermediate phases of planet formation are not directly observable due to lack of emission from planetesimals. Planet formation is, however, a dynamically active process resulting in collisions between the evolving planetesimals and the production of dust. Thus, indirect observation of planet formation may indeed be possible in the near future. In this paper we present synthetic observations based on numerical N-body simulations of the intermediate phase of planet formation including a state-of-the-art collision model, EDACM, which allows multiple collision outcomes, such as, accretion, erosion, and bouncing events. We show that the formation of planetary embryos may be indirectly observable by a fully functioning ALMA telescope if the surface area involved in planetesimal evolution is sufficiently large and/or the amount of dust produced in the collisions is sufficiently high in mass.

Download/Website: `http://adsabs.harvard.edu/abs/2015ApJ...806...23L`

Contact: `zoe.leinhardt@bristol.ac.uk`

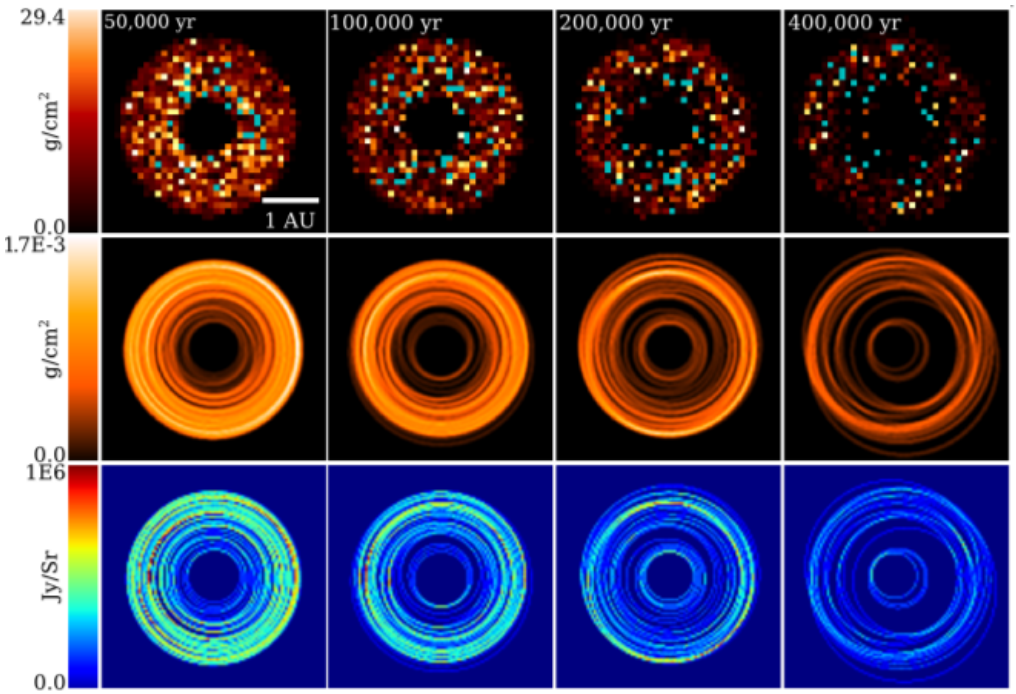

Figure 3: (Leinhardt et al.) Planetesimal evolution during runaway and oligarchic growth shown in planetesimal surface density (top row), instantaneous predicted collisional dust surface density (middle row), and as synthetic images of instantaneous dust (bottom row). Saturated pixels are shown in the planetesimal surface density images in cyan. The synthetic images were made using the radiative transfer package RADMC3D at a wavelength of 850 μm. Dust species are modeled as amorphous carbon and silicates, both species have sizes of 0.1 and 0.631 μm and relative abundances of 0.2 and 0.8, respectively. Larger dust from 1 to 1000 μm is modeled using simple Mie scattering spheres.

The dynamical evolution of low-mass hydrogen-burning stars, brown dwarfs and planetary-mass objects formed through disc fragmentation

Yun Li[1,2]*, M.B.N. Kouwenhoven*[2,1]*, D. Stamatellos*[3]*, S.P. Goodwin*[4]

[1] Department of Astronomy, School of Physics, Peking University, Yiheyuan Lu 5, Haidian Qu, Beijing 100871, Chin
[2] Kavli Institute for Astronomy and Astrophysics, Peking University, Yiheyuan Lu 5, Haidian Qu, Beijing 100871, China
[3] Jeremiah Horrocks Institute for Mathematics, Physics & Astronomy, University of Central Lancashire, Preston, PR1 2HE, UK
[4] Department of Physics & Astronomy, The University of Sheffield, Hicks Building, Hounsfield Road, Sheffield S3 7RH, UK

The Astrophysical Journal, published (arXiv:1506.03185)

Theory and simulations suggest that it is possible to form low-mass hydrogen-burning stars, brown dwarfs and planetary-mass objects via disc fragmentation. As disc fragmentation results in the formation of several bodies at comparable distances to the host star, their orbits are generally unstable. Here, we study the dynamical evolution of these objects. We set up the initial conditions based on the outcomes of the smoothed-particle hydrodynamics (SPH) simulations of Stamatellos & Whitworth (2009), and for comparison we also study the evolution of systems resulting from lower-mass fragmenting discs. We refer to these two sets of simulations as set 1 and set 2, respectively. At 10 Myr, approximately half of the host stars have one companion left, and approximately 22% (set 1) to 9.8% (set 2) of the host stars are single. Systems with multiple secondaries in relatively stable configurations are common (about 30% and 44%, respectively). The majority of the companions are ejected within 1 Myr with velocities mostly below 5 $\mathrm{km\,s^{-1}}$, with some runaway escapers with velocities over 30 $\mathrm{km\,s^{-1}}$. Roughly 6% (set 1) and 2% (set 2) of the companions pair up into very low-mass binary systems, resulting in respective binary fractions of 3.2% and 1.2%. The majority of these pairs escape as very low-mass binaries, while others remain bound to the host star in hierarchical configurations (often with retrograde inner orbits). Physical collisions with the host star (0.43 and 0.18 events per host star for set 1 and set 2, respectively) and between companions (0.08 and 0.04 events per host star for set 1 and set 2, respectively) are relatively common and their frequency increases with increasing disc mass. Our study predicts observable properties of very low-mass binaries, low-mass hierarchical systems, the brown dwarf desert, and free-floating brown dwarfs and planetary-mass objects in and near young stellar groupings, which can be used to distinguish between different formation scenarios of very low-mass stars, brown dwarfs and planetary-mass objects.

Download/Website: `http://arxiv.org/abs/1506.03185`

Contact: `yunli@pku.edu.cn`

No circumbinary planets transiting the tightest Kepler binaries — a possible fingerprint of a third star

D. V. Martin[1]*, T. Mazeh*[2]*, D. C. Fabrycky*[3]

[1] Observatoire de Genève, Université de Genève, 51 chemin des Maillettes, Sauverny 1290, Switzerland
[2] School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv 69978, Israel
[3] Department of Astronomy and Astrophysics, University of Chicago, 5640 South Ellis Avenue, Chicago, IL 60637, USA

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1505.05749)

The *Kepler* mission has yielded the discovery of eight circumbinary systems, all found around eclipsing binaries with periods greater than 7 d. This is longer than the typical eclipsing binary period found by *Kepler*, and hence there is a dearth of planets around the closest binaries. In this paper we demonstrate how this dearth may be explained by the presence of a distant stellar tertiary companion, which shrunk the inner binary orbit by the process of Kozai cycles and tidal friction, a mechanism that has been implicated for producing most binaries with periods below 7 d. We show that the geometry and orbital dynamics of these evolving triple-star systems are highly restrictive for a circumbinary planet, which is subject itself to Kozai modulation, on one hand, and can shield the two inner stars from their Kozai cycle and subsequent shrinking, on the other hand. Only small planets on wide and inclined orbits may form, survive and allow for the inner binary shrinkage. Those are difficult to detect.

Download/Website: http://http://arxiv.org/abs/1505.05749/
Contact: david.martin@unige.ch

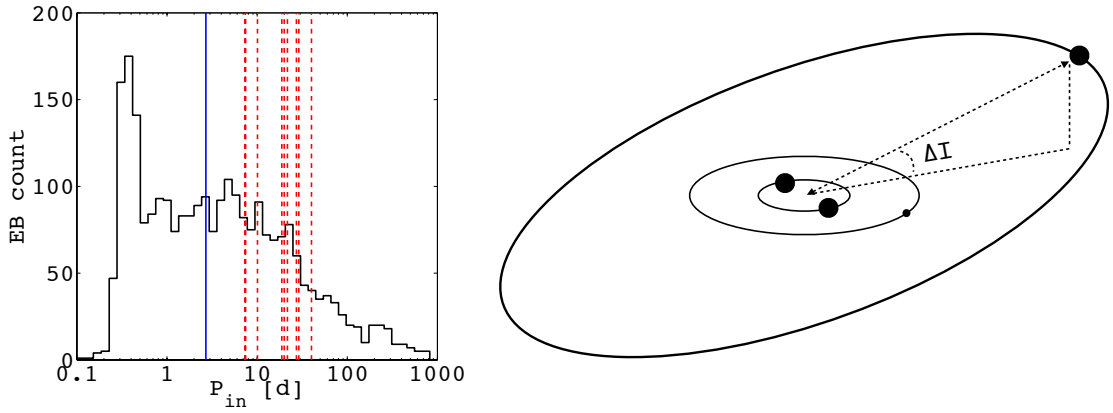

Figure 4: (Martin, Mazeh & Fabrycky) *Left*: Histogram of periods of the *Kepler* eclipsing binary catalog, with a blue solid vertical line indicating the median of this population and red dashed vertical lines indicating the binary periods known to host circumbinary periods. *Right*: Geometry of a close binary orbited by a planet and a distant stellar companion on a misaligned orbit. All orbits are drawn with respect to the centre of mass of the inner binary. All orbits are actually circular but misaligned with respect to our line of sight; the planet is coplanar with the inner binary.

Radial velocity eclipse mapping of exoplanets

N. Nikolov, F. Sainsbury-Martinez
Astrophysics Group, School of Physics, University of Exeter, Stocker Road, Exeter EX4 4QL, UK

The Astrophysical Journal, in press (arXiv:1506.04901)

Planetary rotation rates and obliquities provide information regarding the history of planet formation, but have not yet been measured for evolved extrasolar planets. Here we investigate the theoretical and observational perspective of the Rossiter-McLauglin effect during secondary eclipse (*RMse*) ingress and egress for transiting exoplanets. Near secondary eclipse, when the planet passes behind the parent star, the star sequentially obscures light from the approaching and receding parts of the rotating planetary surface. The temporal block of light emerging from the approaching (blue-shifted) or receding (red- shifted) parts of the planet causes a temporal distortion in the planet's spectral line profiles resulting in an anomaly in the planet's radial velocity curve. We demonstrate that the shape and the ratio of the ingress-to-egress radial velocity amplitudes depends on the planetary rotational rate, axial tilt and impact factor (i.e. sky-projected planet spin-orbital alignment). In addition, line asymmetries originating from different layers in the atmosphere of the planet could provide information regarding zonal atmospheric winds and constraints on the hot spot shape for giant irradiated exoplanets. The effect is expected to be most-pronounced at near-infrared wavelengths, where the planet-to-star contrasts are large. We create synthetic near-infrared, high-dispersion spectroscopic data and demonstrate how the sky-projected spin axis orientation and equatorial velocity of the planet can be estimated. We conclude that the *RMse* effect could be a powerful method to measure exoplanet spins.

Contact: nikolay@astro.ex.ac.uk

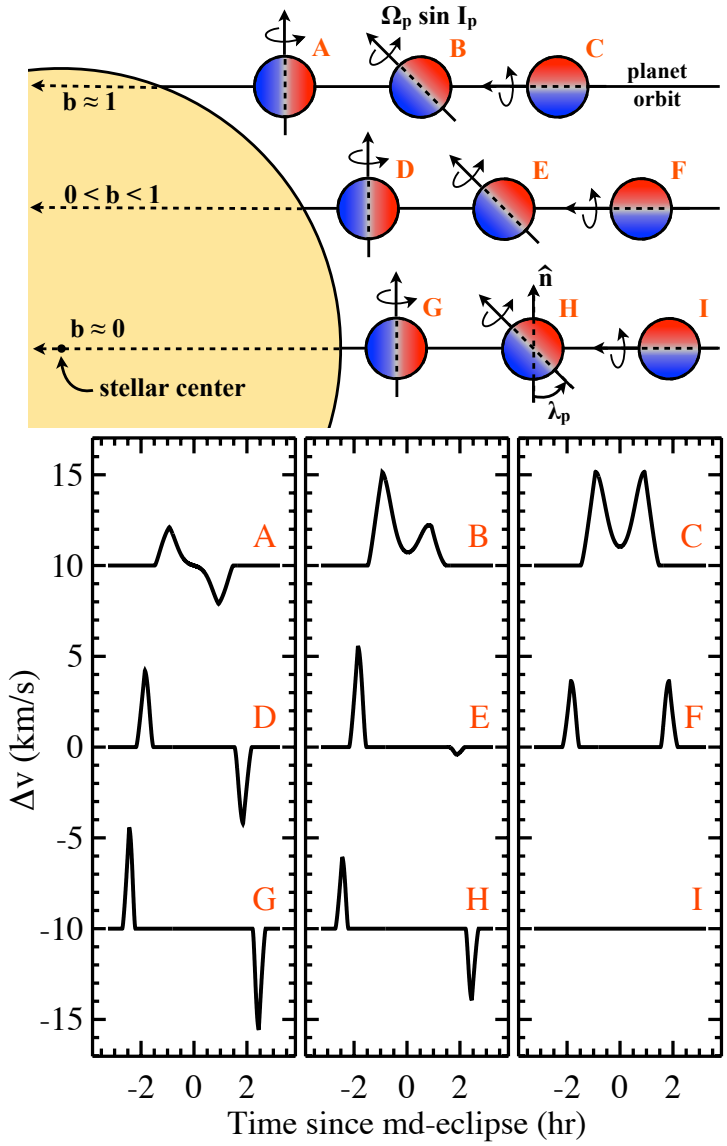

Figure 5: (Nikolov & Sainsbury-Martinez.) Illustration of the planet radial velocity curve anomaly due to *RMse* effect for nine (representative) prograde spin-orbital alignments. The curves are plotted with a constant $10\,\mathrm{km\,s^{-1}}$ offset for clarity. Cases A to I correspond to the top planet-star configurations. The curves flip and invert as λ_p increases to 360° and when $b < 0$.

Sequential planet formation in the HD 100546 protoplanetary disk?

P. Pinilla[1], T. Birnstiel[2] and C. Walsh[1]

[1] Leiden Observatory, Leiden University, P.O. Box 9513, 2300RA Leiden, The Netherlands
[2] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Astronomy & Astrophysics, in press (arXiv:1506.02383)

Context. The disk around the Herbig Ae star, HD 100546, shows structures that suggest the presence of two companions in the disk at ~ 10 and ~ 70 AU. The outer companion seems to be in the act of formation.
Aims. Our aims are to provide constraints on the age of the planets in HD 100546 and to explore the potential evidence for sequential planet formation in transition disks such as HD 100546.
Methods. We compare the recent resolved continuum observations of the disk around HD 100546 with the results of dust evolution simulations using an analytical prescription for the shapes of gaps carved by massive planets.
Results. An inner pressure bump must have been present since early in the disk lifetime to have good agreement between the dust evolution models and the continuum observations of HD 100546. This pressure bump may have resulted from the presence of a very massive planet ($\sim 20\ M_{\rm Jup}$), which formed early in the inner disk ($r \sim$10 AU). If only this single planet exists, the disk is likely to be old, comparable to the stellar age ($\sim$5-10 Myr). Another possible explanation is an additional massive planet in the outer disk ($r \sim 70$ AU): either a low-mass outer planet ($\sim 5\ M_{\rm Jup}$) injected at early times, or a higher mass outer planet ($\sim 15\ M_{\rm Jup}$) formed very recently, traps the right amount of dust in pressure bumps to reproduce the observations. In the latter case, the disk could be much younger (~ 3.0 Myr).
Conclusions. In the case in which two massive companions are embedded in the disk around HD 100546, as suggested in the literature, the outer companion could be at least $\sim$2.5 Myr younger than the inner companion.

Download/Website: `http://arxiv.org/pdf/1506.02383v1.pdf`

Contact: `pinilla@strw.leidenuniv.nl`

MOA-2007-BLG-197: Exploring the brown dwarf desert

C. Ranc[1], A. Cassan[1], M. D. Albrow, D. Kubas, I. A. Bond, V. Batista, J.-P. Beaulieu, D. P. Bennett, M. Dominik, Subo Dong, P. Fouqué, A. Gould, J. Greenhill, U. G. Jørgensen, N. Kains, J. Menzies, T. Sumi, E. Bachelet, C. Coutures, S. Dieters, D. Dominis Prester, J. Donatowicz, B. S. Gaudi, C. Han, M. Hundertmark, K. Horne, S. R. Kane, C.-U. Lee, J.-B. Marquette, B.-G. Park, K. R. Pollard, K. C. Sahu, R. Street, Y. Tsapras, J. Wambsganss, A. Williams, M. Zub, F. Abe, A. Fukui, Y. Itow, K. Masuda, Y. Matsubara, Y. Muraki, K. Ohnishi, N. Rattenbury, To. Saito; D. J. Sullivan, W. L. Sweatman, P. J. Tristram, P. C. M. Yock & A. Yonehara*

[1] Sorbonne Universités, UPMC Univ Paris 6 et CNRS, UMR 7095, Institut d'Astrophysique de Paris, 98 bis bd Arago, 75014 Paris, France
* see paper for affiliations of all authors

Astronomy & Astrophysics, in press (arXiv: 1505.06037)

We present the analysis of MOA-2007-BLG-197Lb, the first brown dwarf companion to a Sun-like star detected through gravitational microlensing. The event was alerted by the MOA collaboration and further followed-up photometrically by a network of telescopes from the PLANET, μFUN and MOA collaborations. The event was also observed at high angular resolution using the NaCo instrument at the VLT. From a detailed analysis including several second order effects in the light curve modelling and constraints from NaCo (J, H, K_s) colors, we find that MOA-2007-BLG-197Lb is a brown dwarf of $41 \pm 2\,\mathrm{M_J}$ observed at a projected separation of $a_\perp = 4.3 \pm 0.1$ AU, and orbits a $0.82 \pm 0.04\,\mathrm{M_\odot}$ G-K dwarf star located at $4.2 \pm 0.3\,\mathrm{kpc}$ from Earth. We then compiled an up-to-date list of brown dwarfs extending existing catalogs, with detections from different methods including microlensing. Plotting these data in a mass-period diagram and fitting a two-dimensional, non-parametric probability density function to the data reveals a structured brown dwarf desert – or dwarf desert landscape. We confirm the existence of a region that is strongly depleted in objects at short periods and intermediate masses ($P < 30\,\mathrm{d}$, $M \sim 30 - 60\,\mathrm{M_J}$), but we

also find an accumulation of objects around $P \sim 500\,\mathrm{d}$ and $M \sim 20\,\mathrm{M_J}$, as well as another depletion region at long orbital periods ($P > 500\,\mathrm{d}$) and high masses ($M > 50\,\mathrm{M_J}$). While these data provide important clues on the different physical mechanisms of formation (or destruction) that shape the brown dwarf desert, more data will be needed to establish their relative importance, in particular as a function of host star mass.

Download/Website: `http://adsabs.harvard.edu/abs/2015arXiv150506037R`

Contact: `ranc@iap.fr`

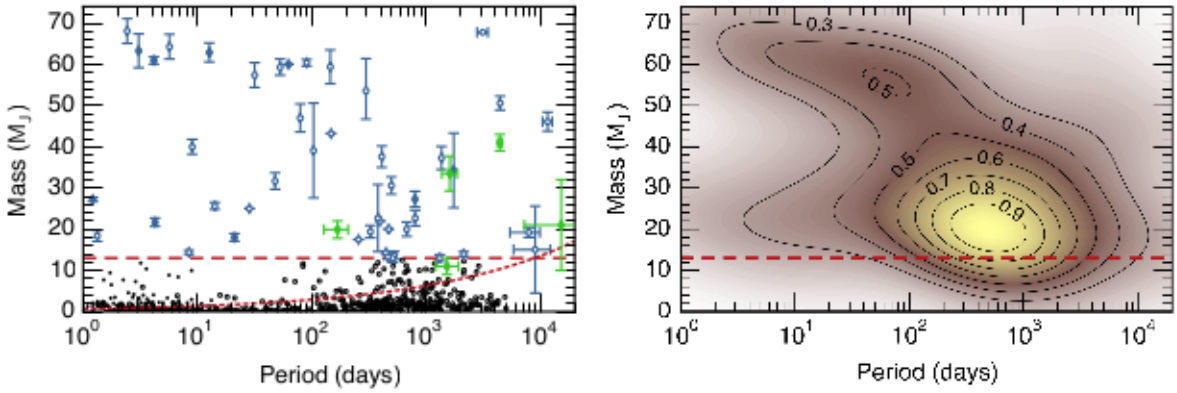

Figure 6: (Ranc et al.) *Left panel:* Current brown dwarfs detected through radial velocity and transit (blue circles, filled when the exact mass is measured) and microlensing (green points) are displayed in a mass-period diagram. The red dotted line is the mean detection completeness limit for radial velocity. Exoplanets are plotted as black dots for reference. *Right panel:* Detections above the red dashed line in the previous diagram are used to calculate a non-parametric, two-dimensional probability density function fitting the brown dwarfs mass-period distribution. The resulting density reveals a structured brown dwarf landscape (see abstract), clearly indicating that different formation (or destruction) mechanisms are shaping the brown dwarf desert.

Collisional modelling of the AU Microscopii debris disc

Ch. Schüppler[1], *T. Löhne*[1], *A. V. Krivov*[1], *S. Ertel*[2], *J. P. Marshall*[3,4], *S. Wolf*[5], *M. C. Wyatt*[6], *J.-C. Augereau*[7,8], *S. A. Metchev*[9]

[1] Astrophysikalisches Institut und Universitätssternwarte, FSU Jena, Schillergäßchen 2-3, 07745 Jena, Germany
[2] European Southern Observatory, Alonso de Cordova 3107, Vitacura, Casilia 19001, Santiago, Chile
[3] School of Physics, University of New South Wales, NSW 2052 Sydney, Australia
[4] Australian Centre for Astrobiology, University of New South Wales, NSW 2052 Sydney, Australia
[5] Institut für Theoretische Physik und Astrophysik, CAU Kiel, Leibnizstraße 15, 24098 Kiel, Germany
[6] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK
[7] Univ. Grenoble Alpes, IPAG, F-38000 Grenoble, France
[8] CNRS, IPAG, F-38000 Grenoble, France
[9] Univ. of Western Ontario, Department of Physics and Astronomy, 1151 Richmond Avenue, London, ON N6A 3K7, Canada

Astronomy & Astrophysics, in press (arXiv:1506.04564)

AU Microscopii's debris disc is one of the most famous and best-studied debris discs and one of only two resolved debris discs around M stars. We perform in-depth collisional modelling of the AU Mic disc including stellar radiative and corpuscular forces (stellar winds), aiming at a comprehensive understanding of the dust production and the dust and planetesimal dynamics in the system. Our models are compared to a suite of observational data for thermal and scattered light emission, ranging from the ALMA radial surface brightness profile at 1.3 mm to spatially resolved polarisation measurements in the visible. Most of the data are shown to be reproduced with dust production in a belt of planetesimals with an outer edge at around 40 au and subsequent inward transport of dust by stellar winds. A low dynamical excitation of the planetesimals with eccentricities up to 0.03 is preferred. The radial width of the planetesimal belt cannot be constrained tightly. Belts that are 5 au and 17 au wide, as well as a broad 44 au-wide belt, are consistent with observations. All models show surface density profiles that increase with distance from the star up to ≈ 40 au, as inferred from observations. The best model is achieved by assuming a stellar mass loss rate that exceeds the solar one by a factor of 50. While the spectral energy distribution and the shape of the ALMA radial profile are reproduced well, the scattered light observations deviate from the models more strongly. The observations show a bluer disc colour and a lower degree of polarisation for projected distances < 40 au than predicted by the models. The problem may be mitigated by irregularly shaped dust grains that have scattering properties different from the Mie spheres used in this work. From tests with a handful of selected dust materials, we derive a preference for mixtures of silicate, carbon, and ice of moderate porosity. We also address the origin of the unresolved central excess emission detected by ALMA and show that it cannot stem from an additional inner belt alone. Instead, it should derive, at least partly, from the chromosphere of the central star.

Download/Website: `http://cdsads.u-strasbg.fr/abs/2015arXiv150604564S`

Contact: `christian.schueppler@uni-jena.de`

Sublimation-induced orbital perturbations of extrasolar active asteroids and comets: application to white dwarf systems

D. Veras[1], *S. Eggl*[2], *B.T. Gänsicke*[1]

[1] Department of Physics, University of Warwick, Coventry CV4 7AL, UK
[2] IMCCE Observatroire de Paris, Univ. Lille 1, UPMC, 77 Av. Denfert-Rochereau, 75014 Paris, France

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1506.07174)

The metal budgets in some white dwarf (WD) atmospheres reveal that volatile-rich circumstellar bodies must both exist in extrasolar systems and survive the giant branch phases of stellar evolution. The resulting behaviour of these active asteroids or comets which orbit WDs is not well-understood, but may be be strongly influenced by sublimation due to stellar radiation. Here we develop a model, generally applicable to any extrasolar system with a main sequence or WD star, that traces sublimation-induced orbital element changes in approximately km-sized extrasolar minor planets and comets traveling within hundreds of au. We derive evolution equations on orbital timescales and for arbitrarily steep power-law sublimation dependencies on distance, and place our model in a Solar system context. We also demonstrate the importance of coupling sublimation and general relativity, and the orbital consequences of outgassing in arbitrary directions. We prove that nongravitational accelerations alone cannot result in orbit crossing with the WD disruption radius, but may shrink or expand the orbit by up to several au after a single pericentre passage, potentially affecting subsequent interactions with remnant debris and planets. Our analysis suggests that extant planets must exist in polluted WD systems.

Download/Website: `http://arxiv.org/abs/1506.07174`

Contact: `d.veras@warwick.ac.uk`

3 Jobs and Positions

PhD-level research fellowship

Nuno Santos & Mário Monteiro
Institute of Astrophysics and Space Sciences, Universidade do Porto, Portugal

Institute of Astrophysics and Space Sciences, Universidade do Porto, Portugal, 1 October 2015

The Institute of Astrophysics and Space sciences opens up to two PhD-level positions in the field of planetary systems and up to two PhD-level positions in the field of stars and star formation. Detailed information can be found in the link below. Note the application deadlines: *5th July* for the first thematic line and *25th July* for the second.

Download/Website: `http://www.iastro.pt/ia/jobs.html`

Contact: `pedro.figueira@astro.up.pt`

PhD position: Participation to the SPECULOOS search for terrestrial planets

Dr. Michaël Gillon
University of Liège, Allée du 6 Août, 17 - Bât B5C, 4000 Liège, Belgium

University of Liège, Belgium, August 15, 2015

The University of Liege, Belgium, invites applications for a 4-yr PhD position in the fields of exoplanets and ultra-cool dwarfs variability. The successful applicant is expected to work on the data analysis and scientific aspects of the new photometric survey SPECULOOS, involving scientists in Belgium, UK, Saudi Arabia, and Morocco.

SPECULOOS (Search for habitable Planets EClipsing ULtra-cOOl Stars) is a new astronomical project aiming to search for terrestrial planets transiting the smallest stars (< 0.2 Rsun) and the brightest brown dwarfs of the solar neighborhood. This concept is motivated by the unique possibility to study the detected planets in detail with future giant observatories like the E-ELT or JWST. The exoplanets discovered by SPECULOOS should thus provide an opportunity to study the atmosphere of extrasolar worlds similar in size to our Earth, notably to search for traces of biological activities. The core of the project will be the SPECULOOS-facility, a new observatory composed of four robotic 1m telescopes that will be installed at ESO Paranal Observatory, Chile, in 2016. It will be supported by the TRAPPIST network composed of two robotic 60cm telescopes, one in operation at ESO La Silla Observatory since 2010, and one soon in construction at Oukaïmeden Observatory, Morocco.

The selected PhD student will focus her/his work on optimizing the observational strategy of the survey, and on developing/testing the tools and methods to correct data from the instrumental effects and from the variability of ultra-cool dwarfs. The main goals of this PhD will be to optimize the sensitivity of SPECULOOS to small planets and to make possible drawing the strongest scientific inferences on the monitored ultra-cool dwarfs and the detected transiting planets.

Basic knowledge in programming, observational astronomy, and exoplanets is desirable. The sought applicant should have a strong motivation to acquire a significant expertise in robotic astronomy, software development, numerical data analysis, high-precision photometry, exoplanet detection, and ultra-cool dwarfs variability. The first part of the PhD thesis will be devoted to the optimization of the observational strategy of SPECULOOS based on simulations and observations gathered by its prototype survey on TRAPPIST at La Silla. In a second phase, the PhD will focus on collecting, possibly coding, and testing a large range of algorithms for ground-based photometry and variability/noise modelling (or detrending). The last phase of the PhD will focus on drawing scientific inferences on the detected transiting planets and on the statistics, nature, and origin of activity of ultra-cool dwarfs, basing on SPECULOOS photometry.

Terms: The applicant will work under the direct supervision of Dr. Michaël Gillon and Dr. Valérie Van Grootel, in close collaboration with the whole SPECULOOS team and with Prof. Adam Burgasser (UC San Diego, USA). The contract concerns a full 4-yr PhD. Starting date: October 1st, 2015. Monthly payment: $\sim$ 1900 Euro (net salary, including holidays, healthcare and retirement fees). Travel grants (conferences, on site mission) and equipment (laptop, desktop computer) will be provided to the applicant. Candidates should attach a CV and two letters of recommendation to their applications.

Download/Website: `http://www.orca.ulg.ac.be/SPECULOOS/`

Contact: `michael.gillon@ulg.ac.be`

PhD position: Characterization of the ultra-cool dwarfs observed by SPECULOOS

Dr. V. Van Grootel
University of Liège, Allée du 6 Août, 17 - Bât B5C, 4000 Liège, Belgium

University of Liège, Belgium, August 15, 2015

The University of Liege, Belgium, invites applications for a 4-yr PhD position in the fields of exoplanets and ultra-cool dwarfs. The successful applicant is expected to work on the characterization of the ultra-cool dwarfs observed by the new photometric survey SPECULOOS, involving scientists in Belgium, UK, Saudi Arabia, and Morocco.

SPECULOOS (Search for habitable Planets EClipsing ULtra-cOOl Stars) is a new astronomical project aiming to search for terrestrial planets transiting the smallest stars (< 0.2 Rsun) and the brightest brown dwarfs of the solar neighborhood. This concept is motivated by the unique possibility to study the detected planets in detail with future giant observatories like the E-ELT or JWST. The exoplanets discovered by SPECULOOS should thus provide an opportunity to study the atmosphere of extrasolar worlds similar in size to our Earth, notably to search for traces of biological activities. The core of the project will be the SPECULOOS-facility, a new observatory composed of four robotic 1m telescopes that will be installed at ESO Paranal Observatory, Chile, in 2016. It will be supported by the TRAPPIST network composed of two robotic 60cm telescopes, one in operation at ESO La Silla Observatory since 2010, and one soon in construction at Oukaïmeden Observatory, Morocco.

The proposed PhD thesis is dedicated to the development of tools required to characterize thoroughly the SPECULOOS exoplanet host stars. Indeed, accurate stellar modeling is crucial for exoplanet characterization. The mass and the radius of an exoplanet are only measured relative to those of their host star, while the age of the star is the best proxy for the age of its exoplanets.

The main aim of the PhD project is to develop stellar structure models for the SPECULOOS targets incorporating the most recent improvements in the low-mass ultra-cool regime (e.g. most recent model atmospheres as surface boundary conditions, state-of-the-art equation of state, recent results from 3D simulations). These stellar models will be extensively tested by comparing when possible their results with those obtained by independent methods (interferometry, ultra-cool stars in binaries, parallax measurements, etc.). The PhD candidate will also develop expertise in the knowledge, test and application of more direct methods, if available, to derive some stellar parameters: empirical/semi-empirical relations to derive mass and radius, parallaxes in combination with spectroscopic estimates to derive radius, etc.

These accurate stellar parameters for the SPECULOOS targets will directly feed light curves analysis in order to derive accurate planet parameters. The PhD student will be fully involved in the SPECULOOS project, including for remote observations (e.g. building night observing programs, starting telescopes, checking data quality) and for yearly maintenance on sites.

Terms: This 4-year PhD project is fully funded through an ULg PhD grant starting the 1st October 2015. The applicant will work under the direct supervision of Dr. V. Van Grootel in close collaboration with the stellar physics team at University of Liege and the whole SPECULOOS team. Monthly payment: $\sim$1900 Euro (net salary, including holidays, healthcare and retirement fees). Grants for travels (conferences and on site maintenance) and full equipment (desktop, laptop, HPC servers) are available. Candidates should attach a CV and two letters of recommendation to their applications.

Download/Website: `http://www.orca.ulg.ac.be/SPECULOOS/`

Contact: `valerie.vangrootel@ulg.ac.be`

Postdoctoral position: Participation to the SPECULOOS search for terrestrial planets

Dr. Michaël Gillon
University of Liège, Allée du 6 Août, 17 - Bât B5C, 4000 Liège, Belgium

University of Liège, Belgium, November 1st, 2015

The University of Liege, Belgium, invites applications for a postdoctoral research position in the fields of exoplanets and ultra-cool dwarfs. The successful applicant is expected to work on all operational and scientific aspects of the new photometric survey SPECULOOS, involving scientists in Belgium, UK, Saudi Arabia, and Morocco.

SPECULOOS (Search for habitable Planets EClipsing ULtra-cOOl Stars) is a new astronomical project aiming to search for terrestrial planets transiting the smallest stars (< 0.2 Rsun) and the brightest brown dwarfs of the solar neighborhood. This concept is motivated by the unique possibility to study the detected planets in detail with future giant observatories like the E-ELT or JWST. The exoplanets discovered by SPECULOOS should thus provide an opportunity to study the atmosphere of extrasolar worlds similar in size to our Earth, notably to search for traces of biological activities. The core of the project will be the SPECULOOS-facility, a new observatory composed of four robotic 1m telescopes that will be installed at ESO Paranal Observatory, Chile, in 2016. It will be supported by the TRAPPIST network composed of two robotic 60cm telescopes, one in operation at ESO La Silla Observatory since 2010, and one soon in construction at Oukaïmeden Observatory, Morocco.

Knowledge in the fields of exoplanets, ultra-cool dwarfs, and robotic telescopes is desirable, but not mandatory. Advantage will be given to applicants with any (or all) of these skills: (i) good expertise with astronomical data analysis and high-precision photometry, (ii) good programming expertise in several languages (preferred: fortran, iraf, python), (iii) some expertise with robotic telescopes operations. Limited knowledge in these areas does not exclude any applicant, provided that she/he is motivated to learn quickly.

Duties: (a) supervision of the SPECULOOS data reduction; (b) supervision of the SPECULOOS database; (c) software developments related to (a) and (b); (d) supervision of the telescopes operation (including handling telescope malfunctioning), (e) participation to on-site installation and maintenance missions.

Research: will have to be based on the scientific exploitation of the photometric data gathered by the SPECULOOS telescopes (ultra-cool dwarfs variability, transiting planets detection and characterization).

Terms: The applicant will work under the direct supervision of Dr. Michaël Gillon, in close collaboration with the whole SPECULOOS team. The contract is for one year, renewable for one year depending on mutual satisfaction. Starting date: January 1st, 2016. Monthly payment: $\sim$2250 Euro (net salary, including holidays, healthcare and retirement fees). Travel grants (conferences, on site missions) and equipment (laptop, desktop computer) will be provided to the applicant. Candidates should attach a CV, a list of publications, and two letters of recommendation to their applications.

Download/Website: `http://www.orca.ulg.ac.be/SPECULOOS/`

Contact: `michael.gillon@ulg.ac.be`

Postdoctoral position: Participation to the CHEOPS exoplanet mission

Dr. Michaël Gillon
University of Liège, Allée du 6 Août, 17 - Bât B5C, 4000 Liège, Belgium

University of Liège, Belgium, September 1st, 2015

The University of Liege, Belgium, invites applications for a postdoctoral research position in the field of exoplanets. The successful applicant is expected to work on the development of the data analysis pipeline of the CHEOPS space mission, in which the University of Liege is strongly involved.

CHEOPS (CHaracterising ExOPlanets Satellite) is the first space mission of the new 'S-class' of the European Space Agency (ESA). Due to launch end 2017, it is also the first space mission dedicated to searching for exoplanetary transits by performing ultra-high precision photometry on bright stars already known to host planets. The mission's main science goals are to measure the bulk density of super-Earths and Neptunes orbiting bright stars and provide suitable targets for future in-depth characterization studies of exoplanets in these mass and size ranges.

The successful applicant will work at Liege under the supervision of Dr. Michal Gillon, in close collaboration with the CHEOPS science team. Her/his work will focus on contributing to develop a Bayesian analysis pipeline optimized for the global analysis of the CHEOPS photometry and of additional external data. In a first step, the applicant will explore a large range of algorithms and models. In a second step, she/he will code the selected algorithms and model into a user-friendly pipeline. This work will be assisted at Liege by a computer scientist and by other scientists involved in CHEOPS, and with strong interactions with external members of the CHEOPS science team.

Knowledge in the fields of general astronomy and exoplanets is desirable, but not mandatory. Advantage will be given to applicants with any (or all) of these skills: (i) good expertise with Bayesian analysis of astronomical data, (ii) some expertise with the analysis of space-based high-precision time-series photometry, (iii) good programming expertise, especially in modern Fortran. Limited knowledge in these areas does not exclude any applicant, provided that she/he is motivated to learn quickly.

Research: in parallel to her/his work on the CHEOPS data analysis pipeline, the successful applicant will be allowed to dedicate up to 1/3rd of her/his time to other scientific projects, suggested to be related to that of the Liege exoplanet group (transiting planets detection and characterization) but which could also be chosen independently.

Terms: The applicant will work under the direct supervision of Dr. Michaël Gillon, in close collaboration with the whole CHEOPS science team. The contract is for one year, renewable for one year depending on mutual satisfaction. Starting date: October 1st, 2015 or latter. Monthly payment: ~ 2250 Euro (net salary, including holidays, healthcare and retirement fees). Travel grants (conferences, on site missions) and equipment (laptop, desktop computer) will be provided to the applicant. Candidates should attach a CV, a list of publications, and two letters of recommendation to their applications.

Download/Website: `http://sci.esa.int/cheops/`

Contact: `michael.gillon@ulg.ac.be`

4 Conference announcements

COSPAR Capacity Building Workshop – "Planetary data mission analysis"

Carlos Gabriel
XMM-Newton Science Operations Centre, European Space Agency (ESA), European Space Astronomy Centre (ESAC) P.O. Box 78, 28691 Villanueva de la Cañada, Madrid, SPAIN

UNESP, Guaratinguetá, Brazil, 26 October – 6 November

The registration to the COSPAR Capacity Building workshop "Planetary data mission analysis" is open until 17 July. The workshop will take place in the city of Guaratinguetá, Sao Paulo state, Brazil, from October 26 to November 6

Download/Website: `http://cbw.cosparbrazil2015.org`

Contact: `carlos.gabriel@esa.int`

K2 Sci Con: Featuring Exoplanets and Astrophysics from K2, Kepler, and Tess

R. Street
Las Cumbres Observatory Global Telescope Network (LCOGT), Santa Barbara, CA, USA

Santa Barbara, CA, November 2-5, 2015

Registration and abstract submission are now open for the K2 Science Conference (K2SciCon) which will be held at the Fess Parker Hotel in Santa Barbara, CA from November 2-5.

Hosted by the LCOGT, K2SciCon will celebrate the science from the first year of the K2 mission. All K2 users are welcome to present early scientific results from all areas of research, from our own Solar System and exoplanets, to young stars and distant galaxies. We will hear updates on the mission and discuss the latest in data processing techniques. We also encourage contributions on results from the Kepler prime mission and the future TESS mission.

Please note that September 18 is the deadline for early registration, abstract submission, as well as the hotel reservation deadline to get the special conference rate.

Download/Website: `http://lcogt.net/k2scicon/`

Contact: `k2scicon-loc@lcogt.net`

5 Conference reports

CHEOPS Science Workshop #3: contributions are on-line

D. Barrado[1], J. Lillo-Box[1], M. Morales[1], E. Pallé[2], I. Ribas[3], R. Alonso[2], N. Huélamo[1], H. Bouy[1], F. Galindo[1]. D. Queloz[4], the CHEOPS Science Team.

[1] Centro de Astrobiología (INTA-CSIC), Madrid, SPAIN
[2] Instituto de Astrofísica de Canarias, La Laguna, SPAIN
[3] Institut de Ciències de l'Espai (CSIC-IEEC), Barcelona, SPAIN
[4] Cavendish Laboratory, Cambridge, UK

Madrid, Spain, June 17-19, 2015

The CHEOPS Science Workshop #3 has brought together a large community of researchers interested in the preparation and exploitation of the CHEOPS mission. The meeting was open to anyone and developed in a very nice environment. CHEOPS, a European Space Agency mission, will be the first once dedicated to search for transits by means of ultrahigh precision photometry on bright stars already known to host planets. The launch is planned in late 2017. Participants presented contributed talks on all scientific aspects relevant for CHEOPS including synergies with other facilities (JWST, Kepler, GAIA, TESS, Calar Alto, ESO, La Palma, etc). The workshop was held in central Madrid, Spain, in June 17-19, 2015, very close to cultural heart of the city, at the headquarters of the Spanish Centre for Industrial Technological Development (CDTI). The program included invited talks and oral contributions. The pdf files with the presnetations are included. The meeting was organized by the Center of Astrobiology (CAB, INTA-CSIC), in collaboration with the CDTI, the IAC (Tenerife) and the IEEC (Barcelona).
The meeting is open to everyone.
LOC:
D. Barrado (chair), J. Lillo-Box, M. Morales, E. Pallé, I. Ribas, R. Alonso, N. Huélamo, H. Bouy, F. Galindo.
SOC:
Didier Queloz, D. Ehrenreich, D. Barrado, and CHEOPS Science team.
Program and Contributions on-line:
http://www.laeff.cab.inta-csic.es/users/barrado/0_CHEOPS2015/index.html

Download/Website: `http://www.iac.es/congreso/cheops2015/`

Contact: `cheops2015@iac.es`

6 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during June 2015. If you see any that we missed, please let us know and we'll include them in the next issue.

astro-ph/1506.00430 : **The accumulation and trapping of grains at planet gaps: effects of grain growth and fragmentation** by *J.-F Gonzalez et al.*
astro-ph/1506.00993 : **Asteroid flux towards circumprimary habitable zones in binary star systems: I. Statistical Overview** by *D. Bancelin, et al.*
astro-ph/1506.01004 : **Observational and Theoretical study of the inner region of HH 30** by *Maria Carolina Duran-Rojas*
astro-ph/1506.01007 : **The Transitional Disk around IRAS 04125+2902** by *C. Espaillat, et al.*
astro-ph/1506.01084 : **WHFast: A fast and unbiased implementation of a symplectic Wisdom-Holman integrator for long term gravitational simulations** by *Hanno Rein, Daniel Tamayo*

astro-ph/1506.01274 : **On the possibility of cosmic ray-induced ionizing radiation-powered life in subsurface environments in the Universe** by *Dimitra Atri*

astro-ph/1506.01334 : **HATS-8b: A Low-Density Transiting Super-Neptune** by *D. Bayliss, et al.*

astro-ph/1506.01382 : **Migration of two massive planets into (and out of) first order mean motion resonances** by *Katherine M. Deck, Konstantin Batygin*

astro-ph/1506.01420 : **Global Modeling of Nebulae with Particle Growth, Drift and Evaporation Fronts. I: Methodology and Typical Results** by *Paul R. Estrada, Jeffrey N. Cuzzi, Demitri A. Morgan*

astro-ph/1506.01776 : **HAT-P-56b: An inflated massive Hot Jupiter transiting a bright F star followed up with K2.0 observations** by *C. X. Huang, et al.*

astro-ph/1506.02019 : **The first radial velocity measurements of a microlensing event: no evidence for the predicted binary** by *I. Boisse, et al.*

astro-ph/1506.02039 : **A triple origin for the lack of tight coplanar circumbinary planets around short-period binaries** by *Adrian S. Hamers, Hagai B. Perets, Simon F. Portegies Zwart*

astro-ph/1506.02049 : **Atmospheres of low-mass planets: the "boil-off"** by *James E. Owen, Yanqin Wu*

astro-ph/1506.02383 : **Sequential planet formation in the HD 100546 protoplanetary disk?** by *P. Pinilla, T. Birnstiel, C. Walsh*

astro-ph/1506.02471 : **WASP-121 b: a hot Jupiter in a polar orbit and close to tidal disruption** by *L. Delrez, et al.*

astro-ph/1506.03121 : **An Extreme-AO Search for Giant Planets around a White Dwarf –VLT/SPHERE performance on a faint target GD 50** by *S. Xu et al.*

astro-ph/1506.03548 : **Atmosphere expansion and mass loss of close-orbit giant exoplanets heated by stellar XUV: I. Modeling of hydrodynamic escape of upper atmospheric material** by *I. F. Shaikhislamov, et al.*

astro-ph/1506.03734 : **HAT-P-55b: A Hot Jupiter Transiting a Sun-like Star** by *D. Juncher et al.*

astro-ph/1506.03750 : **Stability of resonant configurations during the migration of planets and constraints on disk-planet interactions** by *J.-B. Delisle, A.C.M. Correia, J. Laskar*

astro-ph/1506.03793 : **Nuclear Fusion in the Deuterated cores of inflated hot Jupiters** by *Rachid Ouyed, Prashanth Jaikumar*

astro-ph/1506.03845 : **The Transiting Exoplanet Survey Satellite: Simulations of planet detections and astrophysical false positives** by *Peter W. Sullivan, et al.*

astro-ph/1506.04175 : **Terrestrial Planet Occurrence Rates for the Kepler GK Dwarf Sample** by *Christopher J. Burke, et al.*

astro-ph/1506.04373 : **Structures in circumbinary disks: Prospects for observability** by *Jan Philipp Ruge, et al.*

astro-ph/1506.04456 : **Using the Rossiter-McLaughlin effect to observe the transmission spectrum of Earth's atmosphere** by *Fei Yan, et al.*

astro-ph/1506.04564 : **Collisional modelling of the AU Microscopii debris disc** by *Ch. Schüppler, et al.*

astro-ph/1506.04829 : **Revisiting a gravity-darkened and precessing planetary system PTFO 8-8695: spin-orbit non-synchronous case** by *Shoya Kamiaka, et al.*

astro-ph/1506.04901 : **Radial velocity eclipse mapping of exoplanets** by *Nikolay Nikolov, Felix Sainsbury-Martinez*

astro-ph/1506.05097 : **A Definition for Giant Planets Based on the Mass-Density Relationship** by *Artie P. Hatzes Heike Rauer*

astro-ph/1506.05175 : **Tidally-driven Roche-Lobe Overflow of Hot Jupiters with MESA** by *Francesca Valsecchi et al.*

astro-ph/1506.05233 : **Numerically Predicted Indirect Signatures of Terrestrial Planet Formation** by *Zoë M. Leinhardt, et al.*

astro-ph/1506.05428 : **IRS Spectra of Debris Disks in the Scorpius-Centaurus OB Association** by *Hannah Jang-Condell, et al.*

astro-ph/1506.05464 : **Stability and fates of hierarchical two-planet systems** by *Cristobal Petrovich*
astro-ph/1506.05685 : **Transmission spectroscopy of the inflated exo-Saturn HAT-P-19b** by *M. Mallonn, et al.*
astro-ph/1506.05816 : **New Extinction and Mass Estimates of the Low-mass Companion 1RXS 1609 B with the Magellan AO System: Evidence of an Inclined Dust Disk** by *Ya-Lin Wu, et al.*
astro-ph/1506.06344 : **Gravitational quantization of exoplanet orbits in HD 10180, Kepler-32, Kepler-33, Kepler-102, and Kepler-186** by *Vassilis S. Geroyannis*
astro-ph/1506.06508 : **Response of Atmospheric Biomarkers to NOx-induced Photochemistry Generated by Stellar Cosmic Rays for Earth-like Planets in the Habitable Zone of M-Dwarf Stars** by *John Lee Grenfell, et al.*
astro-ph/1506.06529 : **Origin and Stability of Exomoon Atmospheres - Implications for Habitability** by *H. Lammer, et al.*
astro-ph/1506.06569 : **Outgassing History and Escape of the Martian Atmosphere and Water Inventory** by *H. Lammer, et al.*
astro-ph/1506.06592 : **Extreme hydrodynamic atmospheric loss near the critical thermal escape regime** by *N. V. Erkaev, et al.*
astro-ph/1506.06759 : **Simulated Photoevaporative Mass Loss from Hot Jupiters in 3D** by *Anjali Tripathi, et al.*
astro-ph/1506.06867 : **A Metallicity Recipe for Rocky Planets** by *Rebekah I. Dawson, Eugene Chiang, Eve J. Lee*
astro-ph/1506.07026 : **Evolution of circumbinary planets around eccentric binaries: The case of Kepler-34** by *Wilhelm Kley, Nader Haghighipour*
astro-ph/1506.07057 : **Vetting Kepler Planet Candidates in the Sub-Jovian Desert with Multi-Band Photometry** by *Knicole D. Colón, Robert C. Morehead, Eric B. Ford*
astro-ph/1506.07067 : **The mass of the Mars-sized exoplanet Kepler-138 b from transit timing** by *Daniel Jontof-Hutter, et al.*
astro-ph/1506.07144 : **The SOPHIE search for northern extrasolar planets VIII. A warm Neptune orbiting HD164595** by *B. Courcol, et al.*
astro-ph/1506.07174 : **Sublimation-induced orbital perturbations of extrasolar active asteroids and comets: application to white dwarf systems** by *Dimitri Veras, Siegfried Eggl, Boris T. Gaensicke*
astro-ph/1506.07187 : **A SMACK Model of Colliding Planetesimals and Dust in the β Pictoris Debris Disk: Thermal Radiation and Scattered Light** by *Erika R. Nesvold, Marc J. Kuchner*
astro-ph/1506.07200 : **UV Surface Environment of Earth-like Planets Orbiting FGKM Stars Through Geological Evolution** by *S. Rugheimer, et al.*
astro-ph/1506.07202 : **Effect of UV Radiation on the Spectral Fingerprints of Earth-like Planets Orbiting M dwarfs** by *S. Rugheimer, et al.*
astro-ph/1506.07304 : **A Gaussian process framework for modelling stellar activity signals in radial velocity data** by *Vinesh Rajpaul, et al.*
astro-ph/1506.07348 : **Outwards migration for planets in stellar irradiated 3D discs** by *E. Lega, et al.*
astro-ph/1506.07541 : **A giant comet-like cloud of hydrogen escaping the warm Neptune-mass exoplanet GJ 436b** by *David Ehrenreich, et al.*
astro-ph/1506.07994 : **Mass ratio of the 2 pc binary brown dwarf LUH16 and limits on planetary companions from astrometry** by *Johannes Sahlmann, Petro F. Lazorenko*
astro-ph/1506.08719 : **Follow-Up Observations of PTFO 8-8695: A 3 MYr Old T-Tauri Star Hosting a Jupiter-mass Planetary Candidate** by *David R. Ciardi, et al.*
astro-ph/1506.08850 : **OGLE-2012-BLG-0563Lb: a Saturn-mass Planet around an M Dwarf with the Mass Constrained by Subaru AO imaging** by *A. Fukui, et al.*
astro-ph/1506.09072 : **No evidence for activity correlations in the radial velocities of Kapteyn's star** by *Guillem Anglada-Escudé, et al.*