ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial **2**

2 Abstracts of refereed papers **2**
- Formation of Massive Rocky Exomoons by Giant Impact *Barr & Bruck Syal* . . . 2
- Formation of exomoons: a solar system perspective *Barr* . . . 3
- The Effect of Protoplanetary Disk Cooling Times on the Formation of Gas Giant Planets by Gravitational Instability *Boss* . . . 3
- A cautionary tale: limitations of a brightness-based spectroscopic approach to chromatic exoplanet radii *Cegla et al.* . . . 4
- Aeronomical constraints to the minimum mass and maximum radius of hot low-mass planets *Fossati, et al.* . . . 5
- Deceleration of high-velocity interstellar photon sails into bound orbits at α Centauri *Heller & Hippke* 5
- Binaries among low-mass stars in nearby young moving groups *Janson, Durkan et al.* . . . 7
- The Planetary Accretion Shock: I. Framework for Radiation-hydrodynamical Simulations and First Fesults *Marleau, et al.* . . . 8
- Highly inclined and eccentric massive planets. II. Planet-planet interactions during the disc phase *Sotiriadis, et al.* . . . 9
- Peculiar architectures for the WASP-53 and WASP-81 planet-hosting systems *Triaud et al.* . . . 10

3 Conference announcements **11**
- Exoplanet Science with Small Telescopes: Precise Radial Velocities *University of Pennsylvania, Philadelphia, PA, USA* . . . 11
- The physics of evolved stars *Nice, France* . . . 11
- Sessions to be held at the EGU General Assembly *Vienna, Austria* . . . 12
- Know Thy Star – Know Thy Planet: Assessing the Relevance of Ground-based High Resolution Imaging and Spectroscopy of Exoplanet Host Stars *Pasadena, CA USA* . . . 13
- EANA2017 (European Astrobiology Network Association) *Aarhus, Denmark* . . . 13
- 5th CHEOPS Science Workshop and The CHEOPS Open Time Workshop *Schloss Seggau, Austria* . . . 14
- Exoplanet Atmospheres - CRAQ Summer School *Montreal, Canada* . . . 15
- 2017 Sagan Summer Workshop: Microlensing in the Era of WFIRST *Pasadena, CA* . . . 16
- The Exoclipse Conference *Boise, Idaho USA* . . . 17

4 Jobs and positions **18**
- 2yr post-doctoral position in exoplanet research *Institute of Astronomy, University of Leuven, Belgium* 18
- PhD positions in Extra-solar Planets *Instituto de Astrofisica e Ciências do Espaço* . . . 19
- Three MSc-PhD Positions in Exoplanet Science *Institute for Research on exoplanets (iREx), Université de Montréal* . . . 20

5 Announcements **21**
– Invitation to apply for Cheops Science Team Associate *Queloz* 21

6 As seen on astro-ph **22**

1 Editorial

Welcome to the 94th edition of Exoplanet News. After an extended winter break, I'm pleased to see an extensive list of conference and workshop announcements this month.

If anyone has suggestions for additional things they would like to see included in the newsletter, please just submit them along with the usual abstracts, job adverts and announcement notices. I don't propose to write much extra content myself, but am happy to compile and edit what others provide!

best wishes
Andrew Norton

2 Abstracts of refereed papers

Formation of Massive Rocky Exomoons by Giant Impact

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:1701.02705)

The formation of satellites is thought to be a natural by-product of planet formation in our Solar System, and thus, moons of extrasolar planets (exomoons) may be abundant in extrasolar planetary systems, as well. Exomoons have yet to be discovered. However, moons larger than 0.1 Earth masses can be detected and characterized using current transit techniques. Here, we show that collisions between rocky planets with masses between a quarter to ten Earth masses can create impact-generated debris disks that could accrete into moons. Collisions between like-sized objects, at oblique impact angles, and velocities near escape speed create disks massive enough to form satellites that are dynamically stable against planetary tides. Impacts of this type onto a superearth between 2 to 7 Earth masses can launch into orbit enough mass to create a satellite large enough to be detected in *Kepler* transit data. Impact velocity is a crucial controlling factor on disk mass, which has been overlooked in all prior studies of moon formation via planetary collision.

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Formation of exomoons: a solar system perspective

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Astronomical Review, published (arXiv:1701.02125)

Satellite formation is a natural by-product of planet formation. With the discovery of numerous extrasolar planets, it is likely that moons of extrasolar planets (exomoons) will soon be discovered. Some of the most promising techniques can yield both the mass and radius of the moon. Here, I review recent ideas about the formation of moons in our Solar System, and discuss the prospects of extrapolating these theories to predict the sizes of moons that may be discovered around extrasolar planets. It seems likely that planet-planet collisions could create satellites around rocky or icy planets which are large enough to be detected by currently available techniques. Detectable exomoons around gas giants may be able to form by co-accretion or capture, but determining the upper limit on likely moon masses at gas giant planets requires more detailed, modern simulations of these processes.

Download/Website: https://www.researchgate.net/publication/312170607_Formation_of_Exomoons_A_Solar_System_Perspective; http://www.tandfonline.com/doi/full/10.1080/21672857.2017.1279469

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The Effect of Protoplanetary Disk Cooling Times on the Formation of Gas Giant Planets by Gravitational Instability

Alan P. Boss
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The Astrophysical Journal, in press

Observational evidence exists for the formation of gas giant planets on wide orbits around young stars by disk gravitational instability, but the roles of disk instability and core accretion for forming gas giants on shorter period orbits are less clear. The controversy extends to population synthesis models of exoplanet demographics and to hydrodynamical models of the fragmentation process. The latter refers largely to the handling of radiative transfer in three dimensional (3D) hydrodynamical models, which controls heating and cooling processes in gravitationally unstable disks, and hence dense clump formation. A suite of models using the β cooling approximation is presented here. The initial disks have masses of 0.091 $M_\odot$ and extend from 4 to 20 AU around a 1 $M_\odot$ protostar. The initial minimum Toomre Q_i values range from 1.3 to 2.7, while β ranges from 1 to 100. We show that the choice of Q_i is equal in importance to the β value assumed: high Q_i disks can be stable for small β, when the initial disk temperature is taken as a lower bound, while low Q_i disks can fragment for high β. These results imply that the evolution of disks toward low Q_i must be taken into account in assessing disk fragmentation possibilities, at least in the inner disk, i.e., inside about 20 AU. The models suggest that if low Q_i disks can form, there should be an as yet largely undetected population of gas giants orbiting G dwarfs between about 6 AU and 16 AU.

Download/Website: https://home.dtm.ciw.edu/users/boss/ftp/beta-cooling.pdf

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A cautionary tale: limitations of a brightness-based spectroscopic approach to chromatic exoplanet radii

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Astronomy & Astrophysics, published (2017A&A...598L...3C)

Determining wavelength-dependent exoplanet radii measurements is an excellent way to probe the composition of exoplanet atmospheres. In light of this, Borsa et al. (2016) sought to develop a technique to obtain such measurements by comparing ground-based transmission spectra to the expected brightness variations during an exoplanet transit. However, we demonstrate herein that this is not possible due to the transit light curve normalisation necessary to remove the effects of the Earth's atmosphere on the ground-based observations. This is because the recoverable exoplanet radius is set by the planet-to-star radius ratio within the transit light curve; we demonstrate this both analytically and with simulated planet transits, as well as through a reanalysis of the HD 189733 b data.

Download/Website: `http://adsabs.harvard.edu/abs/2017A%26A...598L...3C`

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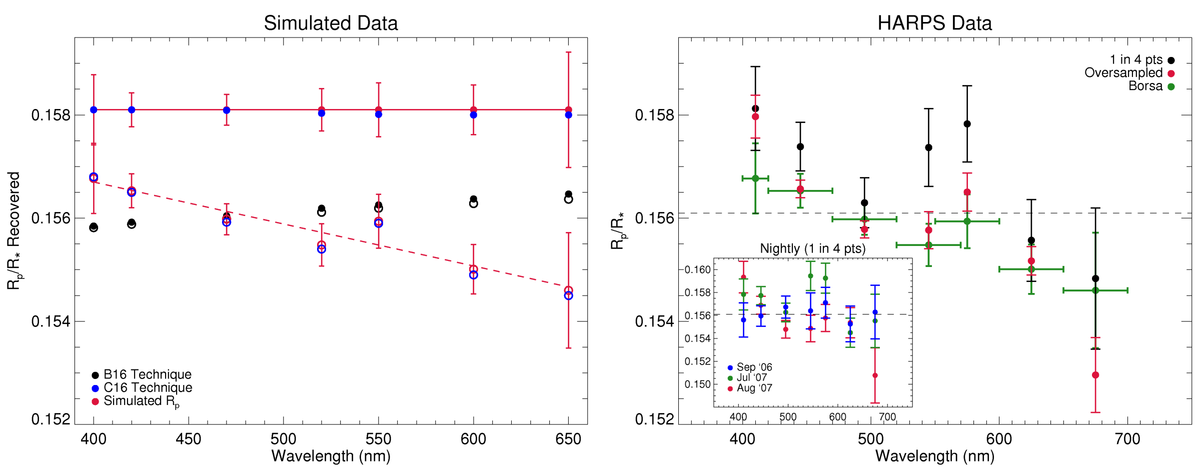

Figure 1: (Cegla et al.) *Left: Simulated* data and recovered planet radius, R_p, for each passband. Red points are the (injected) simulated R_p (error bars are those reported by Borsa et al. 2016 [B16] for comparison purposes only), black are the R_p recovered following B16, and blue are the R_p recovered using a passband-dependent light curve normalisation (as in Cegla et al. 2016 [C16]). Filled and hollow points represent when the simulated R_p was constant and when it varied, respectively. Linear fits to the simulated R_p are also shown for viewing ease. *Right: HARPS* data and recovered R_p. Results from B16 are in green (wavelength error bars represent the passband region), and our reanalysis is in red when using oversampled CCFs and in black when using properly sampled CCFs (i.e. only one in four points). *Subplot:* Nightly recovered R_p when using properly sampled CCFs (night indicated by colour). Horizontal dashed lines show the mean R_p recovered by the B16 method on the simulated data (i.e. the black points in the *Left* plot)

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Aeronomical constraints to the minimum mass and maximum radius of hot low-mass planets

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Astronomy & Astrophysics, in press (arXiv:1612.05624)

Stimulated by the discovery of a number of close-in low-density planets, we generalise the Jeans escape parameter taking hydrodynamic and Roche lobe effects into account. We furthermore define Λ as the value of the Jeans escape parameter calculated at the observed planetary radius and mass for the planet's equilibrium temperature and considering atomic hydrogen, independently of the atmospheric temperature profile. We consider 5 and 10 $M_\oplus$ planets with an equilibrium temperature of 500 and 1000 K, orbiting early G-, K-, and M-type stars. Assuming a clear atmosphere and by comparing escape rates obtained from the energy-limited formula, which only accounts for the heating induced by the absorption of the high-energy stellar radiation, and from a hydrodynamic atmosphere code, which also accounts for the bolometric heating, we find that planets whose Λ is smaller than 15–35 lie in the "boil-off" regime, where the escape is driven by the atmospheric thermal energy and low planetary gravity. We find that the atmosphere of hot (i.e. $T_{\rm eq} > 1000$ K) low-mass ($M_{\rm pl} < 5\,M_\oplus$) planets with $\Lambda <$ 15–35 shrinks to smaller radii so that their Λ evolves to values higher than 15–35, hence out of the boil-off regime, in less than ≈500 Myr. Because of their small Roche lobe radius, we find the same result also for hot (i.e. $T_{\rm eq} > 1000$ K) higher mass ($M_{\rm pl} < 10\,M_\oplus$) planets with $\Lambda <$ 15–35, when they orbit M-dwarfs. For old, hydrogen-dominated planets in this range of parameters, Λ should therefore be ≥15–35, which provides a strong constraint on the planetary minimum mass and maximum radius and can be used to predict the presence of aerosols and/or constrain planetary masses, for example.

Download/Website: `http://arxiv.org/abs/1612.05624`

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Deceleration of high-velocity interstellar photon sails into bound orbits at α Centauri

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Astrophysical Journal Letters, DOI:10.3847/2041-8213/835/2/L32

At a distance of about 4.22 ly, it would take about 100,000 years for humans to visit our closest stellar neighbor Proxima Centauri using modern chemical thrusters. New technologies are now being developed that involve high-power lasers firing at 1 gram solar sails in near-Earth orbits, accelerating them to 20 % the speed of light (c) within minutes. Although such an interstellar probe could reach Proxima 20 years after launch, without propellant to slow it down it would traverse the system within hours. Here we demonstrate how the stellar photon pressures of the stellar triple α Cen A, B, and C (Proxima) can be used together with gravity assists to decelerate incoming solar sails from Earth. The maximum injection speed at α Cen A to park a sail with a mass-to-surface ratio (σ) similar to graphene ($7.6 \times 10^{-4}\,\mathrm{gram\,m^{-2}}$) in orbit around Proxima is about $13,800\,\mathrm{km\,s^{-1}}$ ($4.6\,\%\,c$), implying travel times from Earth to α Cen A and B of about 95 years and another 46 years (with a residual velocity of $1280\,\mathrm{km\,s^{-1}}$) to Proxima. The

size of such a low-σ sail required to carry a payload of 10 grams is about $10^5\,\mathrm{m}^2 = (316\,\mathrm{m})^2$. Such a sail could use solar photons instead of an expensive laser system to gain interstellar velocities at departure. Photogravitational assists allow visits of three stellar systems and an Earth-sized potentially habitable planet in one shot, promising extremely high scientific yields.

Download/Website: `http://dx.doi.org/10.3847/2041-8213/835/2/L32`

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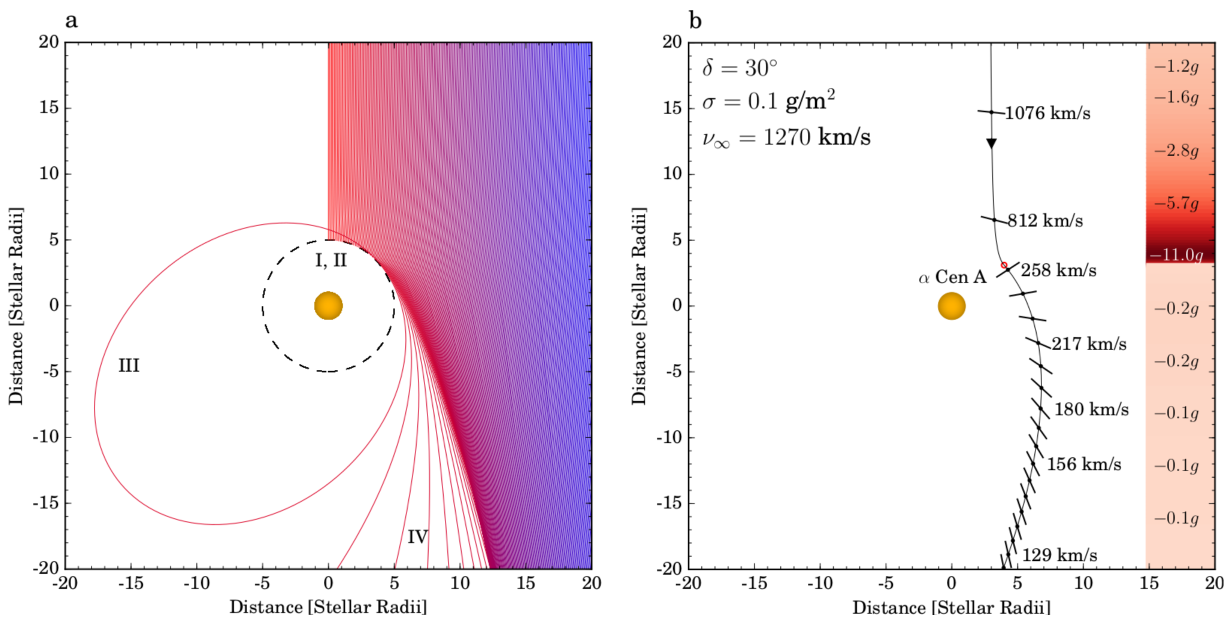

Figure 2: (Heller & Hippke) Fly-by at α Cen A. The orange star is located in the origin of the coordinate system. (a) The dashed circle indicates our nominal distance of closest approach, $r_{\mathrm{min}} = 5\,R_\star$. The colored curves illustrate an iteration of our numerical computer code over various initial impact trajectories from Earth for a 1 gram/10 m^2 sail with an initial speed of $1270\,\mathrm{km\,s}^{-1}$. Trajectory types I to IV are labeled. (b) Example trajectory of the same sail with its instantaneous speed shown along the trajectory in steps of 120 minutes. The sail's orientation is depicted by a black line, the direction of flight is indicated with an arrow at the top, and r_{min} is highlighted with a red open circle. The total time required by the sail to traverse this panel is 48 hr. The sail's deflection angle, mass-per-area ratio, and injection speed for this example are shown in the top left corner. The instantaneous acceleration of the sail is shown in the color bar at the right, using units of the Earth's surface acceleration $g = 9.81\,\mathrm{m\,s}^{-2}$.

Binaries among low-mass stars in nearby young moving groups

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Astronomy & Astrophysics, Accepted (arXiv:1612.02443)

The solar galactic neighbourhood contains a number of young co-moving associations of stars (so-called 'young moving groups') with ages of $\sim 10 - 150$ Myr, which are prime targets for a range of scientific studies, including direct imaging planet searches. The late-type stellar population of such groups still remain in their pre-main sequence phase, and are thus well suited for purposes such as isochronal dating. Close binaries are particularly useful in this regard, since they allow for a model-independent dynamical mass determination. Here we present a dedicated effort to identify new close binaries in nearby young moving groups, through high-resolution imaging with the AstraLux Sur Lucky Imaging camera. We surveyed 181 targets, resulting in the detection of 61 companions or candidates, of which 38 are new discoveries. An interesting example of such a case is 2MASS J00302572-6236015 AB, which is a high-probability member of the Tucana-Horologium moving group, and has an estimated orbital period of less than 10 years. Among the previously known objects is a serendipitous detection of the deuterium burning boundary circumbinary companion 2MASS J01033563-5515561 (AB)b in the z'-band, thereby extending the spectral coverage for this object down to near-visible wavelengths.

Download/Website: `https://arxiv.org/abs/1612.02443`

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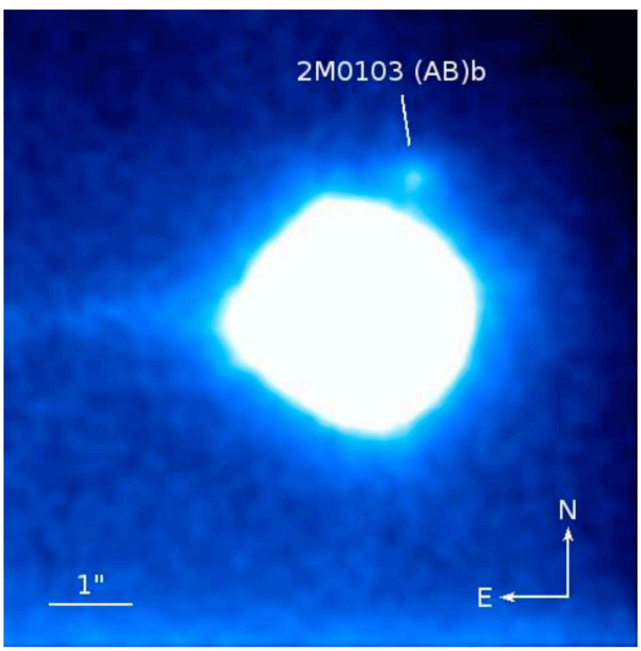

Figure 3: (Janson, Durkan et al.) AstraLux z' image of the 2M0103 system. Smoothing with a Gaussian kernel has been applied to better show the faint very low-mass companion first reported in Delorme et al. (2013).

The Planetary Accretion Shock: I. Framework for Radiation-hydrodynamical Simulations and First Fesults

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The Astrophysical Journal, in press (arXiv:1701.02747)

The key aspect determining the post-formation luminosity of gas giants has long been considered to be the energetics of the accretion shock at the planetary surface. We use 1D radiation-hydrodynamical simulations to study the radiative loss efficiency and to obtain post-shock temperatures and pressures and thus entropies. The efficiency is defined as the fraction of the total incoming energy flux which escapes the system (roughly the Hill sphere), taking into account the energy recycling which occurs ahead of the shock in a radiative precursor. We focus here on a constant equation of state to isolate the shock physics but use constant and tabulated opacities. While robust quantitative results will require a self-consistent treatment including hydrogen dissocation and ionization, the results show the correct qualitative behavior and can be understood semi-analytically. The shock is found to be isothermal and supercritical for a range of conditions relevant to core accretion (CA), with Mach numbers greater than ca. 3. Across the shock, the entropy decreases significantly, by a few entropy units ($k_{\rm B}$/baryon). While nearly 100 percent of the incoming kinetic energy is converted to radiation locally, the efficiencies are found to be as low as roughly 40 percent, implying that a meaningful fraction of the total accretion energy is brought into the planet. For realistic parameter combinations in the CA scenario, a non-zero fraction of the luminosity always escapes the system. This luminosity could explain, at least in part, recent observations in the LkCa 15 and HD 100546 systems.

Download/Website: `https://arxiv.org/abs/1701.02747`

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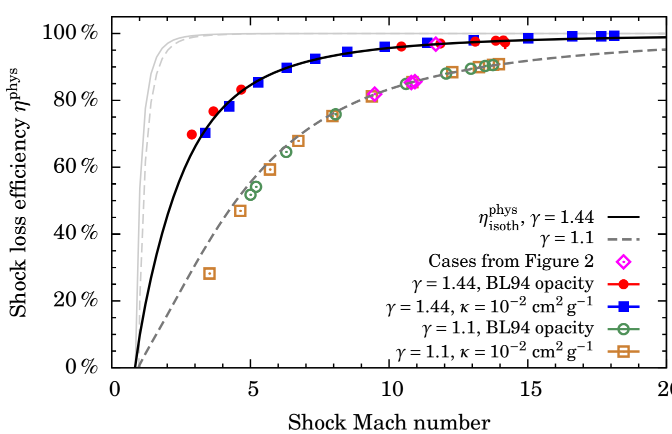

Figure 4: (Marleau et al.) Physical loss efficiency $\eta^{\rm phys}$ of the radiative accretion shock (see Equation (18)). The limit $\eta^{\rm phys} = 0$ corresponds to all the incoming energy being absorbed (no loss), while $\eta^{\rm phys} = 100$ percent means that the kinetic energy of the gas entirely leaves the accretion flow onto the planet. The diamonds display the efficiency for the cases shown in Figure 2. The other points come from considering a range of accretion rates $\dot{M} = 10^{-5}$–10^{-2} $M_\oplus\,{\rm yr}^{-1}$, masses $M_{\rm p} \approx 0.3$–$10\ M_{\rm J}$, and planetary radii $R_{\rm p} \approx 1$–$20\ R_{\rm J}$. Both constant and tabulated opacities are used as indicated in the legend. The last four groups of points (see legend) all take $\mu = 2.353$. The results match the analytical result for an isothermal shock at the measured Mach number (Equation (34), from Commerçon et al. 2011), for $\gamma = 1.44$ and $\gamma = 1.1$ (*solid black and dashed dark gray curves, respectively*).

Highly inclined and eccentric massive planets. II. Planet-planet interactions during the disc phase

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Astronomy & Astrophysics, in press (arxiv:1612.02693)

Observational evidence indicates that the orbits of extrasolar planets are more various than the circular and coplanar ones of the Solar system. Planet-planet interactions during migration in the protoplanetary disc have been invoked to explain the formation of these eccentric and inclined orbits. However, our companion paper (Paper I) on the planet-disc interactions of highly inclined and eccentric massive planets has shown that the damping induced by the disc is significant for a single massive planet, leading the planet back to the midplane with its eccentricity possibly increasing over time. In this paper, we investigate the influence of the eccentricity and inclination damping due to planet-disc interactions on the final configurations of the systems, generalizing previous studies on the combined action of the gas disc and planet-planet scattering during the disc phase. Instead of the simplistic K-prescription, our n-body simulations adopt the damping formulae for eccentricity and inclination provided by the hydrodynamical simulations of our companion paper. We follow the orbital evolution of 11000 numerical experiments of three giant planets in the late stage of the gas disc, exploring different initial configurations, planetary mass ratios and disc masses. The dynamical evolutions of the planetary systems are studied along the simulations, with a particular emphasis on the resonance captures and inclination-growth mechanisms. Most of the systems are found with small inclinations ($\leq 10°$) at the dispersal of the disc. Even though many systems enter an inclination-type resonance during the migration, the disc usually damps the inclinations on a short timescale. Although the majority of the multiple systems in our simulations are quasi-coplanar, $\sim 5\%$ of them end up with high mutual inclinations ($\geq 10°$). Half of these highly mutually inclined systems result from two- or three-body mean-motion resonance captures, the other half being produced by orbital instability and/or planet-planet scattering. When considering the long-term evolution over 100 Myr, destabilization of the resonant systems is common, and the percentage of highly mutually inclined systems still evolving in resonance drops to 30%. Finally, the parameters of the final system configurations are in very good agreement with the semi-major axis and eccentricity distributions in the observations, showing that planet-planet interactions during the disc phase could have played an important role in sculpting planetary systems.

Download/Website: `https://arxiv.org/abs/1612.02693`

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Peculiar architectures for the WASP-53 and WASP-81 planet-hosting systems

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:1612.04166)

We report the detection of two new systems containing transiting planets. Both were identified by WASP as worthy transiting planet candidates. Radial-velocity observations quickly verified that the photometric signals were indeed produced by two transiting hot Jupiters. Our observations also show the presence of additional Doppler signals. In addition to short-period hot Jupiters, we find that the WASP-53 and WASP-81 systems also host brown dwarfs, on fairly eccentric orbits with semi-major axes of a few astronomical units. WASP-53c is over 16 $M_{\rm Jup} \sin i_{\rm c}$ and WASP-81c is 57 $M_{\rm Jup} \sin i_{\rm c}$. The presence of these tight, massive companions restricts theories of how the inner planets were assembled. We propose two alternative interpretations: a formation of the hot Jupiters within the snow line, or the late dynamical arrival of the brown dwarfs after disc-dispersal.
We also attempted to measure the Rossiter–McLaughlin effect for both hot Jupiters. In the case of WASP-81b we fail to detect a signal. For WASP-53b we find that the planet is aligned with respect to the stellar spin axis. In addition we explore the prospect of transit timing variations, and of using Gaia's astrometry to measure the true masses of both brown dwarfs and also their relative inclination with respect to the inner transiting hot Jupiters.

Download/Website: `https://arxiv.org/abs/1612.04166`

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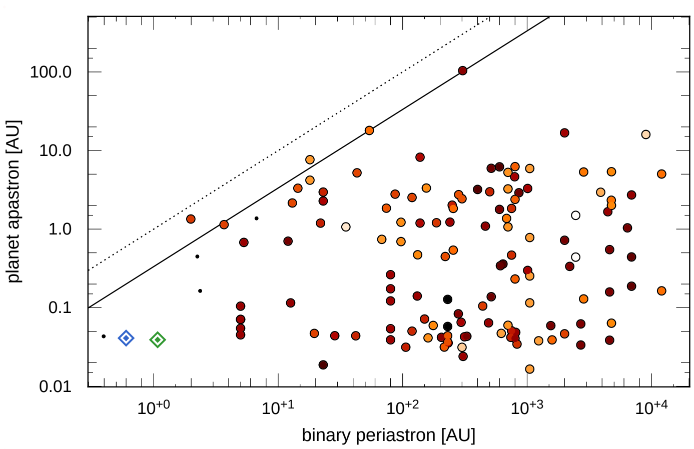

Figure 5: (Triaud et al.) WASP-53b and WASP-81b are two hot Jupiters found to be transiting the primary star of tight binaries. Here, we plot planetary apastron versus binary periastron (or separation if eccentricity is unknown) in astronomical units for known S-type planetary systems. The colour of the dots reflects the logarithm of the ratio of the planet-hosting star mass to the mass of its stellar companion(s) (white = 0.2, black = 18). WASP-53 and WASP-81 are highlighted as a blue and green diamond, respectively. The small black dots represent four systems containing a gas-giant and a brown dwarf. The dotted line is a 1:1 line, and the plain line is a 3:1 contour. Above that line, systems are usually unstable.

3 Conference announcements

Exoplanet Science with Small Telescopes: Precise Radial Velocities

Cullen Blake, Sharon X. Wang
University of Pennsylvania, USA

University of Pennsylvania, April 24-26, 2017

Announcing the first workshop devoted to the discussion of how sub-meter-class telescopes can be used to discover, confirm, and characterize exoplanets using the Doppler method. Registration is open now on our website, and abstracts are due on February 3, 2017. The workshop is on Aprio 24-26, 2017, at University of Pennsylvania, Philadelphia, PA, USA.

Download/Website: `http://web.sas.upenn.edu/smalltrv/`

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The physics of evolved stars

Florentin Millour
Laboratoire LAGRANGE, Observatoire de la Cote d'Azur, Boulevard de l'Observatoire, 06304 Nice, France

Nice, Cote d'Azur, France, 10-13th July 2017

We are organizing the second conference on the physics of evolved stars in Nice between 10-13th of July 2017 (the first one occurred in 2015: poe2015.sciencesconf.org). We aim at focusing it on the role of binarity, be it for low-mass evolved stars (AGB, post-AGB, novae, cataclysmic variables..), or for high-mass stars (RSG, WR, LBV, sgB[e] stars, post-interaction products...).

The goal of the conference is to gather observer and theoreticians from both the low mass stars and massive stars communities. Ample discussion time is a key feature of this conference alongside breakout discussion session to trigger ideas/collaborations to tackle the main questions in the study of evolved stars.

We invite you to save the date, submit an abstract and come to the French riviera to share your work with specialists of stellar physics during this conference. We foresee to link all the talks to the ADS instead of publishing proceedings.

Please visit our website - poe2017.sciencesconf.org, where we will post all the relevant information (registration, program, etc.). So please stay tuned!

Important dates to keep in mind are the following:

- Abstract submissions are now accepted
- 15 Feb: registration starts
- 30 Mar: deadline for abstract submission
- 15 Apr: talk/poster selection announcement
- 1 Jun: end of normal registration/ beginning of late registration
- 15 Jun: no more registration accepted

- 10 Jul: start of the conference

Download/Website: http://poe2017.sciencesconf.org
Contact: fmillour@oca.eu

Sessions to be held at the EGU General Assembly

Lena Noack
Royal Observatory of Belgium, Department of Reference Systems and Planetology, Ringlaan 3, 1180 Brussels, Belgium

Vienna, Austria, 23-28 April 2017

We would like to draw your attention to the following sessions to be held at the EGU General Assembly in Vienna, 23-28 April 2017:

PS6.1 Exoplanets: Observations and modeling
Convened by Lena Noack, James Cho, Daniel Winterhalter, Yann Alibert and John Lee Grenfell

A main goal of this session is to discuss the observations, formation and interior/atmosphere dynamics of exoplanets. This includes recent observations of exoplanets from spacecraft and from ground-based observatories as well as papers discussing the status of, and/or plans for, future observations. Further, theoretical and numerical models, in particular those that interpret or provide support for present and future observations, will be of strong interest. Another topic of high interest pertains the availability and observation of organic matter in planetary systems.

PS7.1 Origin of life and habitability: From Early Earth to the Solar System and Beyond
Convened by Tilman Spohn, Vronique Dehant, Emmanuelle J. Javaux, C. Szopa, Lena Noack and Ozgur Karatekin

The aim of this session is to discuss the possible conditions and habitat for the origin and persistence of life in the solar system and beyond with emphasis on Earth, terrestrial planets, icy moons and exoplanets. We are interested in the conditions for habitability, the signatures of life, and the possible links between habitability and the evolution of planetary reservoirs (atmosphere, geosphere, hydrosphere, interior). We invite contributions of relevance to the topic from all fields of Planetary Sciences and Biogeoscience including e.g., formation and structure of planetary bodies in the habitable zone, interior dynamics (convection, plate tectonics, and magnetic field), atmospheres, impacts and planetary evolution, geological evidence on Martian habitability, biogeochemical interactions, extremophiles and the limits of life, preservation and detection of biosignatures, mission concepts for exploration of planetary habitability.

Abstract submission deadline: 11 Jan 2017

We would highly welcome your abstract in our session!
We look forward to seeing you in Vienna,
The conveners of PS6.1 and PS7.1

Download/Website: http://meetingorganizer.copernicus.org/EGU2017/abstractsubmission/23175

Contact: lena.noack@oma.be

Know Thy Star – Know Thy Planet: Assessing the Relevance of Ground-based High Resolution Imaging and Spectroscopy of Exoplanet Host Stars

David R. Ciardi
IPAC-NExScI, Califonia Institute of Technology

Pasadena, CA USA, 09 - 12 Oct 2017

We are pleased to announce the scientific conference ””Know Thy Star - Know Thy Planet: Assessing the relevance of ground-based high resolution imaging and spectroscopy of Exoplanet Host stars”. The purpose of the meeting is to gather experts in the field to bring to together an understanding of the needs of the community for follow-up observations in the era of K2 and TESS and leading into JWST, PLATO, and WFIRST. The meeting will focus on the needs for stellar characterization, bound (and unbound) companions, false positive assessment, and planetary characterization with an emphasis on the techniques necessary to accomplish these goals.

The meeting will be held in Pasadena, CA USA 09-12 October 2017 at the Pasadena Hilton Hotel.

Download/Website: `http://nexsci.caltech.edu/conferences/2017/knowthystar/`

Contact: `knowthystar@ipac.caltech.edu`

EANA2017 (European Astrobiology Network Association)

LOC: Kai Finster, Louise Borsen-Koch, Ole J. Knudsen
Department of Physics and Astronomy, Aarhus University, 120 Ny Munkegade, DK-8000 Aarhus C, Denmark

Aarhus, Denmark, 14-17 August, 2017

The annual conference will this year take place in Denmark. Among the many interesting and relevant topics for Astrobiology, EANA17 emphasizes Exoplanets, a new and exciting field in the search for extraterrestrial life. EANA therefore welcomes contributions from observations and modelling of exoplanets, as well as mission and instrument design studies.

Important dates:

- Registration and poster submission will open 1 March, 2017
- Deadline for registration and payment: 1 June, 2017
- Travel grant application: 1 May, 2017
- Abstract deadline for posters and contributed talks: 1 June, 2017
- Notification deadline from the EANA 2017 SOC regarding talks and posters: 30 June, 2017

We have the opportunity to offer travel grants (260) for students that attend the EANA17 workshop in Aarhus. The grants can be used to cover travel expenses and housing in Aarhus. In order to be eligible for a travel grant you have to bring a poster or give an oral presentation at the workshop.

Download/Website: `http://sac.au.dk/currently/eana-2017-aarhus/`

Contact: `kai.finster@bios.au.dk`

5th CHEOPS Science Workshop and The CHEOPS Open Time Workshop

Luca Fossati and Kate Isaac
Space Research Institute, Austrian Academy of Sciences, Schmiedlstrasse 6, A-8042 Graz, Austria

Schloss Seggau, Austria, 24-26th July and 26-27th July 2017

We have the pleasure of informing you that registration for two CHEOPS workshops taking place in 2017 is now open.

Details of the 5th CHEOPS Science Workshop and the CHEOPS Open Time Workshop, to be held consecutively from the 24-26th July 2017 and 26-27th July 2017 in Schloss Seggau near Graz, in the South of Austria, can be found at the links below.

5th CHEOPS Science Workshop

The workshop will focus on CHEOPS science: priority will be given to describing the implementation of the Guaranteed Time Observations and to exploring the synergies with other exoplanet missions and observational facilities. Ample time will be devoted to discussions. Participants are invited to submit contributions - oral or poster - on any scientific aspect relevant to the mission.

Bursaries are available to provide financial help to both PhD students and early career postdocs to attend the Science Workshop.

The CHEOPS ESA Open Time Workshop

The objective of the CHEOPS ESA Open Time Workshop is to inform the Community about the CHEOPS mission and the CHEOPS Guest Observers' Programme. Talks will provide an overview of the mission – its capabilities, scientific objectives, payload and specifications, observing modes and performances, schedule and data products – as well details on how to apply for observing time on CHEOPS and to access CHEOPS data. Hands-on demonstrations will provide the opportunity to see and to use tools that will be available to support the observer through all steps of the CHEOPS observing process: from proposal preparation, through observation preparation to archive access to CHEOPS data.

The deadline for submission of abstracts for the Science Workshop is 30th April 2017, and for registration for either/both workshops 1st July 2017.

We look forward to seeing you at the workshops.

Luca Fossati (IWF, Graz) on behalf of the Science Workshop Organising Committee
Kate Isaak (ESA Project Scientist) on behalf of the ESA Open Time Workshop Organising Committee

Download/Website: `http://geco.oeaw.ac.at/cheops-workshop-05.html`
Download/Website: `http://www.cosmos.esa.int/web/cheops-open-time-workshop-2017/`
Contact: `cheopsws5@oeaw.ac.at ; CHEOPS-OT-workshop@cosmos.esa.int`

Exoplanet Atmospheres - CRAQ Summer School

René Doyon[1], *David Lafrenière*[1], *Nicolas Cowan*[2,3,4,5]
[1] Institut de Recherche sur les Exoplanètes, Départment de Physique, Université de Montréal, Montréal, QC H3C 3J7, Canada
[2] Department of Earth and Planetary Sciences, McGill University, 3450 rue University, Montreal, QC, H3A 0E8, Canada
[3] Department of Physics, McGill University, 3450 rue University, Montreal, QC, H3A 0E8, Canada
[4] McGill Space Institute, McGill University
[5] Institut de Recherche sur les Exoplanètes, Université de Montréal

Montreal, Canada, June 12–14th, 2017

The Centre for Research in Astrophysics of Quebec (CRAQ) is announcing its second Summer School, which will be held on June 12–14th 2017 in Montreal, Quebec. This year's topic is *Exoplanet Atmospheres*. During this 3-day school you will learn both theoretical and observational aspects of exoplanets and their atmosphere. This summer school will include lectures from local and international experts in the field.

The CRAQ Summer School is principally aimed at graduate students in the field of physics, astronomy, and astrophysics, although students who have completed their undergraduate studies in these fields will also be considered.

Confirmed School Instructors and Topics:

1. Exoplanets 101 – René Doyon and David Lafrenière (Université de Montréal, iREx)
2. Exoplanet atmospheres 101 – Nicolas Cowan (McGill University, MSI, iREx)
3. Theory of transmitted light – Eliza Kempton (Grinnell College)
4. Clouds – To be determined
5. Reflected and emitted light – Michael R. Line (Arizona State University)
6. Atmospheric dynamics – Nikole Lewis (Space Telescope Science Institute)

Fees:
There is no registration fee. However, we will not offer traveling funds or cover lodging expenses.

Lodging:
A block of rooms has been reserved at Les Studios Hôtel, the Université de Montréal residence on campus, located at about 5–10 minute walking distance from the conference room and the public transportation system. To have the preferential rates, mention $\mathrm{CRAQ_S}$S2017. Studios Hôtel Université de Montréal, 2450 Édouard Montpetit, Montréal, (Québec), Canada H3T 1J4, Phone : (514) 343-8006 You must contact the hotel yourself and place your reservation before **April 30th**.

Important Dates:

- 16 December 2016: First Announcement
- 19 January 2017: Second (and last) Announcement, Registration opens
- 30 April 2017: Registration and accommodation reservation deadlines
- 12-14 June 2017: The school

Download/Website: `http://craq-astro.ca/summerschool/?lang=en`
Contact: `Summer.School@craq-astro.ca`

2017 Sagan Summer Workshop: Microlensing in the Era of WFIRST

D. Gelino, R. Paladini
NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Pasadena, CA, August 7-11, 2017

Registration and the financial aid application are now available for the 2017 Sagan Summer Workshop. The workshop will focus on searching for planets with WFIRST microlensing. Leaders in the field will discuss the importance of microlensing to understanding planetary populations and demographics, especially beyond the snow line. They will review the microlensing method, both in the context of current capabilities and the future WFIRST microlensing survey. In addition, speakers will address the broad potential of the WFIRST's Wide Field Imaging microlensing survey for (non-microlensing) science in the galactic bulge. Attendees will participate in hands-on group projects related to the WFIRST microlensing planet survey and will have the opportunity to present their own work through short presentations (research POPs) and posters.

Topics to be covered include:

- Microlensing Science: Current and Future
- An Introduction to the Theory of Microlensing
- Fitting Microlensing Light Curves
- The K2/C9 and Spitzer Microlens Parallax Campaigns
- The WFIRST Microlensing Survey
- Planet Populations Beyond the Snow Line: Formation and Demographics
- Galactic Science with Wide Field imaging Data in the Galactic Bulge, including microlensing and Galactic Structure
- Finding Exotic Massive Objects with Microlensing

Important Dates

- January 27, 2017: On-line Registration and Financial Support application period open
- February 24, 2017: Financial Support application due
- March 10, 2017: Financial Support decisions announced via email
- May 26, 2017: POP/Poster/Talk submission period open and on-line lunch and workshop dinner purchase periods open
- July 14, 2017: deadline for POP/Poster/Talk submission and deadline to purchase lunches and workshop dinner
- July 29, 2017: final agenda posted
- August 7-11, 2017: Sagan Exoplanet Summer Workshop

Download/Website: `http://nexsci.caltech.edu/workshop/2017`

Contact: `sagan_workshop@ipac.caltech.edu`

The Exoclipse Conference

David Bennett, Scientific Organizing Committee Chair
NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

Boise State University, 2017 Aug 20-24

Exoclipse is an exoplanet conference designed to shed light on the growing population of known planets on wide orbits. Topics include discovery strategies, nascent population statistics, formation mechanisms, the planetary initial mass function, and connections to other populations of planets in short and moderate periods. We will discuss instrumentation and observing strategies for detecting and characterizing the planets, including ground-based and space-based coronagraphy, long-term RV monitoring, and microlensing and transit work from the ground and space. We will explore the possibility of discovering extrasolar analogs to Saturn, Uranus, and Neptune, and assess how observations can discriminate between formation models of wide-orbit planets.

Hosted by Boise State University, the conference spans five days (2017 Aug 20-24) and includes a trip to view the total solar eclipse on Aug 21. Friends and family are welcome to attend the eclipse-viewing, although space will be limited.

Abstracts and travel/dependent care grant applications are due by 2017 June 2. Registration is due by 2017 June 20.

SCIENTIFIC ORGANIZING COMMITTEE:
Charles Beichman (California Institute of Technology), David Bennett (NASA Goddard Space Flight Center), Beth Biller (University of Edinburgh), Sarah Dodson-Robinson (University of Delaware), Hannah Jang-Condell (University of Wyoming), Bruce Macintosh (Stanford University), Stan Metchev (University of Western Ontario), & Aki Roberge (NASA Goddard Space Flight Center)

LOCAL ORGANIZING COMMITTEE:
Christine Chang (Boise State University), Brian Jackson (Boise State University), Daryl Macomb (Boise State University), Christian Marois (NRC-Herzberg), Angelle Tanner (Mississippi State University), & Tiffany Watkins (Boise State University)

Download/Website: `https://physics.boisestate.edu/exoclipse/`

Contact: `exoclipse@boisestate.edu`

4 Jobs and positions

2yr post-doctoral position in exoplanet research

L. Decin
Institute of Astronomy, University of Leuven, Belgium

Deadline application: 1 April 2017, Preferred starting date: 1 May 2017 - 1 December 2017

Job opening for a 2 yr post-doctoral position in the field of exoplanets
Interdisciplinary project on exoplanet atmospheres at the Leuven University.

The project
At the Leuven University (Belgium), we seek an excellent candidate for a post-doctoral research position, ready to play a key role in our interdisciplinary project focusing on exoplanet atmosphere modelling. The goal of the project is to understand the intricate host star - exoplanet interaction, both in terms of dynamics and chemistry.

We seek a post-doctoral researcher with expertise in theoretical modelling and/or retrieval algorithms. We aim to further develop our in-house developed dynamical + chemistry exoplanet modelling tools and to confront the model observables with new exoplanet spectra which will be obtained with the James Webb Space Telescope (JWST, launch in 2018). The post-doc will be part of an active and highly performing team, which guarantees an environment in which the post-doc has access to ample support and which will train the post-doc towards his/her own career path.

Institute of Astronomy
The Institute of Astronomy (IoA) of the Leuven University is a young and active research group of some 50 scientists, engineers and administrative staff (`http://fys.kuleuven.be/ster`). The institute is involved in several international networks and research projects, involving telescopes at international observatories and space missions. The organisation of the Master in Astronomy & Astrophysics of the Faculty of Science at the Leuven University is in the hand of the IoA.

The position
At the Leuven University, the candidates will join the Institute of Astronomy (Prof. L. Decin). The interdisciplinary project is carried out in collaboration with dr. L. Carone (Heidelberg) and dr. O. Venot (Paris). The candidate will interact closely with the other team members at the IoA and within the departments of mathematics and chemistry. At the Leuven University, we have access to parallel computing facilities, to be exploited extensively in this project.

Contract
The postdoc candidate will be employed at the Institute of Astronomy. The initial contract runs over 2 years. The salary will be commensurate to the standard scale for post-doctoral researchers at the Leuven University. The preferred starting date is between 1 May 2017 and 1 December 2017, but will be adapted to the selected candidate's availability. Candidates are thus requested to indicate their preferred starting date in the application.

Interested?
The successful post-doc candidate must have a PhD degree in astrophysics, (theoretical) physics or (applied) mathematics. The application must be sent as single pdf document including

- A Curriculum Vitae (including publication list).
- A statement of research interests and future plans (maximum 3 pages).

- A letter detailing your specific qualifications for the position and your career/educational goals (maximum 1 page).
- Two letters of recommendation from professors well acquainted with your academic achievements. The letters are to be submitted separately to the address mentioned below.

The application should be sent by email to Prof. L. Decin (Leen.Decin@ster.kuleuven.be) and dr. K. Clémer (Katrijn.Clemer@ster.kuleuven.be).

DEADLINE for the application: 1 April 2017
More information can be obtained by contacting
Prof. L. Decin
Institute for Astronomy
Department of Physics and Astronomy, KU Leuven
Celestijnenlaan 200D, 3001 Heverlee, Belgium
++32-16-32 70 41

Download/Website: http://fys.kuleuven.be/ster/staff/senior-staff/leen ; http://fys.kuleuven.be/ster/

Contact: Leen.Decin@ster.kuleuven.be

PhD positions in Extra-solar Planets

Nuno Santos
Instituto de Astrofísica e Ciências do Espaço

Porto and Lisbon, Portugal, October 1st, 2017

A call is open for up to 5 PhD Fellowships in the context of the PhD::SPACE programme, hosted by the Instituto de Astrofísica e Ciências do Espaço (IA – U.Porto and U.Lisbon, Portugal). The positions are to be appointed for projects in the fields of research IA. In particular, PhD projects will be offered in different domains of exoplanet research. Among others, included are proposals that will explore data from the future ESPRESSO (ESO) and NIRPS (ESO) high resolution spectrographs and the CHEOPS (ESA) mission, projects where the "Planetary Systems" team in IA has a strong participation.

IA presently assembles more than two-thirds of all active researchers working in Space Sciences in Portugal, and is responsible for an even greater fraction of the national productivity in international ISI journals in this area. The research and development effort at the IA includes most of the topics at the forefront of research in Astrophysics and Space Sciences, complemented by work on instrumentation and systems with potential use in Astronomy and Astrophysics.

Download/Website: http://phd-space.iastro.pt/?page_id=1042

Contact: Mario.Monteiro@astro.up.pt; Nuno.Santos@astro.up.pt

Three MSc-PhD Positions in Exoplanet Science

Björn Benneke[1,2]
[1] Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA
[2] Institut de recherche sur les exoplanètes, iREx, Département de physique, Université de Montréal, Montréal, QC, H3C 3J7, Canada

Université de Montréal, Contact Professor Benneke by February 15, 2017 to start in September 2017

We are happy to announce three MSc/PhD positions in exoplanet science at the Institute for Research on Exoplanets (iREx) at Université de Montréal. The three students will work in Professor Björn Benneke's new group on the characterization and discovery of exoplanets and their atmospheres.
Professor Benneke is arriving at iREx with state-of-art atmospheric modeling tools and a wide range of exciting new data sets from the Hubble Space Telescope, Spitzer Space Telescope, and the 10-meter Keck telescopes. Among other things Professor Benneke is the principal investigator of the largest Hubble Space Telescope program to characterize super-Earths as well as a large Keck Telescope program to study giant exoplanets.
Topics that the MSc/PhD student will be able to work on include:

- Exploring the diversity of planetary atmospheres on super-Earths using Hubble Space Telescope transit spectroscopy.
- Probing the formation of giants planets using high-resolution near-infrared spectroscopy from Keck telescopes.
- Atmospheric characterization and mapping of exoplanets using the upcoming James Webb Space Telescope (JWST).
- Exploring and understanding the exotic nature of clouds on exoplanets.
- Discovery and initial characterization of prime targets for future JWST characterization using K2, TESS, and ground-based follow-up.

Applicants must have an Undergraduate or a Master degree in physics. Interested applicants can contact Professor Benneke directly at bbenneke@astro.umontreal.ca before February 15th 2017.
For more information on Professor Benneke's work, please also see his webpage `http://www.exoplanetes.umontreal.ca/?page_id=4476&lang=en` or contact him directly.
The Institute for Research on Exoplanets (iREx) consists of a growing team of about 40 people (professors, postdocs, research assistants and students) from UdeM and McGill working on various research programs focused on the study of exoplanets and related fields of stellar astrophysics. Members of iREx are actively involved in large international projects related to the detection and characterization of exoplanets, notably the future JWST, the Gemini Planet Imager and the infrared spectrographs SPIRou and NIRPS. More information on iREx research projects can be found on the website `http://www.exoplanetes.umontreal.ca/?page_id=1230&lang=en`.
Working languages at iREx are French and English. Université de Montréal is a French institution. Support will be offered to students to learn French if necessary.

For more information on iREx, contact Marie-Eve Naud, iREx Scientific and EPO Coordinator: naud@astro.umontreal.ca.
For more information on UdeM application process contact Sophie Tremblay, Technicienne en gestion des dossiers etudiants des cycles superieurs: sophie.tremblay.2@umontreal.ca and-or see the UdeM admission process at the MSc and PhD level webpages `http://en.phys.umontreal.ca/programs/graduate-programs/`.

Download/Website: `http://www.exoplanetes.umontreal.ca/?p=4686&lang=en`

Contact: `bbenneke@astro.umontreal.ca`

5 Announcements

Invitation to apply for Cheops Science Team Associate

Didier Queloz
Cambridge, UK

CHEOPS Science Team, closing deadline: 1 March 2017

We invite proposals from motivated scientists to join the Cheops Science Team as a CHEOPS Science Team Associate member (CSTA). CHEOPS is a photometric satellite to be launched in late 2018 into low Earth orbit. CHEOPS will carry out a comprehensive observation program related to exoplanet science. CHEOPS nominal operations are currently planned for 3.5 years. Information about the mission and mission consortium may be found at (*http://cheops.unibe.ch*). A good overview of the consortium scientific program may be obtained by browsing through contributions to the CHEOPS workshop held in 2016 at Geneva *http://cheops.unige.ch/meetings/science-workshop-04/*.

The CHEOPS mission consortium has received 80% of the satellite's observing time as guaranteed time observing (GTO) to carry out its scientific program. The CHEOPS Science Team (CST), which consists of 31 members, is responsible for the preparation and the scientific exploitation of this program. CSTAs will join the CST in carrying out these tasks. We anticipate making up to 5 such appointments of two years' duration, with a possibility for a one-year extension in motivated cases.

CSTAs are expected to take an active role in the preparation of the GTO program and its exploitation. The CST will be particularly interested in proposed contributions related to aspects of global mission performance. These include calibration monitoring and data reduction aiming at maximizing the scientific return of the mission. CSTAs should be willing to devote a significant share of their time to the proposed tasks (25% or more would be envisaged), and bring added values to the CST activities. CSTA shall be accountable to the PI to carry out the activities for which they have been selected. In return, CSTAs will be granted the same privileges as regular CST members for the duration of their appointment.

A CSTA application should include: (a) Curriculum Vitae (1 page); (b) a list of publications; (c) a narrative with no more 10,000 characters1 describing the proposed contribution including its relevance to the scientific operations of CHEOPS and the candidate's suitability and availability to carry out the proposed task; (d) a narrative with no more than 5,000 characters2 describing past experience relevant to the proposed contribution; (e) a short supporting letter from the candidate's Head of Department or line manager at the host institution/supervisor confirming availability of the proposed fraction of fulltime effort and "sufficient travel support to attend 3 Science Team meetings and a workshop within Europe per year".

The proposal material should be sent to Sara Bowen (Sara.Bowen@unige.ch) as a single file in PDF format, by email, with "CHEOPS-CSTA" in the subject line before the closing deadline.

Enquiries about this invitation should be directed, in the first instance, to Didier Queloz (dq212@cam.ac.uk) chair of the CHEOPS Science Team.

Download/Website: `http://bit.ly/2cheopsCSTA`

Contact: `dq212@cam.ac.uk`

6 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during December 2016 and January 2017. If you see any that we missed, please let us know and we'll include them in the next issue.

December 2016

astro-ph/1612.00228 : **ACCESS I: An Optical Transmission Spectrum of GJ 1214b Reveals a Heterogeneous Stellar Photosphere** by *Benjamin Rackham, et al.*
astro-ph/1612.00333 : **Discovery of a low-mass companion inside the debris ring surrounding the F5V star HD206893** by *Julien Milli, et al.*
astro-ph/1612.00342 : **Atmospheric Retrieval for Direct Imaging Spectroscopy of Gas Giants In Reflected Light II: Orbital Phase and Planetary Radius** by *Michael Nayak, et al.*
astro-ph/1612.00446 : **How Bright are Planet-Induced Spiral Arms in Scattered Light?** by *Ruobing Dong, Jeffrey Fung*
astro-ph/1612.00848: **First Detection of Hydrogen in the β Pictoris Gas Disk** by *P. A. Wilson, et al.*
astro-ph/1612.00883 : **Global simulations of protoplanetary disks with net magnetic flux: I. Non-ideal MHD case** by *William Béthune, Geoffroy Lesur, Jonathan Ferreira*
astro-ph/1612.01245 : **An Information-Theoretic Approach to Optimize JWST Observations and Retrievals of Transiting Exoplanet Atmospheres** by *Alex R. Howe, Adam Burrows, Drake Deming*
astro-ph/1612.01616: **The metallicity distribution and hot Jupiter rate of the Kepler field: Hectochelle High-resolution spectroscopy for 776 Kepler target stars** by *Xueying Guo, et al.*
astro-ph/1612.01648 : **1.3 mm ALMA Observations of the Fomalhaut Debris System** by *J. A. White, et al.*
astro-ph/1612.01739: **SALT observations of the Chromospheric Activity of Transiting Planet Hosts: Mass Loss and Star Planet Interactions** by *D. Staab, et al.*
astro-ph/1612.01863: **Dust in brown dwarfs and extra-solar planets V. Cloud formation in carbon- and oxygen-rich environment** by *Ch. Helling, et al.*
astro-ph/1612.01985 : **The gravitational interaction between planets on inclined orbits and protoplanetary disks as the origin of primordial spin–orbit misalignments** by *Titos Matsakos, Arieh Königl*
astro-ph/1612.02072 : **The Anglo-Australian Planet Search XXV: A Candidate Massive Saturn Analog Orbiting HD 30177** by *Robert A. Wittenmyer, et al.*
astro-ph/1612.02085 : **Information Content Analysis for Selection of Optimal JWST Observing Modes for Transiting Exoplanet Atmospheres** by *Natasha E. Batalha, Michael R. Line*
astro-ph/1612.02237 : **TEE, a simple estimator for the precision of eclipse and transit minimum times** by *Hans J. Deeg, Brandon Tingley*
astro-ph/1612.02425 : **Detection of the atmosphere of the 1.6 Earth mass exoplanet GJ 1132b** by *John Southworth, et al.*
astro-ph/1612.02432 : **Kepler Transit Depths Contaminated by a Phantom Star** by *Paul A. Dalba, et al.*
astro-ph/1612.02693 : **Highly inclined and eccentric massive planets. II. Planet-planet interactions during the disc phase** by *Sotiris Sotiriadis, et al.*
astro-ph/1612.02740 : **3D Radiation Non-ideal Magnetohydrodynamical Simulations Of The Inner Rim In Protoplanetary Disks** by *M. Flock, et al.*
astro-ph/1612.02776 : **Discovery of XO-6b: a hot Jupiter transiting a fast rotating F5 star on an oblique orbit** by *N. Crouzet, et al.*
astro-ph/1612.02854 : **Gaps in Protoplanetary Disks as Signatures of Planets: III. Polarization** by *Hannah Jang-Condell*
astro-ph/1612.02872 : **On the Orbital Inclination of Proxima Centauri b** by *Stephen R. Kane, Dawn M. Gelino, Margaret C. Turnbull*
astro-ph/1612.03091: **Characterization of the inner disk around HD 141569 A from Keck/NIRC2 L-band**

vortex coronagraphy by *Dimitri Mawet, et al.*

astro-ph/1612.03174 (cross-list from astro-ph.SR) : **Atmospheric Compositions of Three Brown Dwarfs and Implications for their Formation Conditions** by *Nikku Madhusudhan, Daniel Apai, Siddharth Gandhi*

astro-ph/1612.03381 : **Detecting planet pairs in mean motion resonances via astrometry method** by *Dong-Hong Wu, et al.*

astro-ph/1612.03511 : **Faint source star planetary microlensing: the discovery of the cold gas giant planet OGLE-2014-BLG-0676Lb** by *N. J. Rattenbury, et al.*

astro-ph/1612.03556 : **Classification of exoplanets according to density** by *Andrzej Odrzywolek, Johann Rafelski*

astro-ph/1612.03786 : **Proxima Centauri reloaded: Unravelling the stellar noise in radial velocities** by *M. Damasso, F. Del Sordo*

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January 2017

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