ExoPlanet News
An Electronic Newsletter

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Editors: S. P. Quanz,Y. Alibert, A. Leleu, C. Mordasini
NCCR PlanetS, Gesellschaftsstrasse 6, CH-3012 Bern, Switzerland

exoplanetnews@nccr-planets.ch http://nccr-planets.ch/exoplanetnews

Contents

1 Editorial

Welcome to edition 114 of the ExoPlanet News!

Thanks a lot to all of you who contributed to this issue of the newsletter!

As you will see, the newsletter of this month is particularly long, with 18 abstracts of new scientific papers, 7 job ads, 3 conference announcement, the monthly updates from the NASA exoplanet archive, and the overview of the new articles on astro-ph. Thanks for all these contributions!

We are looking forward to your paper abstract, job ad or meeting announcement for the coming edition of ExoPlanet News. As usual, we would also be happy to receive feedback concerning the newsletter. The Latex template for submitting contributions of any kind, as well as all previous editions of ExoPlanet News, can be found on the webpage ExoPlanet News webpage (http://nccr-planets.ch/exoplanetnews/).

The next issue will appear January 14, 2019.

Thanks for all your support, we wish to all of you a nice Christmas break!

Yann Alibert
Sascha P. Quanz
Christoph Mordasini
Adrien Leleu

2 Abstracts of refereed papers

Explicit relations and criteria for eclipses, transits and occultations

Dimitri Veras[1,2]

[1] Centre for Exoplanets and Habitability, University of Warwick, Coventry, CV4 7AL, UK
[2] Department of Physics, University of Warwick, Coventry, CV4 7AL, UK

MNRAS, In Press, arXiv:1811.05484

Solar system, exoplanet and stellar science rely on transits, eclipses and occultations for dynamical and physical insight. Often, the geometry of these configurations are modelled by assuming a particular viewpoint. Here, instead, I derive user-friendly formulae from first principles independent of viewpoint and in three dimensions. I generalise the results of Veras & Breedt (2017) by (i) characterising three-body systems which are in transit but are not necessarily perfectly aligned, and by (ii) incorporating motion. For a given snapshot in time, I derive explicit criteria to determine whether a system is in or out of transit, if an eclipse is total or annular, and expressions for the size of the shadow, including their extreme values and a condition for engulfment. These results are exact. For orbital motion, I instead obtain approximate results. By assuming fixed orbits, I derive a single implicit algebraic relation which can be solved to obtain the frequency and duration of transit events – including ingresses and egresses – for combinations of moons, planets and stars on arbitrarily inclined circular orbits; the eccentric case requires the solution of Kepler's equation but remains algebraic. I prove that a transit shadow – whether umbral, antumbral or penumbral – takes the shape of a parabolic cylinder, and finally present geometric constraints on Earth-based observers hoping to detect a three-body syzygy (or perfect alignment) – either in extra solar systems or within the solar system – potentially as a double annular eclipse.

Download/Website: `https://arxiv.org/abs/1811.05484`

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

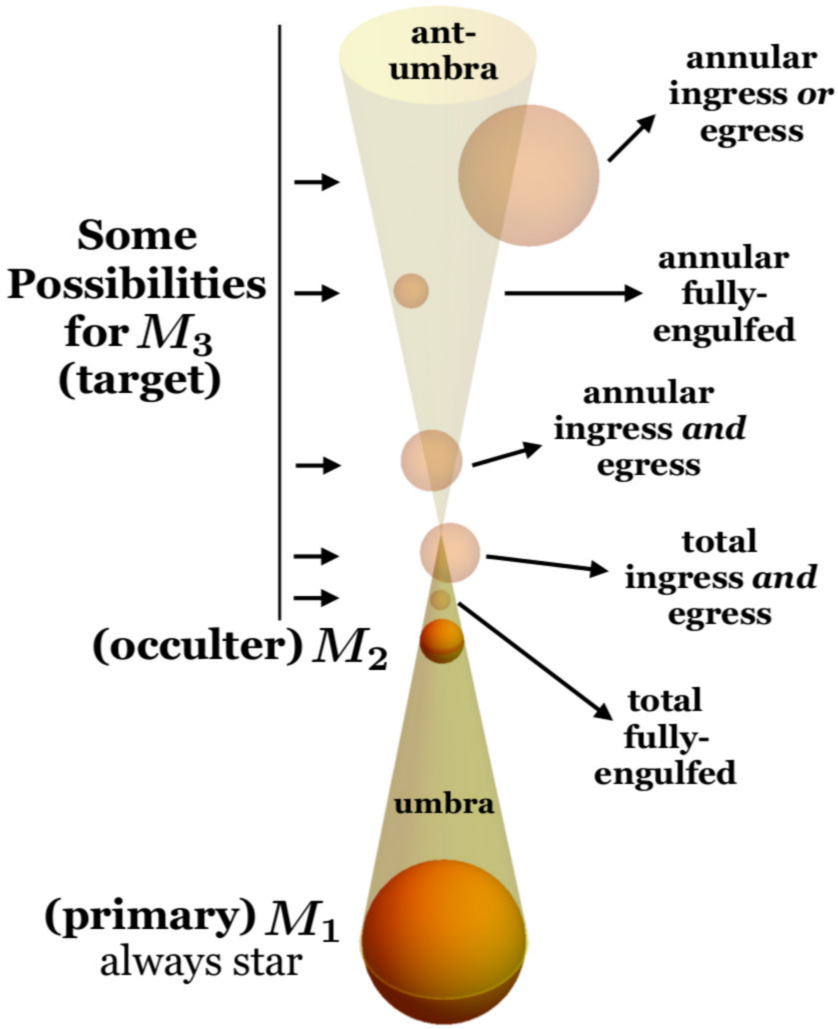

Figure 1: Potential configurations of three bodies in transit. The primary, which is always a star and the largest body, always forms a radiation cone with the occulter. If the target intersects this cone, then the target is said to be "in transit". If the near side of the target intersects the bottom nappe, the eclipse is total; otherwise, it is annular; the near side of the Earth, for example, lies coincidentally just at the vertex of the cone, which is why there are both annular and total solar eclipses. The entire target may or may not be completely engulfed in shadow. When not engulfed, as is the case for solar eclipses as seen on Earth, the target may be in ingress, egress or both, and the observability of the eclipse then depends on one's location on the target surface.

Multiple water band detections in the CARMENES near-infrared transmission spectrum of HD 189733 b

F. J. Alonso-Floriano[1], *A. Sánchez-López*[2], *I. A. G. Snellen*[1], *M. López-Puertas*[2], *E. Nagel*[3], *P. J. Amado*[2], *F. F. Bauer*[2], *J. A. Caballero*[4], *S. Czesla*[3], *L. Nortmann*[5,6], *E. Pallé*[5,6], *M. Salz*[3], *A. Reiners*[7], *I. Ribas*[8,9], *A. Quirrenbach*[10], *J. Aceituno*[11], *G. Anglada-Escudé*[12], *V. J. S. Béjar*[5,6], *E. W. Guenther*[13], *T. Henning*[14], *A. Kaminski*[10], *M. Kürster*[14], *M. Lampón*[2], *L. M. Lara*[2], *D. Montes*[15], *J. C. Morales*[8,9], *L. Tal-Or*[16,7], *J. H. M. M. Schmitt*[3], *M. R. Zapatero Osorio*[4], *and M. Zechmeister*[5]

[1] Leiden Observatory, Leiden University, Postbus 9513, 2300 RA, Leiden, The Netherlands
[2] Instituto de Astrofísica de Andalucía (IAA-CSIC), Glorieta de la Astronomía s/n, 18008 Granada, Spain
[3] Hamburger Sternwarte, Universität Hamburg, Gojenbergsweg 112, 21029 Hamburg, Germany
[4] Centro de Astrobiología, CSIC-INTA, ESAC campus, Camino bajo del castillo s/n, 28692 Villanueva de la Cañada, Madrid, Spain
[5] Instituto de Astrofísica de Canarias (IAC), Calle Vía Lactea s/n, E-38200 La Laguna, Tenerife, Spain
[6] Departamento de Astrofísica, Universidad de La Laguna, 38026 La Laguna, Tenerife, Spain
[7] Institut für Astrophysik, Georg-August-Universität, 37077 Göttingen, Germany
[8] Institut de Ciències de l'Espai (CSIC-IEEC), Campus UAB, c/ de Can Magrans s/n, 08193 Bellaterra, Barcelona, Spain
[9] Institut d'Estudis Espacials de Catalunya (IEEC), 08034 Barcelona, Spain
[10] Landessternwarte, Zentrum für Astronomie der Universität Heidelberg, Königstuhl 12, 69117 Heidelberg, Germany
[11] Centro Astronónomico Hispano Alemán, Observatorio de Calar Alto, Sierra de los Filabres, E-04550 Gérgal, Spain
[12] School of Physics and Astronomy, Queen Mary, University of London, 327 Mile End Road, London, E1 4NS, UK
[13] Thüringer Landessternwarte Tautenburg, Sternwarte 5, 07778 Tautenburg, Germany
[14] Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, Germany
[15] Departamento de Física de la Tierra y Astrofísica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain
[16] School of Geosciences, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv, 6997801, Israel

Astronomy & Astrophysics, in press (arXiv: 1811.08901)

Aims: We explore the capabilities of CARMENES for characterizing hot-Jupiter atmospheres by targeting multiple water bands, in particular, those at 1.15 and 1.4 μm. *Hubble Space Telescope* observations suggest that this wavelength region is relevant for distinguishing between hazy/cloudy and clear atmospheres.
Methods: We observed one transit of the hot Jupiter HD 189733 b with CARMENES. Telluric and stellar absorption lines were removed using SYSREM, which performs a principal component analysis including proper error propagation. The residual spectra were analysed for water absorption with cross-correlation techniques using synthetic atmospheric absorption models.
Results: We report a cross-correlation peak at a signal-to-noise ratio (SNR) of 6.6, revealing the presence of water in the transmission spectrum of HD 189733 b. The absorption signal appeared slightly blueshifted at –3.9 $\pm$ 1.3 km s^{-1}. We measured the individual cross-correlation signals of the water bands at 1.15 and 1.4 μm, finding cross-correlation peaks at SNRs of 4.9 and 4.4, respectively. The 1.4 μm feature is consistent with that observed with the *Hubble Space Telescope*.
Conclusions: The water bands studied in this work have been mainly observed in a handful of planets from space. The ability of also detecting them individually from the ground at higher spectral resolution can provide insightful information to constrain the properties of exoplanet atmospheres. Although the current multiband detections can not yet constrain atmospheric haze models for HD 189733 b, future observations at higher signal-to-noise ratio could provide an alternative way to achieve this aim.

Download/Website: `http://arxiv.org/abs/1811.08901/`

Contact: `alonso@strw.leidenuniv.nl`

An automated search for transiting exocomets

G. M. Kennedy[1,2], *G. Hope*[3], *S. T. Hodgkin*[3], *M. C Wyatt*[3]

[1] Department of Physics, University of Warwick, Gibbet Hill Road, Coventry, CV4 7AL, UK
[2] Centre for Exoplanets and Habitability, University of Warwick, Gibbet Hill Road, Coventry, CV4 7AL, UK
[3] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1811.03102)

This paper discusses an algorithm for detecting single transits in photometric time-series data. Specifically, we aim to identify asymmetric transits with ingress that is more rapid than egress, as expected for cometary bodies with a significant tail. The algorithm is automated, so can be applied to large samples and only a relatively small number of events need to be manually vetted. We applied this algorithm to all long cadence light curves from the *Kepler* mission, finding 16 candidate transits with significant asymmetry, 11 of which were found to be artefacts or symmetric transits after manual inspection. Of the 5 remaining events, four are the 0.1% depth events previously identified for KIC 3542116 and 11084727. We identify HD 182952 (KIC 8027456) as a third system showing a potential comet transit. All three stars showing these events have H-R diagram locations consistent with $\sim$100Myr-old open cluster stars, as might be expected given that cometary source regions deplete with age, and giving credence to the comet hypothesis. If these events are part of the same population of events as seen for KIC 8462852, the small increase in detections at 0.1% depth compared to 10% depth suggests that future work should consider whether the distribution is naturally flat, or if comets with symmetric transits in this depth range remain undiscovered. Future searches relying on asymmetry should be more successful if they focus on larger samples and young stars, rather than digging further into the noise.

Download/Website: `https://ui.adsabs.harvard.edu/#abs/arXiv:1811.03102`

Contact: `g.kennedy@warwick.ac.uk`

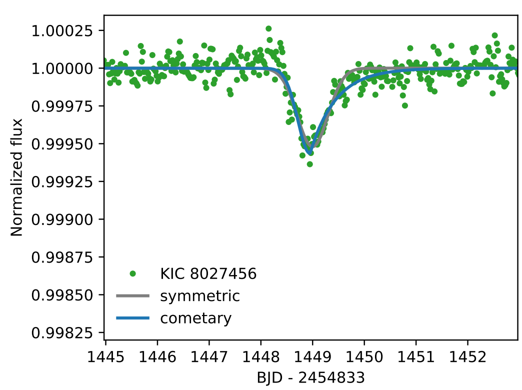

Figure 2: Light curve of a new exocomet detection, for HD 182952. Dots show the *Kepler* photometry, and lines show symmetric and cometary models.

Evolutionary models of cold and low-mass planets: Cooling curves, magnitudes, and detectability

Esther F. Linder[1], *Christoph Mordasini*[1], *Paul Mollière*[2], *Gabriel-Dominique Marleau*[3,1], *Matej Malik*[4], *Sascha P. Quanz*[5], *Michael R. Meyer*[6]

[1] Physikalisches Institut, University of Bern, Gesellschaftsstrasse 6, 3012 Bern, Switzerland
[2] Sterrewacht Leiden, Huygens Laboratory, Niels Bohrweg 2, 2333 CA Leiden, The Netherlands
[3] Institut für Astronomie und Astrophysik, Eberhard Karls Universität Tübingen, Auf der Morgenstelle 10, 72076 Tübingen, Germany
[4] Center for Space and Habitability, University of Bern, Gesellschaftsstrasse 6, CH-3012, Bern, Switzerland
[5] Particle Physics and Astrophysics, ETH Zurich, Wolfgang-Pauli-Strasse 27, CH-8093 Zurich, Switzerland
[6] Department of Astronomy, University of Michigan, 1085 S. University, Ann Arbor MI 48109, United States

Astronomy & Astrophysics, Accepted (arXiv:1812.02027)

Future instruments like NIRCam and MIRI on JWST or METIS at the ELT will be able to image exoplanets that are too faint (because of a low mass, and hence a small size or low effective temperature) for current direct imaging instruments. On the theoretical side, core accretion formation models predict a significant population of low-mass and/or cool planets at orbital distances of $\sim$ 10–100 au. Evolutionary models predicting the planetary intrinsic luminosity as a function of time have traditionally concentrated on gas-dominated giant planets. We extend these cooling curves to Saturnian and Neptunian planets.We simulate the cooling of isolated core-dominated and gas giant planets with masses of 5 $M_\oplus$ to 2 M_J. The planets consist of a core made of iron, silicates, and ices, surrounded by a H/He envelope, similar to the ice giants in the solar system. The luminosity includes the contribution from the cooling and contraction of the core and of the H/He envelope, as well as radiogenic decay. For the atmosphere we use grey, `AMES-Cond`, `petitCODE`, and `HELIOS` models. We consider solar and non-solar metallicities as well as cloud-free and cloudy atmospheres. The most important initial conditions, namely the core-to-envelope ratio and the initial (i.e., post formation) luminosity are taken from planet formation simulations based on the core accretion paradigm.We first compare our cooling curves for Uranus, Neptune, Jupiter, Saturn, GJ 436b, and a 5 $M_\oplus$ planet with a 1% H/He envelope with other evolutionary models. We then present the temporal evolution of planets with masses between 5 $M_\oplus$ and 2 M_J in terms of their luminosity, effective temperature, radius, and entropy. We discuss the impact of different post formation entropies. For the different atmosphere types and initial conditions magnitudes in various filter bands between 0.9 and 30 micrometer wavelength are provided. Using black body fluxes and non-grey spectra, we estimate the detectability of such planets with JWST. It is found that a 20 (100) $M_\oplus$ planet can be detected with JWST in the background limit up to an age of about 10 (100) Myr with NIRCam and MIRI, respectively.

Download/Website: `Article at: https://arxiv.org/abs/1812.02027; Numerical data at: http://www.space.unibe.ch/research/research_groups/planets_in_time/numerical_data/index_eng.html`

Contact: `esther.linder@space.unibe.ch`

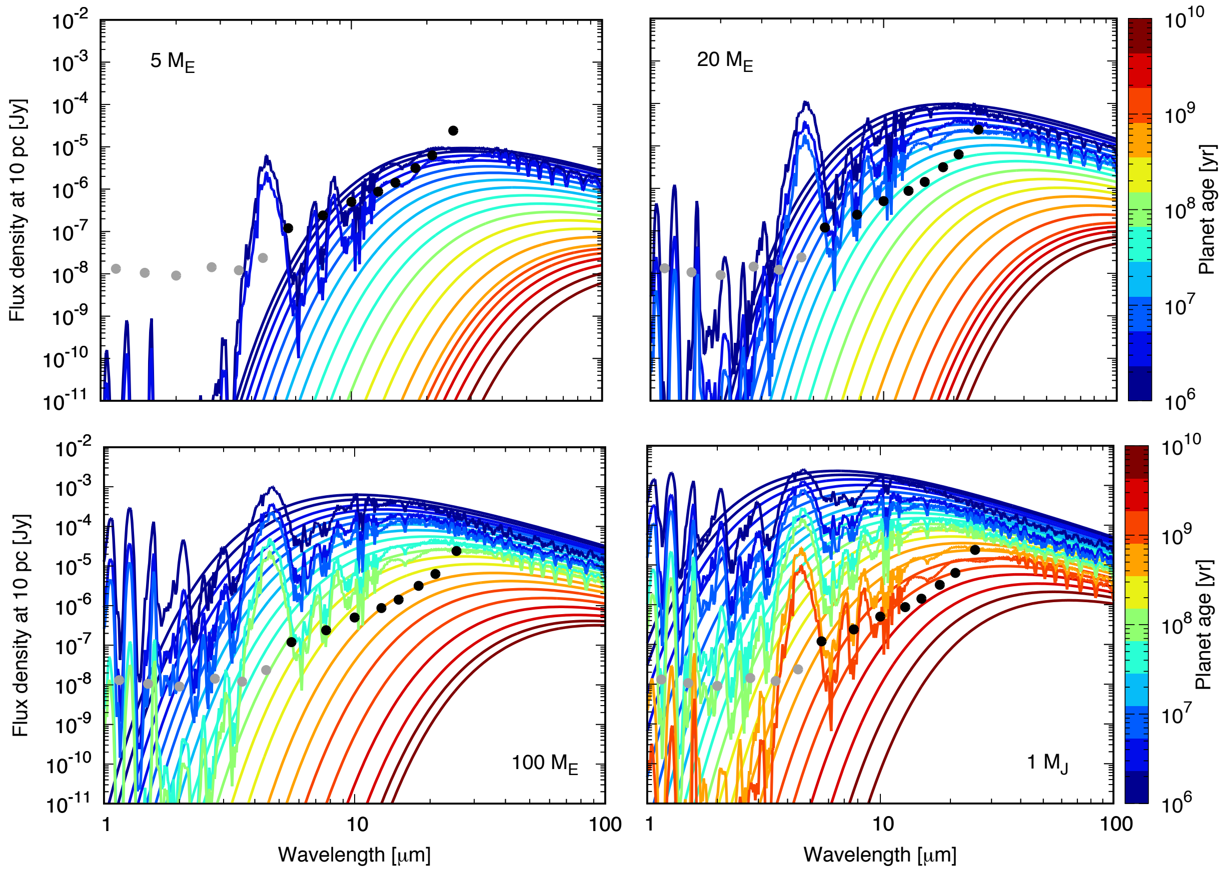

Figure 3: Spectra for cloud-free solar-metallicity atmospheres from the `petitCODE` grid together with the theoretical blackbody for four planetary masses. The age is given in color, the x- and y-axis are the same for all the figures. The temperature of the blackbodies corresponds to the temperature of the planet at the age given in color. The grey dots show the background sensitivity limits for the JWST/NIRCam filters included in this work, the black dots those for JWST/MIRI. There are 2, 3, 5, and 7 spectra shown for the 5, 20, 100, and 318 $M_\oplus$ planet.

Imaging [CI] around HD 131835: reinterpreting young debris discs with protoplanetary disc levels of CO gas as shielded secondary discs

Q. Kral[1,2], *S. Marino*[1], *M.C. Wyatt*[1], *M. Kama*[1], *L. Matra*[3]
[1] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK
[2] LESIA, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Univ. Paris Diderot,
Sorbonne Paris Cité, 5 place Jules Janssen, 92195 Meudon, France
[3] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Monthly Notices of the Royal Astronomical Society, published (2018arXiv181108439K)

Despite being > 10Myr, there are $\sim$10 debris discs with as much CO gas as in protoplanetary discs. Such discs have been assumed to be “hybrid”, i.e., with secondary dust but primordial gas. Here we show that both the dust and gas in such systems could instead be secondary, with the high CO content caused by accumulation of neutral carbon (C^0) that shields CO from photodissociating; i.e., these could be “shielded secondary discs”. New ALMA observations are presented of HD131835 that detect $\sim 3 \times 10^{-3}$ $M_\oplus$ of C^0, the majority 40-200au from the star, in sufficient quantity to shield the previously detected CO. A simple semi-analytic model for the evolution of CO, C and O originating in a volatile-rich planetesimal belt shows how CO shielding becomes important when the viscous evolution is slow (low α parameter) and/or the CO production rate is high. Shielding by C^0 may also cause the CO content to reach levels at which CO self-shields, and the gas disc may become massive enough to affect the dust evolution. Application to the HD 131835 observations shows these can be explained if $\alpha \sim 10^{-3}$; an inner cavity in C^0 and CO may also mean the system has yet to reach steady state. Application to other debris discs with high CO content finds general agreement for $\alpha = 10^{-3}$ to 0.1. The shielded secondary nature of these gas discs can be tested by searching for C^0, as well as CN, N_2 and CH^+, which are also expected to be shielded by C^0.

Download/Website: `https://arxiv.org/abs/1811.08439`

Contact: `quentin.kral@obspm.fr`

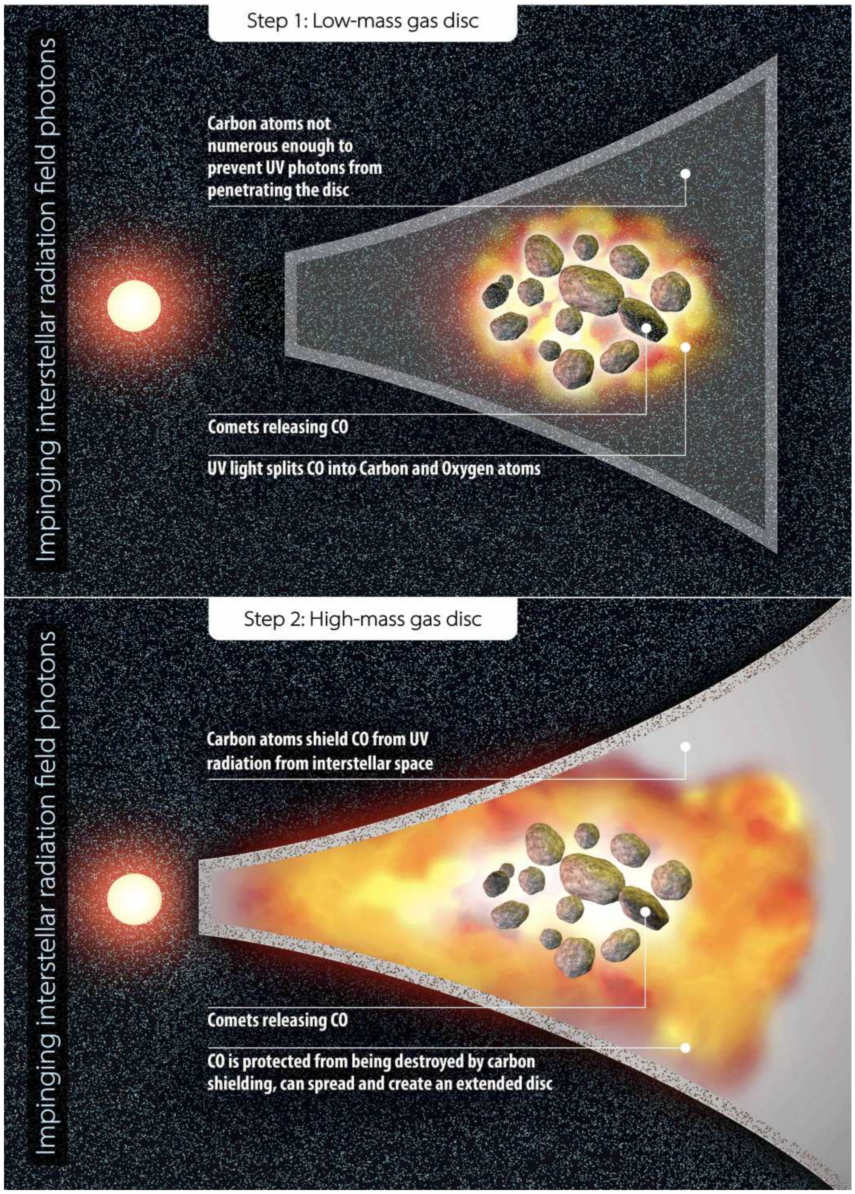

Figure 4: Schematic of the shielding effect proposed in this paper than can explain massive gas discs around > 10 Myr as being of secondary origin (rather than a remnant of the protoplanetary disc phase), i.e. the observed gas is released at a later stage from volatile-rich planetesimals present in the systems.

The 3D thermal, dynamical and chemical structure of the atmosphere of HD 189733b: implications of wind-driven chemistry for the emission phase curve

B. Drummond[1], *N. J. Mayne*[1], *J. Manners*[2,1], *I. Baraffe*[1,3], *J. Goyal*[1], *P. Tremblin*[4], *D. K. Sing*[5], *K. Kohary*[1]

[1] Astrophysics Group, University of Exeter, EX4 2QL, Exeter, UK
[2] Met Office, Exeter, EX1 3PB, UK
[3] Univ Lyon, Ens de Lyon, Univ Lyon1, CNRS, CRAL, UMR5574, F-69007, Lyon, France
[4] Maison de la simulation, CEA, CNRS, Univ. Paris-Sud, UVSQ, Université Paris-Saclay, 91191 Gif-Sur-Yvette, France
[5] Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD, USA

The Astrophysical Journal, published (arXiv:1810.09724)

In this paper we present three-dimensional atmospheric simulations of the hot Jupiter HD 189733b under two different scenarios: local chemical equilibrium and including advection of the chemistry by the resolved wind. Our model consistently couples the treatment of dynamics, radiative transfer and chemistry, completing the feedback cycle between these three important processes. The effect of wind–driven advection on the chemical composition is qualitatively similar to our previous results for the warmer atmosphere of HD 209458b, found using the same model. However, we find more significant alterations to both the thermal and dynamical structure for the cooler atmosphere of HD 189733b, with changes in both the temperature and wind velocities reaching $\sim 10\%$. We also present the contribution function, diagnosed from our simulations, and show that wind–driven chemistry has a significant impact on its three–dimensional structure, particularly for regions where methane is an important absorber. Finally, we present emission phase curves from our simulations and show the significant effect of wind–driven chemistry on the thermal emission, particularly within the 3.6 μm Spitzer/IRAC channel.

Download/Website: http://iopscience.iop.org/article/10.3847/1538-4357/aaeb28

Contact: b.drummond@exeter.ac.uk

SWEET-Cat updated. New homogenous spectroscopic parameters

S. G. Sousa[1], *V. Adibekyan*[1], *E. Delgado-Mena*[1], *N. C. Santos*[1,2], *D. T. Andreasen*[1], *A. C. S. Ferreira*[1], *M. Tsantaki*[1], *S. C. C. Barros*[1], *O. Demangeon*[1], *G. Israelian*[3], *J. P. Faria*[1], *P. Figueira*[4,1], *A. Mortier*[5], *I. Brandão*[1], *M. Montalto*[6], *B. Rojas-Ayala*[7], *A. Santerne*[8,]

[1] Instituto de Astrofísica e Ciências do Espaço, Universidade do Porto, CAUP, Rua das Estrelas, 4150-762 Porto, Portugal
[2] Departamento de Física e Astronomia, FCUP, Rua do Campo Alegre, 4169-007 Porto, Portugal
[3] Instituto de Astrofísica de Canarias, 38200 La Laguna, Tenerife, Spain
[4] European Southern Observatory, Alonso de Cordova 3107, Vitacura, Santiago, Chile
[5] Centre for Exoplanet Science, SUPA, School of Physics and Astronomy, Uni. of St Andrews, St Andrews KY16 9SS, UK
[6] Dipartimento di Fisica e Astronomia "Galileo Galilei", Uni. di Padova, Vicolo dell'Osservatorio 3, Padova IT-35122, Italy
[7] Departamento de Ciencias Fisicas, Universidad Andres Bello, Fernandez Concha 700, Las Condes, Santiago, Chile
[8] Aix Marseille Univ, CNRS, CNES, LAM, Marseille, France

Astronomy & Astrophysics, published (2018A&A...620A..58S/arXiv:1810.08108)

Exoplanets have now been proven to be very common. The number of its detections continues to grow following the development of better instruments and missions. One key step for the understanding of these worlds is their characterization, which mostly depend on their host stars. We perform a significant update of the Stars With ExoplanETs CATalog (SWEET-Cat), a unique compilation of precise stellar parameters for planet-host stars provided for the exoplanet community. We made use of high-resolution spectra for planet-host stars, either observed by our team or found in several public archives. The new spectroscopic parameters were derived for the spectra following the same homogeneous process (ARES+MOOG). The host star parameters were then merged together with the planet properties listed in exoplanet.eu to perform simple data analysis. We present new spectroscopic homogeneous parameters for 106 planet-host stars. Sixty-three planet hosts are also reviewed with new parameters. We also show that there is a good agreement between stellar parameters derived for the same star but using spectra obtained from different spectrographs. The planet-metallicity correlation is reviewed showing that the metallicity distribution of stars hosting low-mass planets (below 30 $M_\oplus$) is indistinguishable from that from the solar neighborhood sample in terms of metallicity distribution.

Download/Website: `https://arxiv.org/abs/1810.08108`

Contact: `sergio.sousa@astro.up.pt`

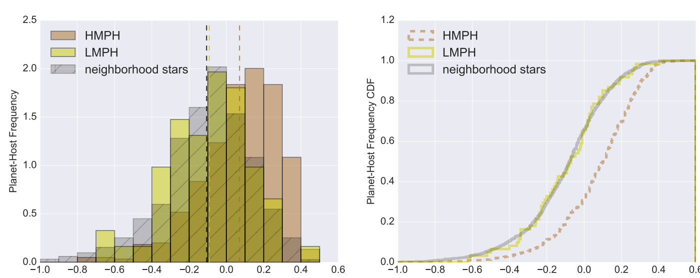

Figure 5: Metallicity distributions for the high- and low- mass-planet host stars, and a sample representing the solar neighborhood stars. The dashed vertical lines represent the average of each distribution. Right panel: CDF for a better comparison. Stars only hosting low mass planets are indistinguishable from solar neighborhood sample in terms of metallicity distribution.

Exoplanet Clouds

Christiane Helling[1]
[1] Centre for Exoplanet Science, University of St Andrews,
St Andrews KY16 9SS, UK

Annual Review of Earth and Planetary Sciences, accepted for publication

Clouds also form in atmospheres of planets that orbit other stars than our Sun, in so-called extrasolar planets or exoplanets. Exoplanet atmospheres can be chemically extremely rich. Exoplanet clouds are therefor made of a mix of materials that changes throughout the atmosphere. They affect the atmospheres through element depletion and through absorption and scattering, hence, they have a profound impact on the atmosphere's energy budget. While astronomical observations point us to the presence of extrasolar clouds and make first suggestions on particle sizes and material compositions, we require fundamental and complex modelling work to merge the individual observations into a coherent picture. Part of this is to develop an understanding for cloud formation in non-terrestrial environments.

Contact: `ch80@st-and.ac.uk`

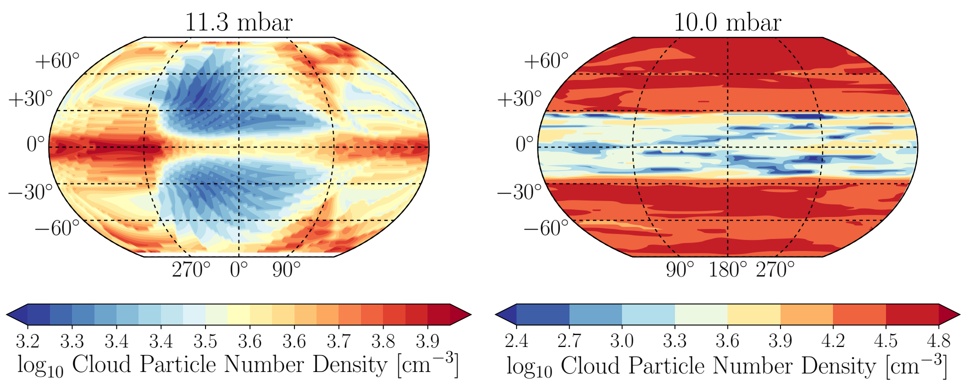

Figure 6: Maps of 3D GCM models with cloud formation for HD189733b (left; Lee et al. 2016) and for HD 209458b (right, Lines et al. 2018). Both plots show the resulting cloud particle number density at a pressure level of ≈ 10 mbar.

High-Resolution Transit Spectroscopy of Warm Saturns

E. K. Deibert[1], E. J. W. de Mooij[2], R. Jayawardhana[3], J. J. Fortney[4], M. Brogi[5], Z. Rustamkulov[4], M. Tamura[6,7,8]

[1] Department of Astronomy & Astrophysics, University of Toronto, 50 St. George St., Toronto, ON M5S 3H4, Canada
[2] School of Physical Sciences and Centre for Astrophysics & Relativity, Dublin City University, Glasnevin, Dublin, Ireland
[3] Department of Astronomy, Cornell University, Ithaca, New York 14853, USA
[4] Department of Astronomy & Astrophysics, University of California Santa Cruz, Santa Cruz, CA 95064, USA
[5] Department of Physics, University of Warwick, Coventry CV4 7AL, UK
[6] Department of Astronomy, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
[7] National Astronomical Observatory of Japan, NINS, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
[8] Astrobiology Center, NINS, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

The Astronomical Journal, in press (arXiv:1812.02748)

We present high-resolution optical transmission spectroscopy of two sub-Saturn mass transiting exoplanets, HAT-P-12b and WASP-69b. With relatively low densities and high atmospheric scale heights, these planets are particularly well-suited to characterization through transit spectroscopy, and serve as ideal candidates for extending previously-tested methods to lower planetary masses. Using a single transit for each planet, we take advantage of the Doppler cross-correlation technique to search for sodium, potassium, and water absorption features. Our analysis reveals a likely (3.2σ) detection of sodium absorption features in the atmosphere of HAT-P-12b, and enables us to place constraints on the presence of alkaline and molecular species in the atmospheres of both planets. With our results, we highlight the efficacy of ground-based campaigns for characterizing exoplanetary atmospheres, and pave the way for future analyses of low-mass planets.

Download/Website: `https://arxiv.org/abs/1812.02748`

Contact: `deibert@astro.utoronto.ca`

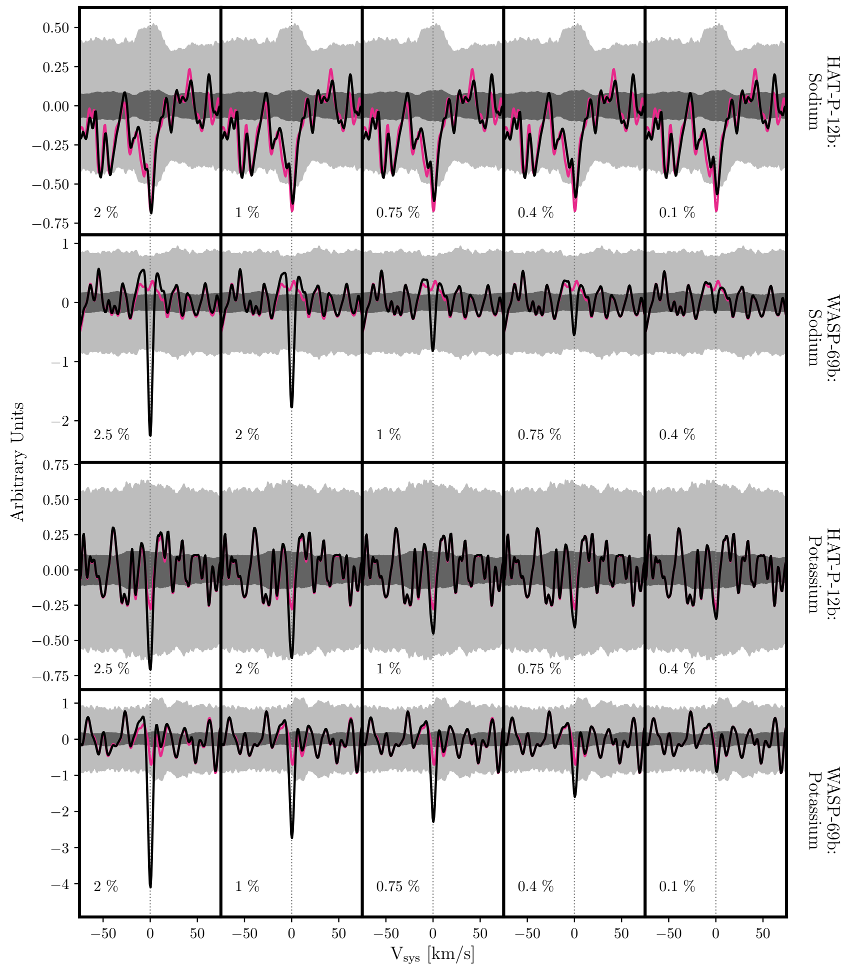

Figure 7: The results of injecting models of various strengths into our data, and repeating the Doppler cross-correlation process used in our analysis. In all panels, the magenta line represents the original data and the black line represents the data with a model injected, where the strength of the injected model is indicated in the bottom-left corner of the panel. We note that this percentage refers to a percentage relative to the normalized flux, i.e. a percentage of the stellar surface area. The dark grey contour represents a 1σ confidence level, while the lighter grey contour represents a 3σ confidence level. The relevant planet and element are indicated on the right-hand side of each row. For HAT-P-12b we phase-fold the data to the planet's orbital radial velocity $K_p = 130$ km/s, and for WASP-69b we phase-fold the data to the planet's orbital radial velocity $K_p = 127$ km/s. We also take into account the orbital systemic velocity of each system. Our 3.2σ detection of sodium absorption in the atmosphere of HAT-P-12b can be seen in the top row of the figure.

A ground-based NUV secondary eclipse observation of KELT-9b

M. J. Hooton[1], *C. A. Watson*[1], *E. J. W. de Mooij*[2], *N. P. Gibson*[1] *and D. Kitzmann*[3]

[1] Astrophysics Research Centre, School of Mathematics and Physics, Queen's University Belfast, Belfast BT7 1NN, UK
[2] School of Physical Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland
[3] University of Bern, Center for Space and Habitability, Gesellschaftsstrasse 6, CH-3012, Bern, Switzerland

Astrophysical Journal Letters, in press (arXiv:1812.02773)

KELT-9b is a recently discovered exoplanet with a 1.49 d orbit around a B9.5/A0-type star. The unparalleled levels of UV irradiation it receives from its host star put KELT-9b in its own unique class of ultra-hot Jupiters, with an equilibrium temperature $>$ 4000 K. The high quantities of dissociated hydrogen and atomic metals present in the dayside atmosphere of KELT-9b bear more resemblance to a K-type star than a gas giant. We present a single observation of KELT-9b during its secondary eclipse, taken with the Wide Field Camera on the Isaac Newton Telescope (INT). This observation was taken in the U-band, a window particularly sensitive to Rayleigh scattering. We do not detect a secondary eclipse signal, but our 3σ upper limit of 181 ppm on the depth allows us to constrain the dayside temperature of KELT-9b at pressures of $\sim$30 mbar to 4995 K (3σ). Although we can place an observational constraint of $A_g < 0.14$, our models suggest that the actual value is considerably lower than this due to H^- opacity. This places KELT-9b squarely in the albedo regime populated by its cooler cousins, almost all of which reflect very small components of the light incident on their daysides. This work demonstrates the ability of ground-based 2m-class telescopes like the INT to perform secondary eclipse studies in the NUV, which have previously only been conducted from space-based facilities.

Download/Website: `https://arxiv.org/abs/1812.02773`
Contact: `mhooton01@qub.ac.uk`

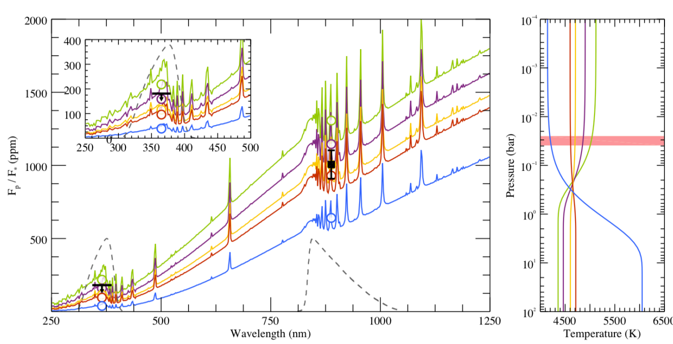

Figure 8: *Left*: model spectra for the five temperature profiles shown in the right panel, incorporating flux associated with both thermal emission and scattering. Our U-band upper limit and the z'-band eclipse depth (Collins et al. 2019, in prep.) are shown in black and the expected eclipse depths for each profile are marked with coloured data points. The response functions associated with the two bandpasses are marked with grey dashed lines. A close-up of U-band wavelengths is shown inset. *Right*: temperature-pressure profiles for each of the spectra shown. The red shaded area shows the pressure levels from which the thermal emission for all the models originate, when approximated as blackbodies.

Solar System formation in the context of extra-solar planets

Sean N. Raymond[1], *Andre Izidoro*[2], *Alessandro Morbidelli*[3]
[1] Laboratoire d'Astrophysique de Bordeaux, CNRS and Université de Bordeaux, Allée Geoffroy St. Hilaire, 33165 Pessac, France; rayray.sean@gmail.com
[2] UNESP, Univ. Estadual Paulista - Grupo de Dinâmica Orbital Planetologia, Guaratinguetá, CEP 12.516-410, São Paulo, Brazil
[3] Laboratoire Lagrange, UMR 7293, Université de Nice Sophia-Antipolis, CNRS, Observatoire de la Côte d'Azur, Boulevard de l'Observatoire, 06304 Nice Cedex 4, France

Planetary Astrobiology (Eds. Meadows, Arney, Des Marais, Schmidt), in press (arxiv:1812.01033)

Exoplanet surveys have confirmed one of humanity's (and all teenagers') worst fears: we are *weird*. If our Solar System were observed with present-day Earth technology – to put our system and exoplanets on the same footing – Jupiter is the only planet that would be detectable. The statistics of exo-Jupiters indicate that the Solar System is unusual at the $\sim$1% level among Sun-like stars (or $\sim$0.1% among all main sequence stars). But why are we different?
This review focuses on global models of planetary system formation. Successful formation models for both the Solar System and exoplanet systems rely on two key processes: orbital migration and dynamical instability. Systems of close-in 'super-Earths' or 'sub-Neptunes' cannot have formed in-situ, but instead require substantial radial inward motion of solids either as drifting mm- to cm-sized pebbles or migrating Earth-mass or larger planetary embryos. We argue that, regardless of their formation mode, the late evolution of super-Earth systems involves migration into chains of mean motion resonances anchored at the inner edge of the protoplanetary disk. The vast majority of resonant chains go unstable when the disk dissipates. The eccentricity distribution of giant exoplanets suggests that migration followed by instability is also ubiquitous in giant planet systems. We present three different models for inner Solar System formation – the low-mass asteroid belt, Grand Tack, and Early Instability models – each of which invokes a combination of migration and instability. We discuss how each model may be falsified.
We argue that most Earth-sized habitable zone exoplanets are likely to form much faster than Earth, with most of their growth complete within the disk lifetime. Their water contents should span a wide range, from dry rock-iron planets to water-rich worlds with tens of percent water. Jupiter-like planets on exterior orbits may play a central role in the formation of planets with small but non-zero, Earth-like water contents. Water loss during giant impacts and heating from short-lived radioisotopes like ^{26}Al may also play an important role in setting the final water budgets of habitable zone planets.
Finally, we identify the key bifurcation points in planetary system formation. We present a series of events that can explain why our Solar System is so *weird*. Jupiter's core must have formed fast enough to quench the growth of Earth's building blocks by blocking the flux of pebbles drifting inward through the gaseous disk. The large Jupiter/Saturn mass ratio is rare among giant exoplanets but may be required to maintain Jupiter's wide orbit. The giant planets' instability must have been gentle, with no close encounters between Jupiter and Saturn, also unusual in the larger (exoplanet) context. Our Solar System system is thus the outcome of multiple unusual, but not unheard of, events.

Download/Website: `https://arxiv.org/abs/1812.01033`

Contact: `rayray.sean@gmail.com`

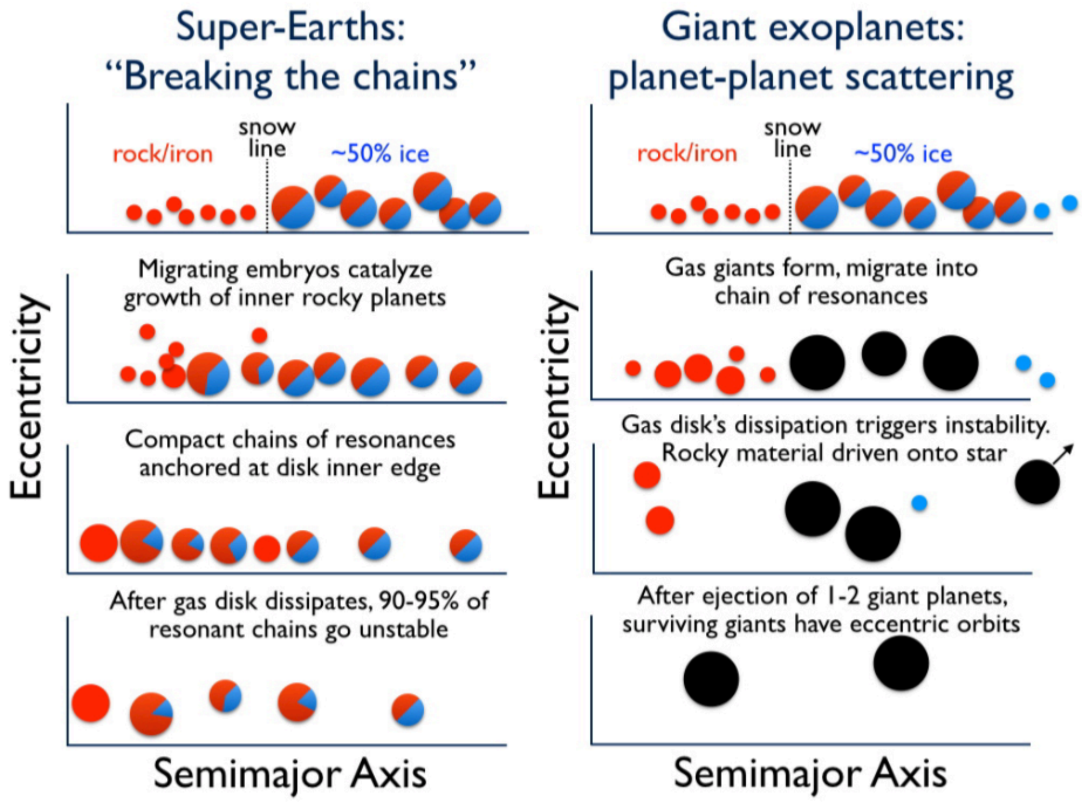

Figure 9: How orbital migration and dynamical instabilities can explain the properties of exoplanet populations. **Left:** Evolution of the "breaking the chains" migration model for the origin of super-Earths (Izidoro et al 2017). Embryos within the snow line are entirely rocky and much smaller than those that form past the snow line, which also incorporate ice. Presumably ice-rich embryos migrate inward through the rocky material, catalyzing the growth of purely rocky planets interior to the ice-rich ones (Raymond et al 2018). Planets migrate into long chains of mean motion resonances, with the innermost planet at the inner edge of the disk. The vast majority (90-95%) of resonant chains become unstable when the gas disk dissipates. The resulting planets match the distributions of known super-Earths (Izidoro et al 2017, 2018). Given various loss process (e.g., Grimm & McSween 1993; Genda & Abe 2005; Marcus et al 2010; Monteux et al 2018) the water/ice contents of these planets may be drastically overestimated. **Right:** Evolution of the planet-planet scattering model for the origin of giant exoplanets (e.g., Adams & Laughlin 2003; Chatterjee et al 2008; Raymond et al 2010). Several embryos grow quickly enough to accrete gas and grow into gas giants. They subsequently migrate into a resonant chain without drastically affecting the orbits of nearby growing rocky planets (or outer planetesimal disks). After the disk dissipates, the vast majority (75-90%) of giant planets systems become unstable. The resulting systems match the correlated mass-eccentricity distribution of known giant exoplanets (e.g., Ford & Rasio 2008; Wright et al 2009).

The Scattered Disc of HR 8799

F. Geiler[1], *A. Krivov*[1], *M. Booth*[1], *T. Löhne*[1]

[1] Astrophysikalisches Institut und Universitätssternwarte, Friedrich-Schiller-Universität Jena, Schillergäßchen 2–3, 07745 Jena, Germany

Monthly Notices of the Royal Astronomical Society, published (2019MNRAS.483..332G)

HR 8799 is a young F0-type star with four directly imaged giant planets and two debris belts, one located exterior and another one interior to the region occupied by the planetary orbits. Having an architecture similar to that of our Solar System, but also revealing dissimilarities such as high masses of planets, a huge radial extent and a high mass of the outer debris belt, HR 8799 is considered to be a benchmark to test formation and evolution models of planetary systems. Here we focus on the outer debris ring and its relation to the planets. We demonstrate that the models of the outer disc, proposed previously to reproduce Herschel observations, are inconsistent with the ALMA data, and vice versa. In an attempt to find a physically motivated model that would agree with both observational sets, we perform collisional simulations. We show that a narrow planetesimal belt and a radiation pressure induced dust halo cannot account for the observed radial brightness profiles. A single, wide planetesimal disc does not reproduce the data either. Instead, we propose a two-population model, comprising a Kuiper-Belt-like structure of a low-eccentricity planetesimal population ("the classical Kuiper Belt") and a high-eccentricity population of comets ("scattered disc"). We argue that such a structure of the exo-Kuiper belt of HR 8799 could be explained with planet migration scenarios analogous to those proposed for the Kuiper Belt of the Solar System.

Download/Website: `https://doi.org/10.1093/mnras/sty3160`

Contact: `fabian.geiler@uni-jena.de`

ALMA Reveals a Misaligned Inner Gas Disk inside the Large Cavity of a Transitional Disk

Satoshi Mayama[1], *Eiji Akiyama*[2], *Olja Panić* [3,17], *James Miley*[3], *Takashi Tsukagoshi*[4], *Takayuki Muto*[5], *Ruobing Dong*[6], *Jerome de Leon*[7], *Toshiyuki Mizuki*[8], *Daehyeon Oh*[9], *Jun Hashimoto*[10], *Jinshi Sai*[7], *Thayne Currie*[11], *Michihiro Takami*[12], *Carol A. Grady*[13,14,15], *Masahiko Hayashi*[4], *Motohide Tamura*[4,7,10], *Shu-ichiro Inutsuka*[16]

[1] SOKENDAI(The Graduate University for Advanced Studies), Shonan International Village, Hayama-cho, Miura-gun, Kanagawa 240-0193, Japan
[2] Institute for the Advancement of Higher Education, Hokkaido University, Kita 8, Nishi 5, Kita-ku, Sapporo, Hokkaido 060-0808, Japan
[3] School of Physics and Astronomy, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK
[4] National Astronomical Observatory of Japan, National Institutes of Natural Sciences, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
[5] Division of Liberal Arts, Kogakuin University, 1-24-2, Nishi-Shinjuku, Shinjuku-ku, Tokyo, 163-8677, Japan
[6] Department of Physics & Astronomy, University of Victoria, 3800 Finnerty Rd, Victoria, BC V8P 5C2, Canada
[7] Department of Astronomy, The University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo 113-0033, Japan
[8] Institute of Space and Astronautical Science, JAXA, 3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan
[9] National Meteorological Satellite Center, 64-18 Guam-gil, Gwanghyewon-myeon, Jincheon-gun, Chungbuk, South Korea
[10] Astrobiology Center, National Institutes of Natural Sciences, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
[11] Subaru Telescope, 650 North A'ohoku Place, Hilo, HI 96720, USA
[12] Institute of Astronomy and Astrophysics, Academia Sinica, P.O. Box 23-141, Taipei 106, Taiwan
[13] Goddard Center for Astrobiology, NASA's Goddard Space Flight Center, Greenbelt, MD 20771, USA
[14] Eureka Scientific, 2452 Delmer, Suite 100, Oakland CA 96002, USA
[15]ExoPlanets and Stellar Astrophysics Laboratory, Code 667, Goddard Space Flight Center, Greenbelt, MD 20771 USA
[16] Department of Physics, Nagoya University, Furo-cho, Chikusa Ward, Nagoya, Aichi 464-0814, Japan
[17] Royal Society Dorothy Hodgkin Fellow

Astrophysical Journal Letters, published (2018The Astrophysical Journal...868..L3)

Pairs of azimuthal intensity decrements at near symmetric locations have been seen in a number of protoplanetary disks. They are most commonly interpreted as the two shadows cast by a highly misaligned inner disk. Direct evidence of such an inner disk, however, remain largely illusive, except in rare cases. In 2012, a pair of such shadows were discovered in scattered light observations of the near face-on disk around 2MASS J16042165-2130284, a transitional object with a cavity ~60 AU in radius. The star itself is a "dipper", with quasi-periodic dimming events on its light curve, commonly hypothesized as caused by extinctions by transiting dusty structures in the inner disk. Here, we report the detection of a gas disk inside the cavity using ALMA observations with $\sim 0.''2$ angular resolution. A twisted butterfly pattern is found in the moment 1 map of CO (3-2) emission line towards the center, which is the key signature of a high misalignment between the inner and outer disks. In addition, the counterparts of the shadows are seen in both dust continuum emission and gas emission maps, consistent with these regions being cooler than their surroundings. Our findings strongly support the hypothesized misaligned-inner-disk origin of the shadows in the J1604-2130 disk. Finally, the inclination of inner disk would be close to -45 ° in contrast with 45 °; it is possible that its internal asymmetric structures cause the variations on the light curve of the host star.

Download/Website: `http://iopscience.iop.org/article/10.3847/2041-8213/aae88b/meta` `https://arxiv.org/abs/1810.06941`

Contact: `mayama_satoshi` *at* `soken.ac.jp`

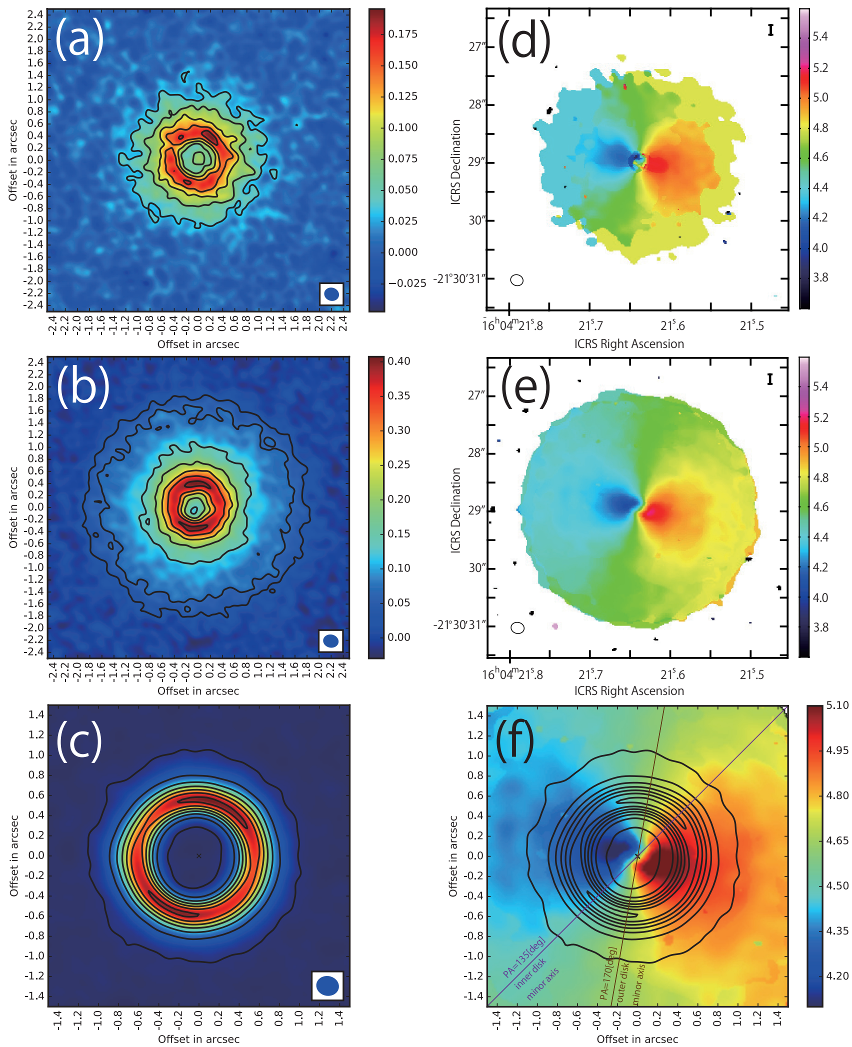

Figure 10: ALMA images of J1604-2130. An ellipse at the bottom right corner for (a),(b),(c), and bottom left corner for (d),(e) denotes the ALMA synthesized beam. The unit of the color bar for (a), (b) and (d),(e),(f) is [Jy/beam.km/s] and [km/s], respectively. (a) HCO^+ (4-3) moment 0 map. Contour levels are (5,10,15,20,25)$\times$rms. (b) CO (3-2) moment 0 map. Contour levels are (5,10,20,30,40,50,60)$\times$ rms. (c) Color map of continuum emission overlaid with and contours at (5,50,100,150,200,250,300)$\times$rms. (d)HCO^+ (4-3) moment 1 map. (e)CO (3-2) moment 1 map. (f)CO moment 1 map is shown in the color map. Continuum in black contours at (5,50,100,150,200,250,300)$\times$rms is overlaid. Purple color line denotes the position angle 135° of inner disk minor axis. Brown color line denotes the position angle 170° of outer disk minor axis.The black cross gives the stellar position.

Direct imaging of molten protoplanets in nearby young stellar associations

A. Irene Bonati[1,2], *Tim Lichtenberg*[2,3], *C. Dan J. Bower*[4], *D. Miles L. Timpe*[5], *E. Sascha P. Quanz*[6]

[1] Earth-Life Science Institute, Tokyo Institute of Technology, 2-12-1 Ookayama I7E-312, Meguro-ku, Tokyo 152-8550, Japan
[2] Institute of Geophysics, ETH Zurich, Sonneggstrasse 5, 8092 Zurich, Switzerland
[3] Atmospheric, Oceanic and Planetary Physics, University of Oxford, Parks Rd, Oxford OX1 3PU, United Kingdom
[4] Center for Space and Habitability, University of Bern, Gesellschaftsstrasse 6, 3012 Bern, Switzerland
[5] Institute for Computational Science, University of Zurich, Winterthurerstrasse 190, 8057 Zurich, Switzerland
[6] Institute for Particle Physics and Astrophysics, ETH Zurich, Wolfgang-Pauli-Strasse 27, 8093 Zurich, Switzerland

Astronomy & Astrophysics, in press (arXiv:1811.07411)

During their formation and early evolution, rocky planets undergo multiple global melting events due to accretionary collisions with other protoplanets. The detection and characterization of their post-collision afterglows (magma oceans) can yield important clues about the origin and evolution of the solar and extrasolar planet population. Here, we quantitatively assess the observational prospects to detect the radiative signature of forming planets covered by such collision-induced magma oceans in nearby young stellar associations with future direct imaging facilities. We have compared performance estimates for near- and mid-infrared instruments to be installed at ESO's Extremely Large Telescope (ELT), and a potential space-based mission called Large Interferometer for Exoplanets (LIFE). We modelled the frequency and timing of energetic collisions using *N*-body models of planet formation for different stellar types, and determine the cooling of the resulting magma oceans with an insulating atmosphere. We find that the probability of detecting at least one magma ocean planet depends on the observing duration and the distribution of atmospheric properties among rocky protoplanets. However, the prospects for detection significantly increase for young and close stellar targets, which show the highest frequencies of giant impacts. For intensive reconnaissance with a K band (2.2 μm) ELT filter or a 5.6 μm LIFE filter, the β Pictoris, Columba, TW Hydrae, and Tucana-Horologium associations represent promising candidates for detecting a molten protoplanet. Our results motivate the exploration of magma ocean planets using the ELT and underline the importance of space-based direct imaging facilities to investigate and characterize planet formation and evolution in the solar vicinity. Direct imaging of magma oceans will advance our understanding of the early interior, surface and atmospheric properties of terrestrial worlds.

Download/Website: `https://arxiv.org/abs/1811.07411`

Contact: `irene.bonati@elsi.jp`

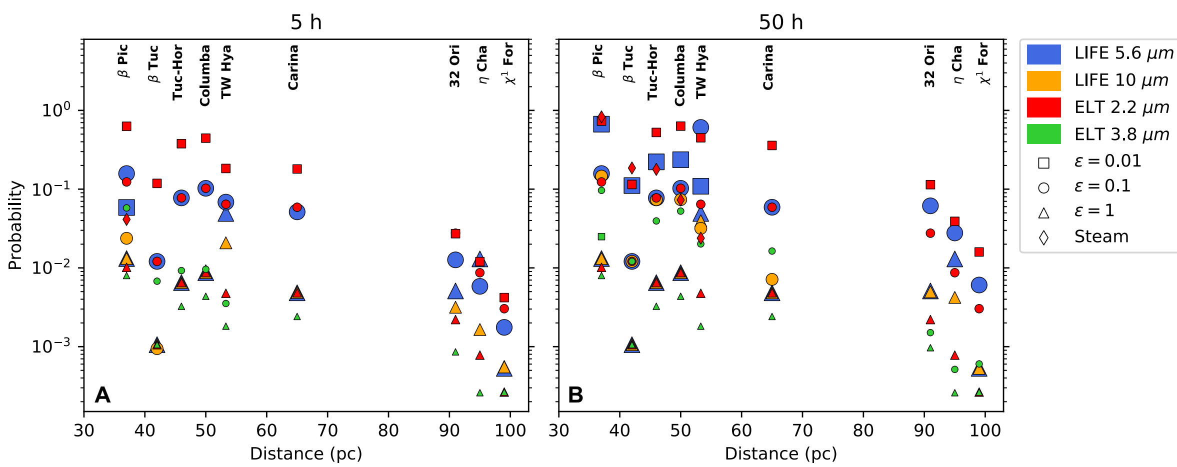

Figure 11: Probability of detecting at least one magma ocean planet in nearby young stellar associations for observation times of **(A)** 5 hours and **(B)** 50 hours using different filters of the Extremely Large Telescope (ELT) and of the Large Interferometer for Exoplanets (LIFE). The colors and shapes refer to telescope filters and planetary atmospheric emissivities, respectively. The prime stellar target for the detection of magma oceans is the β Pictoris association (37 pc, 23 Myr), followed by Columba (50 pc, 42 Myr), TW Hydrae (53 pc, 10 Myr), and Tucana-Horologium (48 pc, 45 Myr).

Spatial resonant periodic orbits in the restricted three-body problem

Kyriaki I. Antoniadou & Anne-Sophie Libert
[1] NaXys, Department of Mathematics, University of Namur, 8 Rempart de la Vierge, 5000 Namur, Belgium

Monthly Notices of the Royal Astronomical Society, In press

The quest of exo-Earths has become a prominent field. In this work, we study the stability of non-coplanar planetary configurations consisting of an inclined inner terrestrial planet in mean-motion resonance with an outer giant planet. We examine the families of circular and elliptic symmetric periodic orbits with respect to the vertical stability, and identify the vertical critical orbits from which the spatial families emanate. We showcase that stable spatial periodic orbits can exist for both prograde and retrograde motion in 3/2, 2/1, 5/2, 3/1, 4/1 and 5/1 resonances for broad ranges of inclinations, when the giant evolves on a circular orbit. When the orbit of the giant is elliptic, only the 2/1 resonance has stable periodic orbits up to high inclinations, while the 3/1, 4/1 and 5/1 resonances possess segments of stability for low inclinations. Furthermore, we show that regular motion can also take place in the vicinity of both horizontally and vertically stable planar periodic orbits, even for very high inclinations. Finally, the results are discussed in the context of asteroid dynamics.

Download/Website: `https://doi.org/10.1093/mnras/sty3195`

Contact: `kyriaki.antoniadou@unamur.be`

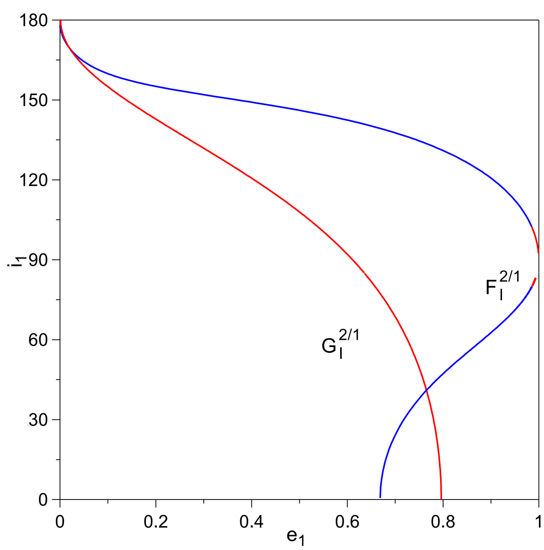

Figure 12: Spatial families of periodic orbits in the 3D-CRTB in the 2/1 MMR bifurcating from the 2D-CRTBP projected on the plane (e_1, i_1). Stability (instability) is depicted by blue (red).

Observability of hydrogen-rich exospheres in Earth-like exoplanets

L. A. dos Santos[1], *V. Bourrier*[1], *D. Ehrenreich*[1], *S. Kameda*[2]

[1] Observatoire astronomique de l'Université de Genève, 51 chemin des Maillettes, 1290 Versoix, Switzerland

[2] Department of Physics, College of Science, Rikkyo University, 3 Chome-34-1 Nishiikebukuro, Tokyo 171-8501, Japan

Astronomy & Astrophysics, in press (arXiv:1812.02145)

The existence of an extended neutral hydrogen exosphere around small planets can be used as an evidence for the presence of water in their lower atmosphere but, to date, such feature has not been securely detected in rocky exoplanets. Planetary exospheres can be observed using transit spectroscopy of the Lyman-α line, which is limited mainly by interstellar medium absorption in the core of the line, and airglow contamination from the geocorona when using low-orbit space telescopes. Our objective in this manuscript is to assess the detectability of the neutral hydrogen exosphere of an Earth-like planet transiting a nearby M dwarf using Lyman-α spectroscopy and provide the necessary strategies to inform future observations. We compute the excess absorption in the stellar Lyman-α line while in transit, and use realistic estimates of the uncertainties involved in observations to determine the observability of the signal. We found that the signal in Lyman-α of the exosphere of an Earth-like exoplanet transiting M dwarfs with radii between 0.1 and 0.6 $R_\odot$ produces an excess absorption between 50 and 600 ppm. The Lyman-α flux of stars decays exponentially with distance because of interstellar medium absorption, which is the main observability limitation. Other limits are related to the stellar radial velocity and instrumental setup. The excess absorption in Lyman-α is observable using LUVOIR/LUMOS in M dwarfs up to a distance of $\sim$15 pc. The analysis of noise-injected data suggests that it would be possible to detect the exosphere of an Earth-like planet transiting TRAPPIST-1 within 20 transits.

Download/Website: `https://arxiv.org/abs/1812.02145`

Contact: `Leonardo.dosSantos@unige.ch`

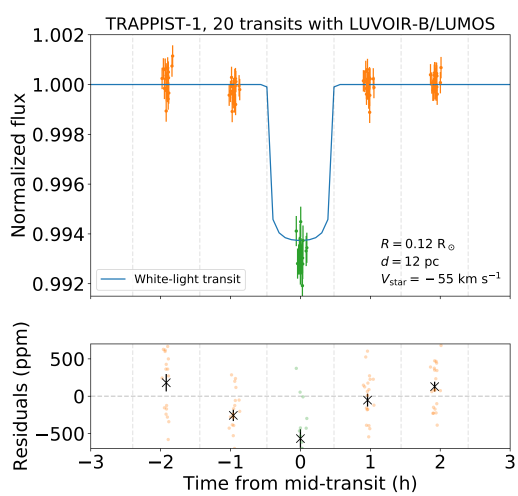

Figure 13: Time series of the Lyman-α flux of a star similar to TRAPPIST-1 during the transit of an Earth-like planet. The vertical dashed lines separate the different exposures (5 in total for each transit; the exposure time for each data point is equal to the transit duration).

Planet-star interactions with precise transit timing. I. The refined orbital decay rate for WASP-12 b and initial constraints for HAT-P-23 b, KELT-1 b, KELT-16 b, WASP-33 b, and WASP-103 b

G. Maciejewski[1], *M. Fernández*[2], *F. Aceituno*[2], *S. Martín-Ruiz*[2], *J. Ohlert*[3,4], *D. Dimitrov*[5,6], *K. Szyszka*[1], *C. von Essen*[7], *M. Mugrauer*[8], *R. Bischoff*[8], *K.-U. Michel*[8], *M. Mallonn*[9], *M. Stangret*[1], *D. Moździerski*[10]

[1] Centre for Astronomy, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5, 87-100 Toruń, Poland
[2] Instituto de Astrofísica de Andalucía (IAA-CSIC), Glorieta de la Astronomía 3, 18008 Granada, Spain
[3] Michael Adrian Observatorium, Astronomie Stiftung Trebur, 65428 Trebur, Germany
[4] University of Applied Sciences, Technische Hochschule Mittelhessen, 61169 Friedberg, Germany
[5] Institute of Astronomy and NAO, Bulgarian Academy of Science, 1784 Sofia, Bulgaria
[6] Department of Physics and Astronomy, Shumen University, 9700 Shumen, Bulgaria
[7] Stellar Astrophysics Centre, Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, DK-8000 Aarhus C, Denmark
[8] Astrophysikalisches Institut und Universitäts-Sternwarte, Schillergässchen 2, 07745 Jena, Germany
[9] Leibniz-Institut für Astrophysik Potsdam, An der Sternwarte 16, D-14482 Potsdam, Germany
[10] Astronomical Institute, University of Wrocław, Kopernika 11, 51-622 Wrocław, Poland

Acta Astronomica, in press (arXiv:1812.2438)

Theoretical calculations and some indirect observations show that massive exoplanets on tight orbits must decay due to tidal dissipation within their host stars. This orbital evolution could be observationally accessible through precise transit timing over a course of decades. The rate of planetary in-spiralling may not only help us to understand some aspects of evolution of planetary systems, but also can be used as a probe of the stellar internal structure. In this paper we present results of transit timing campaigns organised for a carefully selected sample of hot Jupiter-like planets which were found to be the best candidates for detecting planet-star tidal interactions on the Northern hemisphere. Among them, there is the WASP-12 system which is the best candidate for possessing an in-falling giant exoplanet. Our new observations support the scenario of orbital decay of WASP-12 b and allow us to refine its rate. The derived tidal quality parameter of the host star $Q'_* = (1.82 \pm 0.32) \times 10^5$ is in agreement with theoretical predictions for subgiant stars. For the remaining systems – HAT-P-23, KELT-1, KELT-16, WASP-33, and WASP-103 – our transit timing data reveal no deviations from the constant-period models, hence constraints on the individual rates of orbital decay were placed. The tidal quality parameters of host stars in at least 4 systems – HAT-P-23, KELT-1, WASP-33, and WASP-103 – were found to be greater than the value reported for WASP-12. This is in line with the finding that those hosts are main sequence stars, for which efficiency of tidal dissipation is predicted to be relatively weak.

Download/Website: `https://arxiv.org/abs/1812.02438`

Contact: `gmac@umk.pl`

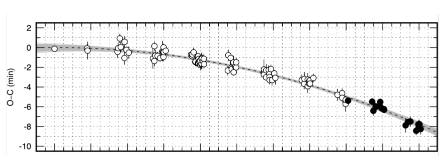

Figure 14: Timing residuals against the linear ephemeris for WASP-12 b. Values from the new observations are marked with dots, while the redetermined literature values are plotted with open circles. A dashed line displays the best-fit quadratic trend. The quadratic ephemeris uncertainties are illustrated by grey lines that are drawn for 100 sets of parameters, randomly chosen from the Markov chains.

Spectrally resolved helium absorption from the extended atmosphere of a warm Neptune-mass exoplanet

R. Allart[1], *V. Bourrier* [1], *C. Lovis* [1], *D. Ehrenreich* [1], *J. Spake* [2], *A. Wyttenbach* [1,3], *L. Pino* [1,4,5], *F. Pepe* [1], *D. K. Sing* [2,6], *A. Lecavelier des Etangs* [7]

[1] Observatoire astronomique de l'Université de Genève, Université de Genève, 51 chemin des Maillettes, CH-1290 Versoix, Switzerland
[2] Astrophysics Group, School of Physics, University of Exeter, Stocker Road, Exeter, EX4 4QL, UK.
[3] Leiden Observatory, Leiden University, Postbus 9513, 2300 RA Leiden, The Netherlands.
[4] Dipartimento di Fisica e Astronomia "Galileo Galilei," Univ. di Padova, Vicolo dell'Osservatorio 3, Padova I-35122, Italy.
[5] Anton Pannekoek Institute for Astronomy, University of Amsterdam, Science Park 904, 1098 XH Amsterdam, Netherlands.
[6] Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD, USA.
[7] Institut d'Astrophysique de Paris, CNRS, UMR 7095, Sorbonne Université, 98 bis boulevard Arago, Paris F-75014, France.

Science, published (10.1126/science.aat5879 and arXiv:1812.02189)

Stellar heating causes atmospheres of close-in exoplanets to expand and escape. These extended atmospheres are difficult to observe because their main spectral signature – neutral hydrogen at ultraviolet wavelengths – is strongly absorbed by interstellar medium. We report the detection of the near-infrared triplet of neutral helium in the transiting warm Neptune-mass exoplanet HAT-P-11b using ground-based, high-resolution observations. The helium feature is repeatable over two independent transits, with an average absorption depth of 1.08$\pm$0.05%. Interpreting absorption spectra with 3D simulations of the planet's upper atmosphere suggests it extends beyond 5 planetary radii, with a large scale height and a helium mass loss rate $\leq 3 \times 10^5 g \cdot s^{-1}$. A net blue-shift of the absorption might be explained by high-altitude winds flowing at 3 $km \cdot s^{-1}$ from day to night-side.

Download/Website: http://science.sciencemag.org/content/early/2018/12/06/science.aat5879

Contact: romain.allart@unige.ch

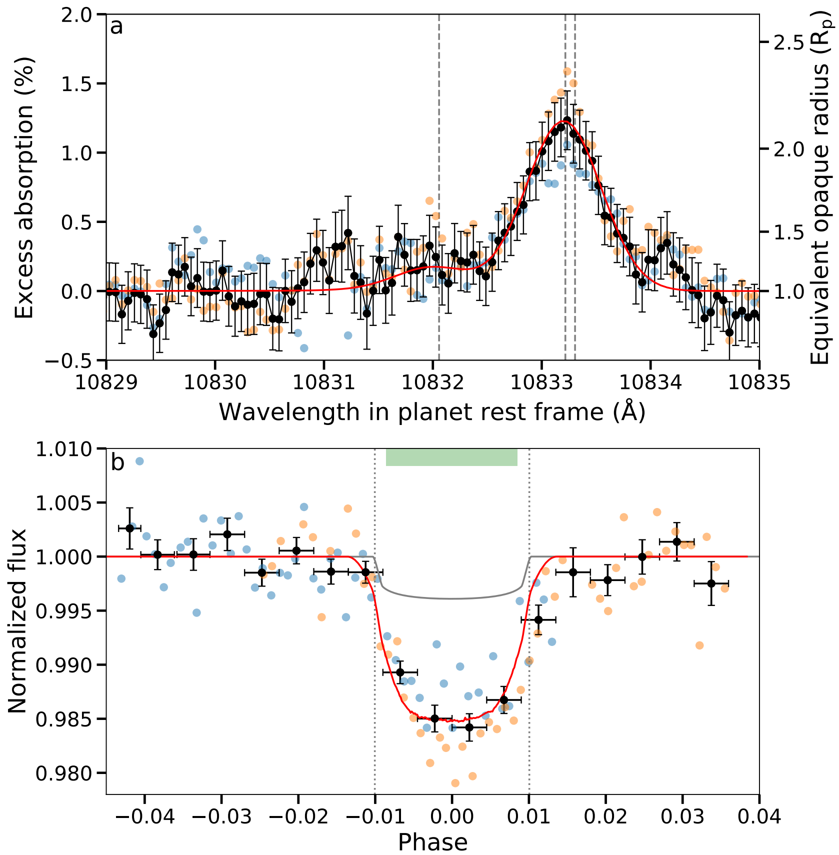

Figure 15: Average HeI transmission spectrum of HAT-P-11b in the planetary rest frame and transit light curve. Panel a: Transmission spectra in Visit 1 (blue) and Visit 2 (orange), showing the absorption signature centered on the HeI triplet (rest wavelengths shown as dashed black lines). The black points show the weighted average over the two visits, and the red line is the best-fitting model. Wavelengths are in the planet rest frame. Panel b: Light curves derived from the spectra in the top panel normalized to the expected planetary continuum absorption and integrated over 10,832.84 -10,833.59 Å. Plotting symbols are the same as in (a), whilst the theoretical planet light curve without helium absorption is shown in grey. The black light curve was binned in phase. The green band is the time window (-1 h to +1 h) used to produce the average spectrum in (a). Vertical grey dashed lines correspond to the beginning and end of the transit.

3 Jobs and Positions

Post-doctoral Fellowships in Exoplanet Science

Michael R. Meyer, John Monnier, & Emily Rauscher
The University of Michigan, Ann Arbor, Michigan, U.S.A.

Department of Astronomy, The University of Michigan, Late summer/Fall 2019

Now is a great time to study exoplanets at the University of Michigan. We are looking to hire multiple postdoctoral scholars, to work with Professors Michael Meyer, John Monnier, and Emily Rauscher on various aspects of exoplanet research. Specifically, we are targeting the areas of:
formation and evolution of planetary systems (Meyer, https://jobregister.aas.org/ad/93fdfa5f, deadline: Jan 4)
imaging of planet-forming disks (Monnier, https://jobregister.aas.org/ad/27e4d7a9, deadline: Jan 15), and
theoretical studies of exoplanet atmospheres (Rauscher, https://jobregister.aas.org/ad/393515bb, deadline: Dec 21).
The University of Michigan hosts a vibrant astrophysics research community within the Astronomy and Physics Departments, as well as significant expertise in planetary sciences within the Earth & Environmental Sciences and Climate & Space Sciences Departments. We are particularly strong in the interrelated study of stars, planets, and their formation (https://lsa.umich.edu/astro/research/stars-exoplanets.html). A postdoctoral researcher in our department can apply as PI to any of our telescope facility partnerships, currently including the Magellan Telescopes in Chile, the MDM Observatory in Arizona, the CHARA Interferometer, the SWIFT space telescope, and the NOEMA mm array. Significant computing resources are available through the Department and through the University of Michigan. The Michigan Institute for Research in Astrophysics funds cross-disciplinary efforts, including a series of intellectually stimulating conferences.
The University of Michigan is recognized as a top academic employer and Ann Arbor, Michigan is routinely celebrated for its high quality of life. We are a department that values diversity, equity, and inclusion as essential to scientific excellence (https://sites.google.com/umich.edu/astro-dei/home) and encourage applications from those with identities underrepresented in astronomy.

Download/Website: `https://lsa.umich.edu/astro`

Contact: `mrmeyer@umich.edu`

JWST Postdoctoral Instrument Scientist

Prof. René Doyon
Université de Montréal, Montréal, QC, Canada

Montréal, Canada, Starting date: April to September 2019

We invite applications for a **Postdoctoral Fellow position to contribute to the development of the FGS/NIRISS** – Fine Guidance Sensor/Near-Infrared Imager and Slitless Spectrograph – the Canadian-built instrument onboard the James Webb Space telescope (JWST) funded by the Canadian Space Agency.

The successful candidate, based out of the Physics Department at the Université de Montréal, is expected to play a leading role at a level of 80% of their time in the development of the NIRISS instrument, more specifically for data pipeline development, data analysis and simulation tools. We are also seeking a candidate with solid experience in exoplanet research. The successful candidate may use 20% of their time to conduct independent research programs related to exoplanets.

The successful candidate will ideally have **a Ph.D. in physics, astronomy or other related field** with a strong background in the development of complex data pipelines for ground- and/or space-based instruments along with experience in exoplanet research. Candidates with a M.Sc. and very strong experience will be considered. The initial term of employment is for two years and is renewable annually, subject to performance and availability of funding.

All applications received by January 15th, 2019 will be given full consideration, but the position will remain open until filled. The successful candidate is expected to **start between April and September 2019**. Salary will be commensurate with experience and be competitive with leading international research centres. Review of applications will begin February 1st, 2019 and candidates should be contacted in mid-February.

Applicants should email **a CV, list of publications, and a statement of no more than 3 pages of significant research contributions** (in a single PDF file) to: Prof René Doyon, **irex@astro.umontreal.ca**. Applicants must also have two references email letters of recommendation directly to the same address.

This position is a joint appointment between the Observatoire du Mont-Mégantic (OMM) and the Institute for Research on Exoplanets (iREx). OMM is actively involved in the development of astronomical instrumentation for ground- and space-based facilities. iREx brings together more than 40 people (professors, researchers and students) actively involved in the detection and characterization of exoplanets and related stellar astrophysics science programs.

Social Benefits:
Postdoctoral researchers at iREx at UdeM enjoy a comprehensive benefits package, see: http://www.fesp.umontreal.ca/fileadmin/Documents/PDF/GuideStagiairePostdoctoral_Eng.pdf

Contact: `irex@astro.umontreal.ca`

3 year Postdoc Position Funded by STFC

Aurora Sicilia-Aguilar

University of Dundee, 1 April 2019 (subject to negotiation)

We are looking for a motivated postdoc to join the Astrophysics group at the University of Dundee, UK, working on emission line tomography of young stars to study accretion, activity, and planet migration in the innermost disk. The successful candidate will work with Aurora Sicilia-Aguilar and Soko Matsumura, analyzing time-resolved emission line spectra of young stars to map accretion structures and the innermost disk and their relation to planet formation and migration. Part of the project includes the development of Python-based tools to analyze the emission line spectra of significant numbers of stars.

A background in star formation, protoplanetary disks, planet searches, and/or high-resolution optical spectroscopy is required. Knowledge of Python programming language is highly desirable.

The starting date is 1 April 2019 (subject to negotiation), and the post is for 3 years.

Please arrange for a cv with publication list, research statement (max 2 pages), and 2 reference letters to be sent to Dr. A. Sicilia-Aguilar (asiciliaaguilar@dundee.ac.uk). Informal enquiries can be also directed to the same address.

Applications received before 10 January 2019 will receive full consideration.

Contact: `asiciliaaguilar@dundee.ac.uk`

Postdoctoral Fellowship in exoplanet observations with CHEOPS.

Y.Alibert, B. Demory, W. Benz
[1] University of Bern, Switzerland

Bern, Switzerland, Sept. 2019

The Theoretical Astrophysics and Planetary Science Group (led by Prof. Willy Benz and Yann Alibert) and the SAINT-EX research group (led by Prof. Brice-Olivier Demory), both at the University of Bern, Switzerland, seek qualified candidates for a Postdoctoral Fellowship position in CHEOPS exoplanet observations.

The Characterising ExoPlanets Satellite (CHEOPS) is a joint mission between ESA and Switzerland to be launched during the first half of 2019. ESA's Science Programme has selected CHEOPS in 2012 as the first small mission (S-mission) in its Programme. The goal of the CHEOPS mission is to characterise the structure of exoplanets with typical sizes ranging from Neptune down to Earth diameters orbiting bright star. This will be achieved by measuring high-precision photometric sequences to detect variation in the stellar brightness induced by a transiting planet. For details about the mission's science goals and technical implementation, see the CHEOPS website at http://cheops.unibe.ch.

The successful applicant will hold a PhD in astrophysics with previous expertise in ground- and/or space-based exoplanet observations (data reduction, analysis and scheduling). The Fellow will be expected to contribute to the search and characterisation of transiting exoplanets using CHEOPS. The successful applicant will also be expected to conduct competitive research programmes in exoplanets. She/he will also have privileged access to CHEOPS GTO data by collaboration with CHEOPS science team members. In addition, the successful applicant will benefit from interactions with researchers from the Centre for Space and Habitability (e.g. Prof. Christoph Mordasini, see www.csh.unibe.ch) and with members of the NCCR PlanetS (see www.nccr-planets.ch).

This Postdoctoral Fellowship is for 2 years, with possible extension up to two years depending on results. The annual salary is between 75,000 and 97,000 CHF, depending upon experience (years after Ph.D) and is set by a predetermined matrix from the University and Canton of Bern.

Each prospective candidate will submit a research proposal with a maximum length of 5 pages. The candidate will use a maximum of 3 pages to explain her/his existing research expertise and interests performed either during the PhD or previous postdoctoral position(s). Additional application materials include a 2-page CV, a list of peer-reviewed publications (no page limit) and a cover letter (1 page) listing the names of 3 referees/references.

The entire application should be submitted as a single PDF file to Mrs Janine Jungo (janine.jungo@space.unibe.ch) by the application deadline of 30 January 2019. Applications sent as multiple files will not be processed. Please state ≪ Postdoctoral Fellowship in exoplanet observations with CHEOPS ≫ as the title of your email.

It is the responsibility of the applicant to ensure that three letters of recommendation are sent directly and separately to Mrs Janine Jungo by the letter writers themselves.

The starting date of the position is negotiable, but preferentially not later than 30th September 2019.

For inquiries about the job, contact Brice-Olivier Demory (brice.demory@csh.unibe.ch) and Yann Alibert (yann.alibert@space.unibe.ch))

Contact: `alibert@space.unibe.ch,brice.demory@csh.unibe.ch`

PostDoctoral Research on exoplanets with CHEOPS

Sérgio Sousa[1,2], *Susana Barros*[1,2]

[1] Instituto de Astrofísica e Ciências do Espaço, Universidade do Porto, CAUP, Rua das Estrelas, 4150-762 Porto, Portugal
[2] https://www.astro.up.pt/exoearths/

Porto, Portugal, Starting date: from 1st February to 1st May 2019

Centro de Investigação em Astronomia/Astrofísica da Universidade do Porto (CAUP) is advertising a postdoctoral position in the field of exoplanets. The position has duration of 25 months and cannot exceed the end date of the project, 21st of May 2021. The starting date of the position is negotiable, but not later than 1st May 2019. The gross monthly remuneration is 2128.34 EUR.

The researcher is expected to give support to the participation of the team in CHEOPS satellite data exploitation. Within the scientific themes of CHEOPS, the candidate should be involved in the search of transits of already known exoplanets, the characterization of its radius and composition. It is also expected for the researcher to work on the study of the exoplanet's atmosphere by using observations of the transit occultation and/or the observed phase curves. The team has already most of the tools for these analysis in place, but it is expected that the researcher participate on their optimization and in the development of new tools.

The call will be open until 21st January 2019. Candidates shall submit their application through the form available online (link bellow), including all supporting documentation, namely: motivation letter; certificate or PhD diploma copy; Curriculum Vitae, detailed and structured according to section 8 of this announcement; other documentation relevant for the evaluation of qualifications in a related scientific area; and a brief description of the most relevant scientific activities of the last 5 years;

IA assembles more than two-thirds of all active researchers working in Space Sciences in Portugal. 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. IA provides all necessary research conditions in a friendly and scientifically active environment.

Full details of this call is presented in the online anouncement: www.iastro.pt/jobs/IA2018-41-CTTI

Please contact us if you need further information.

Download/Website: `www.iastro.pt/jobs/IA2018-41-CTTI`

Contact: `sergio.sousa@astro.up.pt, susana.barros@astro.up.pt`

Design, development and implementation of a neural network for the analysis of photometric data from transit surveys

contact: J. Cabrera (juan.cabrera@dlr.de)
[1] Institute of Planetology, DLR, Rutherfordstr. 2, 12489 Berlin

DLR Berlin, 01.03.2019

The Institute of Planetary Research at the German Aerospace Center (DLR) carries out and supports research programs on the internal structure, formation and evolution of the planets, their moons, and asteroids and comets. Techniques employed include remote sensing and in-situ investigations using instruments carried on spacecraft, astronomical observations from the ground, theoretical modeling, and laboratory experiments.
The department on Extrasolar Planets and Atmospheres investigates the following fundamental questions: How do planets and planetary systems form and evolve? What makes a planet habitable? Is there life in other planets or moons and how can we detect it? The search for extrasolar planets and their characterization provide answers to these questions.
The successful analysis of large time series of photometric data from transit surveys is limited by the presence of residuals of instrumental noise. These noise sources complicate the detection of the small signal of transiting Earth-sized planets. Machine learning techniques have the potential to discriminate between genuine planetary signals and instrumental effects more effectively than classic detrending methods. It has been shown that Machine Learning Methods can compete with classic transit search algorithms, providing a higher yield of detections, which result in a better understanding of fundamental questions on planet formation and evolution.
Your **tasks**:

- Design, developm and implement a neural network for the analysis of photometric data from transit surveys.
- Adapt the known methods to the task to optimize the results and application to existing data sets (for example, public data from the Kepler mission).
- Develop and implement scientific algorithms based on Big Data techniques to the detection of transiting extrasolar planets (for example, for the PLATO mission).

Your **qualifications**:

- Graduate/Master degree in physics, mathematics or informatics
- Experience with the analysis of photometric light curves or with the analysis of signals (in particular, search for periodic signals).
- Knowledge of computer programming language (IDL, Python, Matlab, C...).
- Good level of English.
- Ability to work in an international Team.
- Good publication record in recognized international scientific journal is an asset (for applicants with background in physics, including astronomy and astrophysics).
- Ability to apply for third party funding is advantageous.
- Experience supervising master-level students is a plus.
- Interest in EPO (Education and Public Outreach) activities is of advantage.

Your **benefits**:
Look forward to a fulfilling job with an employer who appreciates your commitment and supports your personal and professional development. Our unique infrastructure offers you a working environment in which you have unparalled scope to develop your creative ideas and accomplish your professional objectives. Our human resources policy puts great value on a healthy work-life balance as well as equal opportunities for men and women. Individuals with disabilities will be given preferential consideration in the event their qualifications are equivalent to those of other candidates.

Download/Website: `https://www.dlr.de/dlr/jobs/en/desktopdefault.aspx/tabid-10596/1003_read-31098/`

Contact: `juan.cabrera@dlr.de`

PLATO Calibration and Operations Team Manager

contact: J. Cabrera (juan.cabrera@dlr.de)
[1] Institute of Planetology, DLR, Rutherfordstr. 2, 12489 Berlin

DLR Berlin, 01.03.2019

The Institute of Planetary Research of the German Aerospace Center (DLR) carries out and supports research programs on the internal structure, formation and evolution of the planets, their moons, and asteroids and comets. Techniques employed include remote sensing and in-situ investigations using instruments carried on spacecraft, astronomical observations from the ground, theoretical modeling, and laboratory experiments.
PLATO is the third of the M-class missions in the Cosmic Vision Programme of ESA. PLATO is Europe's next large-scale space mission to detect and characterise exoplanets. The primary goal of the mission is to look for Earth-like planets up to the habitable zone of solar-like stars. The aim is to determine the radius, mass and age of exoplanets with unprecedented accuracy. The Institute of Planetary Research at DLR is leading the international consortium responsible for the development of the PLATO payload, consisting of 26 cameras forming a wide-field space telescope.
Applicants shall contribute to the work in the department of Extrasolar Planets and Atmospheres and take part in the implementation of the PLATO mission and the preparation for the scientific exploitation of the data. This is a part of the existing PLATO system team. The department has leading positions in PLATO, CHEOPS, ground-based transit survey NGTS, and is involved in the exploitation of data from NASA's Kepler, K2 mission (KESPRINT collaboration), and ESO facilities.
The **tasks** associated with the position are:

- Manage the PLATO Characterization and Operations Team (PCOT), composed by members of the PLATO Mission Consortium (PMC) geographically distributed in Europe and coordinate the interaction between the PCOT and ESA. This task includes the coordination with the AIT teams.
- Ensure the provision of all information relevant to data calibration of the PLATO instrument (including calibration plans, calibration results, calibration algorithms, and managing data for archiving) and second-level quality control (on calibrated data).
- Support the spacecraft operations by participating in the establishment of the procedures needed for payload calibration & characterization, payload operation, and for scientific mission planning.
- Coordinate the provision of parameters for the PLATO Instrument TM/TC Database, the PLATO Instrument User's Manual, the documentation related to the maintenance of the instrument, the payload operational procedures considering the payload operational constraints, and the procedures to monitor instrument health and the instrument trend analysis.

Your **qualifications**: We are searching for a highly motivated, experienced researcher or engineer and we will value positively the following skills:

- Required education: M.S. (PhD beneficial) in Physics, Optical Engineering or equivalent.
- Project management experience.
- Experience in the planning, development, and implementation of assembly integration tests of optical systems for space missions.
- Experience in the conception and definition of test procedures and test plans with emphasis on optical systems.
- Experience with space system and subsystem integration and test execution.
- Fluent in English.

- Applicants shall have experience in the implementation of space projects or large ground-based astronomical instrument projects, including the activities of calibration, characterization and operation of scientific instrumentation (optical payloads).
- Experience in the field of extrasolar planets and related instrumentation is beneficial.

Your **benefits**:
Look forward to a fulfilling job with an employer who appreciates your commitment and supports your personal and professional development. Our unique infrastructure offers you a working environment in which you have unparalled scope to develop your creative ideas and accomplish your professional objectives. Our human resources policy puts great value on a healthy work-life balance as well as equal opportunities for men and women. Individuals with disabilities will be given preferential consideration in the event their qualifications are equivalent to those of other candidates.

Download/Website: `https://www.dlr.de/dlr/jobs/en/desktopdefault.aspx/tabid-10596/1003_read-31099/`

Contact: `juan.cabrera@dlr.de`

4 Conferences

ExoClimes V: The Diversity of Planetary Atmospheres

Ray Pierrehumbert, Nick Cowan, Joe Harrington, David Sing

Oxford, UK, 12-15 August 2019

Pre-registration for ExoClimes V is now open!

The Exoclimes conference series is one of the original conferences devoted to exoplanets, and still the only one to focus on their climates and climate evolution. The goal of the series is to bring together exoplanet observers, modelers and theorists with researchers on fundamental atmospheric and planetary interior processes in the Solar System and Earth Science communities, so that the communities can learn from one another. Exoplanets are a source of new problems to be treated by methods developed for the Earth and other Solar System planets, while work in Earth and Solar System disciplines provides a storehouse of fundamental advances which can be generalized to a broader planetary context. The motto of the conference is ”Long talks and even longer breaks” with the idea that there should be ample opportunities for informal discussion and striking up new collaborations. Exoclimes does not seek to comprehensively cover all developments related to exoplanet climate, but picks a few themes to emphasize for each meeting. Invited keynote talks, which generally have a considerable pedagogical component, are supplemented by a number of contributed talks on related themes.

Exoclimes first met in 2010. The founding steering committee consisted of Frederic Pont (at Exeter at the time, and who had the initial vision) David Sing (also at Exeter at the time, who arranged key funding), Nick Cowan (then at Northwestern, who insisted on something outdoorsy to do) and Joe Harrington (Florida State University, who made sure the meeting actually happened). The current steering committee consists of Ray Pierrehumbert (Oxford), David Sing (Johns Hopkins), Nick Cowan (McGill) and Joe Harrington (Florida State).

Exoclimes generally meets in alternate years, and alternates between North American and European venues. Exoclimes V was delayed by one year so as to get out of phase with the more general Exoplanets conference series.

To pre-register, go to http://exoclimes2019.org.

Deadline 31st Jaunary 2019.

Participants will be selected on the basis of information provided during pre-registration. The pre-registration deadline is 31 January, 2019. Conference fees do not need to be paid as part of pre-registration, but anticipated fees are listed on the pre-registration page. Some financial aid will be available.

An exciting list of keynote speakers has been lined up, and an outline programme is now available on the web site. We are looking forward to another stimulating and enjoyable ExoClimes.

Ray Pierrehumbert, on behalf of the SOC

Dorian Abbot (University of Chicago); Suzanne Aigrain (University of Oxford); Beth Biller (University of Edinburgh); Jayne Birkby (University of Amsterdam); Nick Cowan (McGill University); Joe Harrington (University of Central Florida); Yohai Kaspi (Weizmann Institute); Heather Knutson (California Institute of Technology); Jeremy LeConte (University of Bordeaux); Nathan Mayne (University of Exeter); Ruth Murray-Clay (University of California, Santa Cruz); Ray Pierrehumbert (University of Oxford); Emily Rauscher (University of Michigan); David Sing (Johns Hopkins University); Robin Wordsworth (Harvard University)

2019 Sagan Summer Workshop: Astrobiology for Astronomers

D. Gelino, E. Furlan
NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Pasadena, CA, July 15-19, 2019

The 2019 Sagan Summer Workshop will focus on astrobiology. It will feature introductions on the formation of Earth and terrestrial planets, their evolution over time, current geochemical cycles on Earth, and the emergence of life on Earth. Our knowledge of exo-Earths will be reviewed, including demographics, composition, atmospheric signatures, and comparison with Earth. Detection of biosignatures, with an emphasis on false positives and false negatives, will also be discussed. Attendees will participate in hands-on group projects related to astrobiology and will have the opportunity to present their own work through short presentations (research POPs) and posters.

The Sagan Summer Workshops are free to attend and are aimed at graduate and post doctoral level students, however anyone who is interested in learning more about the field is welcome to attend. More details will be posted on the workshop website in early 2019.

Download/Website: `http://nexsci.caltech.edu/workshop/2019`

Contact: `sagan_workshop@ipac.caltech.edu`

The Earth as an Exoplanet (session at EGU 2019)

C. P. Johnstone[1], *L. Noack*[2], *G. Feulner*[3], *M. Schönbächler*[4]

[1] University of Vienna, Department of Astrophysics, Türkenschanzstrasse 17, 1180 Vienna, Austria
[2] Free University Berlin, Department of Earth Sciences, Geochemistry, Berlin, Germany
[3] Potsdam Institute for Climate Impact Research, Leibniz Association, D–14473 Potsdam, Germany
[4] Department of Earth Sciences, ETH Zurich, Switzerland

Vienna, Austria, 7-12 April 2019

The solar system terrestrial planets, and especially the Earth, provide the best opportunity to learn about the basic physical principles of rocky planets, which can then be applied to the evolution of exoplanets and their atmospheres. Similarly, knowledge of the diversity and properties of exoplanetary systems can provide important information about the formation and evolution of our own solar system. In this session, we will focus on the application of solar system based knowledge to exoplanets and understanding how the Earth can be understood in the exoplanetary context. We welcome contributions focusing on theoretical studies of both solar system planets and exoplanets, and any observational studies that fit the topic of the session. Of particular interest are studies of atmospheric evolution due to surface-atmosphere interactions and atmospheric losses to space, as well as interactions between stars and planets. The abstract submission deadline is 10 January 2019.

Contact: `colin.johnstone@univie.ac.at`

5 Exoplanet Archive Updates

November Updates at the NASA Exoplanet Archive

The NASA Exoplanet Archive team
Caltech/IPAC-NASA Exoplanet Science Institute, MC 100-22 Pasadena CA 91125

Pasadena CA USA, December 10, 2018

November 29, 2018

We've added eight new radial velocity planets and two new microlensing planets, bringing the total exoplanet count to **3,848**.
The new planets are: GJ 317 c, HD 33142 c, HD 95089 c, HD 99706 c, HD 102329 c, HD 116029 c, HD 156279 c, HD 114783 c, MOA-2016-BLG-319L b, and MOA-2011-BLG-291L b. Also, there are new parameters for pi Men b and eight new parameter sets for three microlensing planets: MOA-2016-BLG-319L b (two sets), MOA-2011-BLG-291L b (six sets), and TCP J05074264+2447555 b (two sets).
View the data in the Confirmed Planets (`http://bit.ly/2MqFnub`), Composite Planet Data (`http://bit.ly/2l84Qw9`), and Extended Planet Data (`http://bit.ly/2NLy1Ci`) tables. In addition, the new MOA and TCP data appear in the Microlensing table (`http://bit.ly/2JQr180`).

November 15, 2018
One new planet, K2-284 b, has been added this week, plus new planet parameter sets for pi Men b & c (a.k.a. HD 39091 b & c). The new planet is a sub-Neptune orbiting a young star found by the K2 mission. View the data in the Confirmed Planets, Composite Planet Data, and Extended Planet Data tables.
November 8, 2018
We've added the data for pi Mensae c (a.k.a. HD 39091 c), the first published planet to be discovered by the Transiting Exoplanet Sky Satellite (TESS) mission! The planet is a super-Earth and orbits around an extremely bright star that is known to host another planet (HD 39091 b).

Note: The TESS planet host star was previously known to host a longer-period planet and was added to the archive as HD 39091. As a result, the archive default name for pi Mensae appears as HD 39091 in the interactive tables. When using our Explore the Archive search interface on the home page, you may enter pi Mensae c (or its abbreviation pi Men c) or HD 39091 c to get the same result.

We've added an additional 10 planets this week as well: GJ 96 b, KMT-2016-BLG-1820L b KMT-2016-BLG-2142L b, KMT-2016-BLG-1397L b, MOA-2015-BLG-337L b, OGLE-2013-BLG-1761L b, WASP-147 b, WASP-160 B b, WASP-164 b, and WASP-165 b. These planets bring the total confirmed planet count to **3,837**!

View their data in the Confirmed Planets, Composite Planet Data, and Extended Planet Data tables. In addition, the new MOA, KMT, and OGLE planets and parameters appear in the Microlensing table.

Download/Website: `https://exoplanetarchive.ipac.caltech.edu`

Contact: `mharbut@caltech.edu`

6 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during November 2018.

astro-ph/1811.00011: **H2O abundances and cloud properties in ten hot giant exoplanets** by *Arazi Pinhas et al.*

astro-ph/1811.00023: **Origin of 1I/'Oumuamua. II. An ejected exo-Oort cloud object?** by *Amaya Moro-Martín*

astro-ph/1811.00107: **Masses of the Kepler-419 Planets from Transit Timing Variations Analysis** by *X. Saad-Olivera et al.*

astro-ph/1811.00412: **Deep ALMA Search for CO Gas in the HD 95086 Debris Disc** by *Mark Booth et al.*

astro-ph/1811.00441: **Two new free-floating planet candidates from microlensing** by *P. Mroz et al.*

astro-ph/1811.00523: **How planetary growth outperforms migration** by *Anders Johansen , Shigeru Ida , Ramon Brasser*

astro-ph/1811.00935: **The HST PanCET Program: Hints of Na I & Evidence of a Cloudy Atmosphere for the Inflated Hot Jupiter WASP-52b** by *Munazza K. Alam et al.*

astro-ph/1811.01681: **Retrieving Temperatures and Abundances of Exoplanet Atmospheres with High-Resolution Cross-Correlation Spectroscopy** by *Matteo Brogi, Michael R Line*

astro-ph/1811.01882: **A Jovian planet in an eccentric 11.5 day orbit around HD1397 discovered by TESS** by *L.D. Nielsen et al.*

astro-ph/1811.01970: **Prospects for TTV Detection and Dynamical Constraints with TESS** by *Sam Hadden et al.*

astro-ph/1811.02060: **Ground-based Spectroscopy of the Exoplanet XO-2b using a Systematic Wavelength Calibration** by *Kyle A. Pearson et al.*

astro-ph/1811.02108: **Detecting Unresolved Binaries in TESS Data with Speckle Imaging** by *Rachel A. Matson, Steve B. Howell, David Ciardi*

astro-ph/1811.02156: **HD 1397b: a transiting warm giant planet orbiting a V = 7.8 mag sub-giant star discovered by TESS** by *Rafael Brahm et al.*

astro-ph/1811.02303: **Atmospheric mass loss from hot Jupiters irradiated by stellar superflares** by *D. V. Bisikalo et al.*

astro-ph/1811.02324: **Predicting Exoplanets Mass and Radius: A Nonparametric Approach** by *Bo Ning, Angie Wolfgang, Sujit Ghosh*

astro-ph/1811.02573: **An optical transmission spectrum of the ultra-hot Jupiter WASP-33b. First indication of AlO in an exoplanet** by *C. von Essen et al.*

astro-ph/1811.02588: **Contribution of the core to the thermal evolution of sub-Neptunes** by *A. Vazan et al.*

astro-ph/1811.02677: **Ongoing Resurfacing of KBO Eris by Volatile Transport in Local, Collisional, Sublimation Atmosphere Regime** by *Jason D. Hofgartner et al.*

astro-ph/1811.02715: **First assessment of the binary lens OGLE-2015 BLG-0232** by *E. Bachelet et al.*

astro-ph/1811.02905: **Constraints on Compound Chondrule Formation from Laboratory High-Temperature Collisions** by *Tabea Bogdan et al.*

astro-ph/1811.03043: **Retired A Stars and Their Companions VIII: 15 New Planetary Signals Around Subgiants and Transit Parameters for California Planet Search Planets with Subgiant Hosts** by *Jacob K. Luhn et al.*

astro-ph/1811.03102: **An automated search for transiting exocomets** by *Grant M. Kennedy et al.*

astro-ph/1811.03202: **Sculpting the Valley in the Radius Distribution of Small Exoplanets as a by-product of Planet Formation: The Core-Powered Mass-Loss Mechanism** by *Akash Gupta, Hilke E. Schlichting*

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