ExoPlanet News
An Electronic Newsletter

No. 109, 16. July 2018

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Contents

1 Editorial

Welcome to edition 109 of the ExoPlanet News!

A big thank you to all who contributed to this issue of the newsletter. However, as you can see, the number of abstracts and announcements is comparatively small this time and we have been discussing internally whether this has to do with the FIFA world-cup or whether the summer vacation period already kicked in... Whatever the reason, please consider submitting your paper abstract, job ad or meeting announcement to ExoPlanet News; more than 1400 subscribers are interested to hear about it!

Despite the small number, we have an interesting mix of topics covered by the abstracts submitted this month and, as you can see, we also have another monthly update from NASA's Exoplanet Archive team this time announcing the New Composite Planet Data Table – feedback welcome!

Concerning the information available on the ExoPlanet News webpage (http://nccr-planets.ch/exoplanetnews/) we are still welcoming suggestions from the community what to further include and / or improve. Please do not hesitate to get in touch with us.

The current Latex template for submitting contributions of any kind, as well as all previous editions of ExoPlanet News, can also be found on the webpage mentioned above. As usual, we would be happy to receive feedback concerning the newsletter.

The next issue of will appear August 13, 2018.

Thanks for all your support and best regards from Switzerland

Sascha P. Quanz
Yann Alibert
Adrien Leleu
Christoph Mordasini

2 Abstracts of refereed papers

The 55 Cnc system reassessed

V. Bourrier[1], *X. Dumusque*[1], *C. Dorn*[2], *G.W. Henry*[3], *N. Astudillo-Defru*[4], *J. Rey*[1], *B. Benneke*[5], *G. Hébrard*[6,7], *C. Lovis*[1], *B.O. Demory*[8], *C. Moutou*[9,10], *D. Ehrenreich*[1]

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Astronomy & Astrophysics, in press (arXiv:1807.04301)

Orbiting a bright, nearby star the 55 Cnc system offers a rare opportunity to study a multiplanet system that has a wide range of planetary masses and orbital distances. Using two decades of photometry and spectroscopy data, we have measured the rotation of the host star and its solar-like magnetic cycle. Accounting for this cycle in our velocimetric analysis of the system allows us to revise the properties of the outermost giant planet and its four planetary companions. The innermost planet 55 Cnc e is an unusually close-in super-Earth, whose transits have allowed for detailed follow-up studies. Recent observations favor the presence of a substantial atmosphere yet its composition, and the nature of the planet, remain unknown. We combined our derived planet mass ($M_{\rm p}$ = 8.0±0.3 $\rm M_{Earth}$) with refined measurement of its optical radius derived from HST/STIS observations ($R_{\rm p}$ = 1.88±0.03 $\rm R_{Earth}$ over 530-750 nm) to revise the density of 55 Cnc e (ρ = 6.7±0.4 g cm^{-3}). Based on these revised properties we have characterized possible interiors of 55 Cnc e using a generalized Bayesian model. We confirm that the planet is likely surrounded by a heavyweight atmosphere, contributing a few percents of the planet radius. While we cannot exclude the presence of a water layer underneath the atmosphere, this scenario is unlikely given the observations of the planet across the entire spectrum and its strong irradiation. Follow-up observations of the system in photometry and in spectroscopy over different time-scales are needed to further investigate the nature and origin of this iconic super-Earth.

Download/Website: `https://arxiv.org/abs/1807.04301`

Contact: `vincent.bourrier@unige.ch`

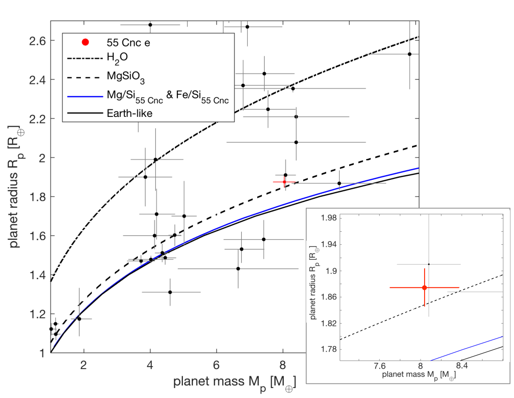

Figure 1: Bourrier et al.: Refined mass and radius of 55 Cnc e (shown in red) in comparison with four mass-radius-relationships of idealized rocky interiors: a pure water composition, the least-dense purely-silicate interior represented by $\rm MgSiO_3$, an interior of an iron core and a iron-free mantle that fits the stellar refractory abundances of 55 Cnc, and an Earth-like composition. We show exoplanets with mass known to better than 30% (error bars represent 1-σ uncertainties on their mass and radius).

Quantifying the observational effort required for the radial velocity characterization of TESS planets

R. Cloutier[1,2,3], *R. Doyon*[3], *F. Bouchy*[4], *G. Hébrard*[5]

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[5] Institut d'astrophysique de Paris

The Astronomical Journal, in press

The Transiting Exoplanet Survey Satellite will conduct a 2-year long wide-field survey searching for transiting planets around bright stars. Many TESS discoveries will be amenable to mass characterization via ground-based radial velocity measurements with any of a growing suite of existing and anticipated velocimeters in the optical and near-infrared. In this study we present an analytical formalism to compute the number of radial velocity measurements—and hence the total observing time—required to characterize RV planet masses with the inclusion of either a white or correlated noise activity model. We use our model to calculate the total observing time required to measure all TESS planet masses from the expected TESS planet yield while relying on our current understanding of the targeted stars, stellar activity, and populations of unseen planets which inform the expected radial velocity precision. We also present specialized calculations applicable to a variety of interesting TESS planet subsets including the characterization of 50 planets smaller than 4 Earth radii which is expected to take as little as 60 nights of observation. Although, the efficient RV characterization of such planets requires a-priori knowledge of the 'best' targets which we argue can be identified prior to the conclusion of the TESS planet search based on our calculations. Our results highlight the comparable performance of optical and near-IR spectrographs for most planet populations except for Earths and temperate TESS planets which are more efficiently characterized in the near-IR. Lastly, we present an online tool to the community to compute the total observing times required to detect any transiting planet using a user-defined spectrograph.

Download/Website: `https://arxiv.org/abs/1807.01263`

Contact: `cloutier@astro.utoronto.ca`

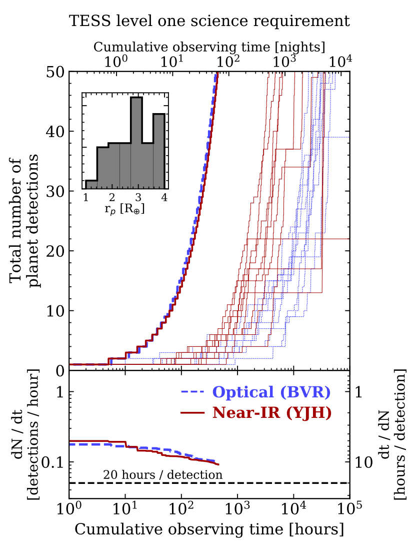

Figure 2: Cloutier et al.: The cumulative observing time required to complete the TESS level one science requirement of measuring the masses of 50 planets smaller than 4 Earth radii using radial velocity measurements. Solid curves in the upper panel represent the most efficient characterization of 50 such TESS planets with either a fiducial optical or near-IR spectrograph. The suite of thin curves represent random subsets of planets smaller than 4 Earth radii which require much more observing time to characterize 50 such planets. The bottom panel shows the first time derivative of the solid cumulative observing time curves and represents the observing efficiency as the number of RV planet detections per hour of observing time.

Formation of hot Jupiters through disk migration and evolving stellar tides

R. Heller[1]
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Astronomy & Astrophysics, (1806.04672)

Since the discovery of Jupiter-sized planets in extremely close orbits around Sun-like stars, several mechanisms have been proposed to produce these “hot Jupiters”. None of them addressed the pile-up of giant planets at 0.05 AU observed in stellar radial velocity surveys, their longterm orbital stability in the presence of stellar tides, and their occurrence rate of $1.2\,(\pm 0.38)$ % at the same time. Here we calculate the combined torques on the planet from both the dissipation by the stellar dynamical tide and from the protoplanetary disk in the type II migration regime. The disk is modelled as a 2D non-isothermal viscous disk and parameterized to reproduce the minimum-mass solar nebula. The planet is on a circular orbit in the disk midplane and in the star's equatorial plane. We show that the torques from star-planet and planet-disk interaction can add up to zero beyond the co-rotation radius around young, solar-type stars, where inwards migration would stop. Monte Carlo simulations with plausible variations of our nominal parameterization of the star-disk-planet model predict a survival rate of 28.4 % against tidal destruction. Once the protoplanetary disk has gone, the surviving hot Jupiters are pushed outward from their tidal migration barrier and pile up at about 0.05 AU, as we demonstrate using a numerical implementation of a stellar dynamical tide model coupled with stellar evolution tracks. Orbital decay is negligible on a billion year time scale due to the contraction of the highly dissipative convective envelopes in young Sun-like stars. We also find that the lower pile-up efficiency around metal-poor stars partly explains the absence of a hot Jupiter pile-up in the Kepler data. When combined with the observed hot Jupiter occurrence rate, our results for the survival rate imply a hot Jupiter formation rate of $4.2\,(\pm 1.3)$ % around sun-like stars, or roughly one hot Jupiter initially forming around every 25th sun-like star. This value depends on the distribution of the relevant star and disk properties and can change by a factor of a few within reasonable margins. Our scenario reconciles models and observations of young spinning stars with the observed hot Jupiter pile up and hot Jupiter occurrence rates.

Download/Website: `https://arxiv.org/abs/1806.06601`

Contact: `heller@mps.mpg.de`

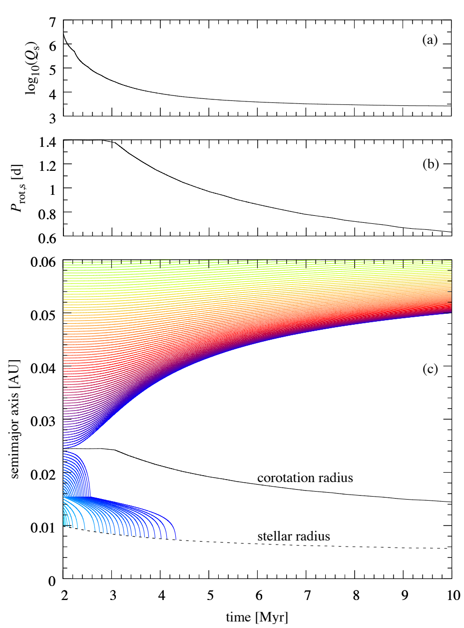

Figure 3: Heller: Evolution of the spin and orbital properties of a Sun-like star (initial rotation period 1.4 d, metallicity $Z = 0.0134$) as per Amard et al. (2016) and Bolmont et al. (2017) and orbital evolution of a hot Jupiter population. **(a)** Frequency-averaged tidal dissipation factor and **(b)** rotation period of the star during the first 10 Myr of stellar evolution. **(c)** Tidally-driven orbital evolution of a single planet on a grid of 100 equally-spaced initial orbits. Orbital decay is calculated assuming zero eccentricity and according to the dynamical tide model with stellar evolution as per **(a)** and **(b)**.

Cometary impactors on the TRAPPIST-1 planets can destroy all planetary atmospheres and rebuild secondary atmospheres on planets f, g, h

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MNRAS, in press (arXiv:1802.05034)

The TRAPPIST-1 system is unique in that it has a chain of seven terrestrial Earth-like planets located close to or in its habitable zone. In this paper, we study the effect of potential cometary impacts on the TRAPPIST-1 planets and how they would affect the primordial atmospheres of these planets. We consider both atmospheric mass loss and volatile delivery with a view to assessing whether any sort of life has a chance to develop. We ran N-body simulations to investigate the orbital evolution of potential impacting comets, to determine which planets are more likely to be impacted and the distributions of impact velocities. We consider three scenarios that could potentially throw comets into the inner region (i.e within 0.1au where the seven planets are located) from an (as yet undetected) outer belt similar to the Kuiper belt or an Oort cloud: Planet scattering, the Kozai-Lidov mechanism and Galactic tides. For the different scenarios, we quantify, for each planet, how much atmospheric mass is lost and what mass of volatiles can be delivered over the age of the system depending on the mass scattered out of the outer belt. We find that the resulting high velocity impacts can easily destroy the primordial atmospheres of all seven planets, even if the mass scattered from the outer belt is as low as that of the Kuiper belt. However, we find that the atmospheres of the outermost planets f, g and h can also easily be replenished with cometary volatiles (e.g. $\sim$ an Earth ocean mass of water could be delivered). These scenarios would thus imply that the atmospheres of these outermost planets could be more massive than those of the innermost planets, and have volatiles-enriched composition.

Download/Website: `http://adsabs.harvard.edu/doi/10.1093/mnras/sty1677`

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The TROY project: II. Multi-technique constraints on exotrojans in nine planetary systems

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Astronomy & Astrophysics, in press (arXiv:180700773L)

Co-orbital bodies are the byproduct of planet formation and evolution, as we know from the Solar System. Although planet-size co-orbitals do not exists in our planetary system, dynamical studies show that they can remain stable for long periods of time in the gravitational well of massive planets. Should they exist, their detection is feasible with the current instrumentation. In this paper, we present new ground-based observations searching for these bodies co-orbiting with nine close-in (P<5 days) planets, using different observing techniques. The combination of all of them

allows us to restrict the parameter space of any possible trojan in the system. We use multi-technique observations (radial velocity, precision photometry and transit timing variations), both newly acquired in the context of the TROY project and publicly available, to constrain the presence of planet-size trojans in the Lagrangian points of nine known exoplanets. We find no clear evidence of trojans in these nine systems through any of the techniques used down to the precision of the observations. However, this allows us to constrain the presence of any potential trojan in the system, specially in the trojan mass/radius versus libration amplitude plane. In particular, we can set upper mass limits in the super-Earth mass regime for six of the studied systems.

Download/Website: `http://adsabs.harvard.edu/abs/2018arXiv180700773L`

Contact: `jlillobox@eso.org`

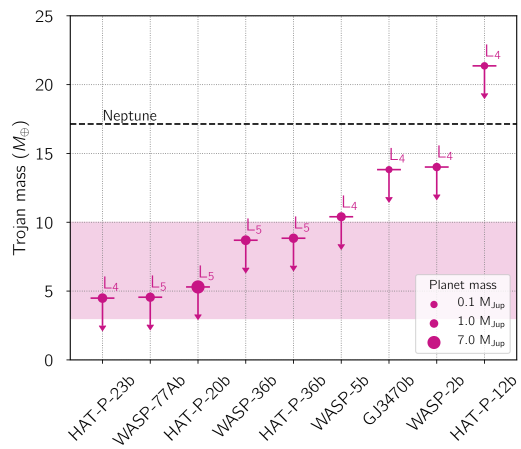

Figure 4: Lillo-Box et al.: Upper limits on the masses of trojan bodies located at the exact Lagrangian points of the nine systems studied. The symbol size scales as the mass of the planet. The mass of Neptune is denoted for reference and the shaded region represents the super-Earth mass regime.

The Exoplanet Population Observation Simulator. I - The Inner Edges of Planetary Systems

Gijs D. Mulders[1,2], Ilaria Pascucci[1,2,3], Dániel Apai[4,1,2,3], Fred J. Ciesla[5,2]

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The Astronomical Journal, 2018AJ....156...24M

The *Kepler* survey provides a statistical census of planetary systems out to the habitable zone. Because most planets are non-transiting, orbital architectures are best estimated using simulated observations of ensemble populations. Here, we introduce `epos`, the Exoplanet Population Observation Simulator, to estimate the prevalence and orbital architectures of multi-planet systems based on the latest *Kepler* data release, `DR25`. We estimate that at least 42% of sun-like stars have nearly coplanar planetary systems with 7 or more exoplanets. The fraction of stars with at least one planet within 1 au could be as high as 100% depending on assumptions about the distribution of single transiting planets. We estimate an occurrence rate of planets in the habitable zone around sun-like stars of $\eta_\oplus = 36 \pm 14\%$.

The innermost planets in multi-planet systems are clustered around an orbital period of 10 days (0.1 au), reminiscent of the protoplanetary disk inner edge or could be explained by a planet trap at that location. Only a small fraction of planetary systems have the innermost planet at long orbital periods, with fewer than $\approx 8\%$ and $\approx 3\%$ having no planet interior to the orbit of Mercury and Venus, respectively. These results reinforce the view that the solar system is not a typical planetary system, but an outlier among the distribution of known exoplanetary systems. We predict that at least half of the habitable zone exoplanets are accompanied by (non-transiting) planets at shorter orbital periods, hence knowledge of a close-in exoplanet could be used as a way to optimize the search for Earth-size planets in the Habitable Zone with future direct imaging missions.

Download/Website: `http://adsabs.harvard.edu/abs/2018AJ....156...24M`

Contact: `mulders@uchicago.edu`

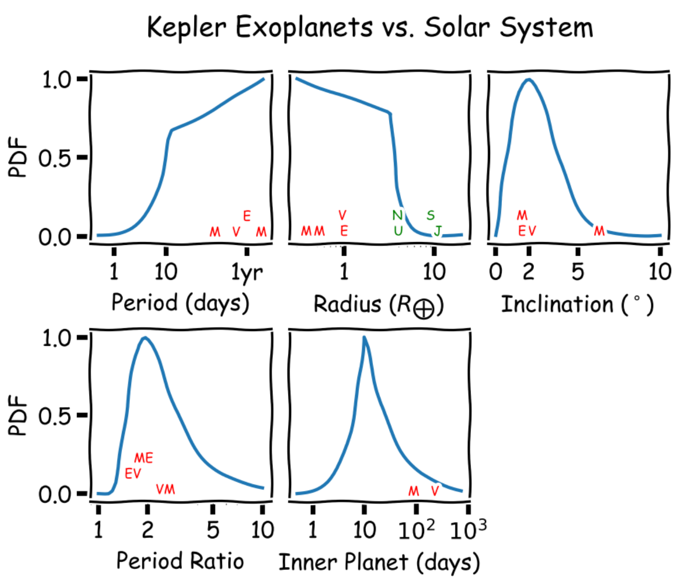

Figure 5: Mulders et al.: Best-fit distribution of planetary system properties from Kepler (blue) compared to the solar system terrestrial planets (red letters). The inclinations of the terrestrial planets are with respect to the invariable plane. The orbital periods, radii, inclinations, and period ratios of the terrestrial planets lie near the peak of the distribution of Kepler systems. The only notable exception is the orbital period of the innermost planet, where Mercury (92th percentile) and Venus (97th percentile) lie in the tail of the distribution.

3 Jobs & Positions

NExScI ExoFOP-TESS Postdoctoral Scholar

David R. Ciardi, NExScI Chief Scientist

Pasadena, CA USA, Applications Due 31 August 2018

The NASA Exoplanet Science Institute (NExScI; http://nexsci.caltech.edu) at the California Institute of Technology has an immediate opening for a Postdoctoral Scholar to work on ExoFOP-TESS. The ExoFOP-TESS website (https://exofop.ipac.caltech.edu/tess/) is a service to help the community organize and share observations, data, and information regarding the follow-up observations of planetary candidates discovered by the recently launched Transiting Exoplanet Survey Satellite (TESS).

The Postdoctoral Scholar will participate scientifically in the TESS Follow-Up Observation Program (TFOP; https://tess.gsfc.nasa.gov/ground_based_followup.html). As part of those duties, the Postdoctoral Scholar will work with the NExScI staff to assist with the community use of the ExoFOP services and to help coordinate the community interaction with the TFOP Working Group.

NExScI is part of IPAC, which is a research center currently supporting several space- and ground-based observatories and surveys including Spitzer, NEOWISE, ZTF, and LSST. The Postdoctoral Scholar will have access to telescopes on Palomar and other observing facilities, and be part of the vibrant research environment of Pasadena, CA.

The Postdoctoral Scholar will participate in the TFOP Working Group (TFOP WG) helping to coordinate and facilitate communication between the TFOP WG, the community, and the ExoFOP-TESS team at NExScI. As part of this effort, the candidate will participate in the TFOP scientific activities related to the TESS exoplanet candidate follow-up and characterization program. The Postdoctoral Scholar will also be expected to pursue a scientific program related to the TESS exoplanet candidate follow-up and characterization or other exoplanet research.
Basic Qualifications:

- Candidates should have obtained, by the starting date, a PhD in Astronomy, Physics, or a related scientific field.
- Experience in observational astronomy – particularly related to the follow-up of exoplanets.
- Strong communication skills, and the ability to work well with others on a small team.

To apply, please send CV, publication list, statement of research, and the names and contact information of three references to Mary Ellen Barba (meb@ipac.caltech.edu) no later than 31 August 2018.

Preference will be given to candidates who can start by 01 December 2018.

We are an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin, disability status, protected veteran status, or any other characteristic protected by law.

Download/Website: `https://jobregister.aas.org/ad/bed9df77`

Contact: `meb@ipac.caltech.edu`

4 Exoplanet Archive Updates

June 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, July 11, 2018

June 15, 2018

Announcing the New Composite Planet Data Table!

In response to user requests, we've created the Composite Planet Data Table—a more complete table of planet parameters drawn from multiple references and/or calculations. This table is intended to help users who need a more "filled in" table to enable a statistical view of the known exoplanet population and their host environments. Each parameter's reference is provided in the table: `http://bit.ly/2l84Qw9`

Please use this table's information on any one planet or stellar host with caution, as the parameters in a given row may not be self-consistent.

Learn more about the table, and its caveats, on its About page (`http://bit.ly/2HPW8LX`), and get details on how the archive calculates the table's values on the Composite Calculations page. `http://bit.ly/2LLQcG0`

Access the table from its button in the Work With Data area of the home page, or from the Data pull-down menu on any archive web page. The Composite Planet Data table is also accessible through the our application programming interface (API). Read the API User Guide to learn how to construct a query for command-line or automated data retrieval. All of the available planet and stellar parameters and their descriptions are listed in the Composite Planet Data Table Definitions document.

If you are not sure whether to use the original Confirmed Planets table, the Extended Planet Data table, or the new Composite Planet Data table for your research, see the graphic that illustrates their differences: `http://bit.ly/2m2FNeu`. More explanation is provided in the About the Composite Planet Data Table document.

Once you've had a chance to work with the new table, please let us know what you think! Contact us through social media, or submit a Helpdesk ticket.

June 7, 2018

We've added five more planets this week: HD 47366 b and c, HD 89345 b (a.k.a. K2-234 b), EPIC 211945201 b (a.k.a. K2-236 b), and NGTS-3 A b. View their data on their respective Planet Host or Confirmed Planet overview pages, or go to the Confirmed Planet interactive table: `http://bit.ly/2MqFnub`

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

Contact: `mharbut@caltech.edu`

5 As seen on astro-ph

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

June 2018

astro-ph/1806.00018: **Is extraterrestrial life suppressed on subsurface ocean worlds due to the paucity of bioessential elements?** by *Manasvi Lingam, Abraham Loeb*

astro-ph/1806.00168: **The curious case of Mars formation** by *Jason Man Yin Woo et al.*

astro-ph/1806.00314: **Migration of planets in circumbinary discs** by *Daniel Thun, Wilhelm Kley*

astro-ph/1806.00487: **A Balanced Budget View on Forming Giant Planets by Pebble Accretion** by *Jonathan W. Lin, Eve J. Lee, Eugene Chiang*

astro-ph/1806.00518: **On the Feasibility of Intense Radial Velocity Surveys for Earth-twin Discoveries** by *Richard D. Hall et al.*

astro-ph/1806.01154: **The methane distribution and polar brightening on Uranus based on HST/STIS, Keck/NIRC2, and IRTF/SpeX observations through 2015** by *Lawrence A. Sromovsky et al.*

astro-ph/1806.01181: **Two planetary systems with transiting Earth-size and super-Earth planets orbiting late-type dwarf stars** by *E. Diez Alonso et al.*

astro-ph/1806.01284: **Exocomet Orbit Fitting: Accelerating Coma Absorption During Transits of β Pictoris** by *Grant M. Kennedy*

astro-ph/1806.01289: **Scattering of exocomets by a planet chain: exozodi levels and the delivery of cometary material to inner planets** by *Sebastian Marino et al.*

astro-ph/1806.01695: **Suppression of atmospheric recycling of planets embedded in a protoplanetary disc by buoyancy barrier** by *Hiroyuki Kurokawa, Takayuki Tanigawa*

astro-ph/1806.02024: **Mercury's Internal Structure** by *Jean-Luc Margot et al.*

astro-ph/1806.02093: **Laboratory Studies of Methane and Its Relationship to Prebiotic Chemistry** by *Kensei Kobayashi et al.*

astro-ph/1806.02259: **Magnetised winds and their influence in the escaping upper atmosphere of HD 209458b** by *Carolina Villarreal D'Angelo et al.*

astro-ph/1806.02391: **Impact of planetesimal eccentricities and material strength on the appearance of eccentric debris disks** by *Minjae Kim et al.*

astro-ph/1806.02573: **A High-performance Atmospheric Radiation Package: with applications to the radiative energy budgets of giant planets** by *Cheng Li et al.*

astro-ph/1806.02904: **Direct Imaging of the HD 35841 Debris Disk: A Polarized Dust Ring from Gemini Planet Imager and an Outer Halo from HST/STIS** by *Thomas M. Esposito et al.*

astro-ph/1806.02966: **Effect of stochastic grain heating on cold dense clouds chemistry** by *Long-Fei Chen, Qiang Chang, Hong-Wei Xi*

astro-ph/1806.03122: **Comparison between Laplace-Lagrange Secular Theory and Numerical Simulation** by *Barbara Celi Braga Camargo, Othon Cabo Winter, Dietmar William Foryta*

astro-ph/1806.03127: **A TESS Dress Rehearsal: Planetary Candidates and Variables from K2 Campaign 17** by *Ian J. M. Crossfield et al.*

astro-ph/1806.03457: **ExoMol line lists - XXIX. The rotation-vibration spectrum of methyl chloride up to 1200 K** by *A. Owens et al.*

astro-ph/1806.03469: **ExoMol molecular line lists - XXVII: spectra of C2H4** by *Barry P. Mant et al.*

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