ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Welcome to the 89th edition of Exoplanet News. After the last few bumper editions, this month's newsletter is on the slim-side, and no-one has submitted any new conference announcements or job advertisements. However, several of the conferences and job adverts included in last month's edition still have not reached their application deadlines, so please do refer back to the June newsletter in case you missed any.

As things seem to be already winding a little for the (northern hemisphere) summer, the newsletter will take a break in August, but I plan to return with the next edition at the beginning of September. So please keep your abstracts and announcements coming over the next couple of months and please encourage colleagues who work in the exoplanet area to submit items to the newsletter, if they've not yet done so!

best wishes
Andrew Norton

2 Abstracts of refereed papers

The Origin and Evolution of Saturn, with Exoplanet Perspective

Sushil K. Atreya[1], Aurelien Crida[2], Tristan Guillot[2], Jonathan I. Lunine[3], Nikku Madhusudhan[4], Oliver Mousis[5]
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In "Saturn in the 21st Century" (K. Baines, M. Flasar, N. Krupp, and T. Stallard, editors), CUP, 2016 (arXiv:1606.04510)

Saturn formed beyond the snow line in the primordial solar nebula that made it possible for it to accrete a large mass. Disk instability and core accretion models have been proposed for Saturn's formation, but core accretion is favored on the basis of its volatile abundances, internal structure, hydrodynamic models, chemical characteristics of protoplanetary disk, etc. The observed frequency, properties and models of exoplanets provide additional supporting evidence for core accretion. The heavy elements with mass greater than ^{4}He make up the core of Saturn, but are presently poorly constrained, except for carbon. The C/H ratio is super-solar, and twice that in Jupiter. The enrichment of carbon and other heavy elements in Saturn and Jupiter requires special delivery mechanisms for volatiles to these planets. In this chapter we will review our current understanding of the origin and evolution of Saturn and its atmosphere, using a multi-faceted approach that combines diverse sets of observations on volatile composition and abundances, relevant properties of the moons and rings, comparison with the other gas giant planet, Jupiter, analogies to the extrasolar giant planets, as well as pertinent theoretical models.

Download/Website: `https://arxiv.org/abs/1606.04510`

Contact: `atreya@umich.edu`

Search for light curve modulations among Kepler candidates: Three very low-mass transiting companions

J. Lillo-Box[1], A. Ribas[2], D. Barrado[3], B. Merín[4], H. Bouy[3]
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Astronomy & Astrophysics, in press (arXiv:1606.02398)

Light curve modulations in the sample of *Kepler* planet candidates allows the disentangling of the nature of the transiting object by photometrically measuring its mass. This is possible by detecting the effects of the gravitational pull of the companion (ellipsoidal modulations) and in some cases, the photometric imprints of the Doppler effect when observing in a broad band (Doppler beaming). We aim to photometrically unveil the nature of some transiting objects showing clear light curve modulations in the phase-folded *Kepler* light curve. We selected a subsample among the large crop of *Kepler* objects of interest (KOIs) based on their chances to show detectable light curve modulations, i.e., close ($a < 12\ R_\star$) and large (in terms of radius, according to their transit signal) candidates. We modeled their phase-folded light curves with consistent equations for the three effects, namely, reflection, ellipsoidal and beaming (known as REB modulations). We provide detailed general equations for the fit of the REB modulations for the case of eccentric orbits. These equations are accurate to the photometric precisions achievable by current and forthcoming instruments and space missions. By using this mathematical apparatus, we find three close-in very low-mass companions (two of them in the brown dwarf mass domain) orbiting main-sequence stars (KOI-554, KOI-1074, and KOI-3728), and reject the planetary nature of the transiting objects (thus classifying them as false

positives). In contrast, the detection of the REB modulations and transit/eclipse signal allows the measurement of their mass and radius that can provide important constraints for modeling their interiors since just a few cases of low-mass eclipsing binaries are known. Additionally, these new systems can help to constrain the similarities in the formation process of the more massive and close-in planets (hot Jupiters), brown dwarfs, and very low-mass companions.

Download/Website: `http://arxiv.org/abs/1606.02398`

Contact: `jlillobox@eso.org`

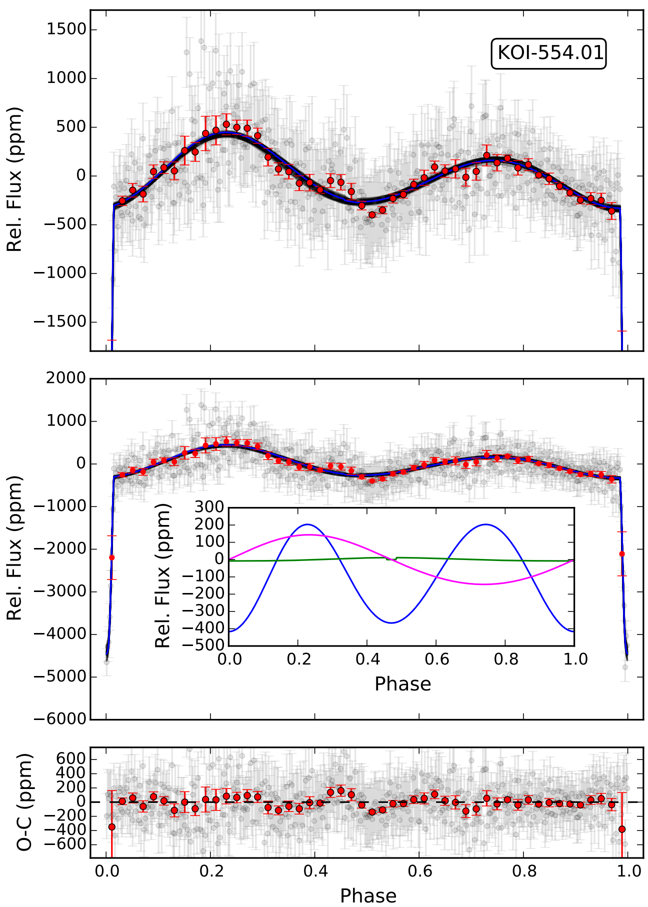

Figure 1: (Lillo-Box et al.) Fitting results for one of the KOIs analyzed in this work. The top panel shows a close view of the out-of-eclipse time interval where the light curve modulations are detectable. The middle panel shows the complex light curve including the eclipse and an inset showing each contribution to the out-of-eclipse modulations. In the bottom panel, we show the residuals of the fit. Gray circles represent 500 bins along the orbit and red circles represent binnings of 100 datapoints. The best one hundred models are shown with black lines and the best model is shown with a blue line.

A Dynamical Analysis of the Kepler-80 System of Five Transiting Planets

Mariah G. MacDonald[1], *Darin Ragozzine*[1,2,3], *Daniel C. Fabrycky*[4], *Eric B. Ford*[5], *Matthew J. Holman*[3], *Howard T. Isaacson*[6], *Jack J. Lissauer*[7], *Eric D. Lopez*[8], *Tsevi Mazeh*[9], *Leslie Rogers*[4], *Jason F. Rowe*[10,11], *Jason H. Steffen*[12], *Guillermo Torres*[3]

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The Astronomical Journal, in press

$Kepler$ has discovered hundreds of systems with multiple transiting exoplanets which hold tremendous potential both individually and collectively for understanding the formation and evolution of planetary systems. Many of these systems consist of multiple small planets with periods less than ~50 days known as Systems with Tightly-spaced Inner Planets, or STIPs. One especially intriguing STIP, Kepler-80 (KOI-500), contains five transiting planets: f, d, e, b, and c with periods of 1.0, 3.1, 4.6, 7.1, 9.5 days, respectively. We provide measurements of transit times and a transit timing variation (TTV) dynamical analysis. We find that TTVs cannot reliably detect eccentricities for this system, though mass estimates are not affected. Restricting the eccentricity to a reasonable range, we infer masses for the outer four planets (d, e, b, and c) to be $6.75^{+0.69}_{-0.51}$, $4.13^{+0.81}_{-0.95}$, $6.93^{+1.05}_{-0.70}$, and $6.74^{+1.23}_{-0.86}$ Earth masses, respectively. The similar masses but different radii are consistent with terrestrial compositions for d and e and ~2% H/He envelopes for b and c. We confirm that the outer four planets are in a rare dynamical configuration with four interconnected three-body resonances that are librating with few degree amplitudes. We present a formation model that can reproduce the observed configuration by starting with a multi-resonant chain and introducing dissipation. Overall, the information-rich Kepler-80 planets provide an important perspective into exoplanetary systems.

Download/Website: `http://mmacdonald.altervista.org/kepler-80.html`

Contact: `mmacdonald2012@my.fit.edu`

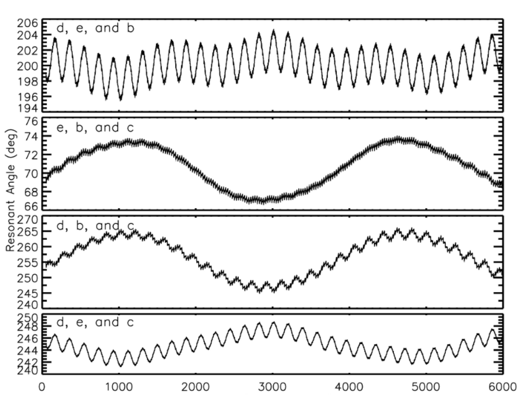

Figure 2: (MacDonald et al.) Time evolution of the four different three-body resonances seen in Kepler-80. In Kepler-80, all four of the possible lowest-order three-body resonances are librating with very small ~3° libration amplitudes. This four-planet configuration is rare among known planetary-like systems, though three-body (Laplace-like) resonances have been seen. The 191-day conjunction cycle (corresponding to the super-period from the near two-body resonances) is clearly seen. On a longer ~10-year timescale, three-body resonance libration is clearly seen. In both cases, the interlocking resonances produce the same timescale for conjunctions and three-body resonance period. Libration centers are shifted from 0 or 180 degrees due to the torque from the planet not in the resonance. This configuration matches the expected result of formation by planetary migration.

Search for an exosphere in sodium and calcium in the transmission spectrum of exoplanet 55 Cancri e

A. R. Ridden-Harper [1], I. A. G. Snellen [1], C. U. Keller [1], R. J. de Kok [1], E. Di Gloria [1], H. J. Hoeijmakers [1], M. Brogi [2], M. Fridlund [1,3,4], B. L. A. Vermeersen [5], W. van Westrenen [6]

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Astronomy & Astrophysics, in press (arXiv:1606.08447)

[Abridged] The aim of this work is to search for an absorption signal from exospheric sodium (Na) and singly ionized calcium (Ca^+) in the optical transmission spectrum of the hot rocky super-Earth 55 Cancri e. Although current best-fitting models to the planet mass and radius require a possible atmospheric component, uncertainties in the radius exist, making it possible that 55 Cnc e could be a hot rocky planet without an atmosphere. High resolution (R$\sim$110000) time-series spectra were analysed of five transits of 55 Cancri e, obtained with three different telescopes (UVES/VLT, HARPS/ESO 3.6m & HARPS-N/TNG). Targeting the sodium D lines and the calcium H and K lines the potential planet exospheric signal was filtered out from the much stronger stellar and telluric signals, making use of the change of the radial component of the orbital velocity of the planet over the transit from -57 to +57 km sec^{-1}. Combining all five transit data sets we detect a signal potentially associated with sodium in the planet exosphere at a statistical significance level of 3σ. Combining the four HARPS transits that cover the calcium H and K lines, we also find a potential signal from ionized calcium (4.1σ). Interestingly, this latter signal originates from just one of the transit measurements - with a 4.9σ detection at this epoch. Unfortunately, due to the low significance of the measured sodium signal and the potentially variable Ca^+ signal, we estimate the p-values of these signals to be too high (corresponding to $<4\sigma$) to claim unambiguous exospheric detections. By comparing the observed signals with artificial signals injected early in the analysis, the absorption by Na and Ca^+ are estimated to be at a level of approximately 2.3×10^{-3} and 7.0×10^{-2} respectively, relative to the stellar spectrum.

Download/Website: `http://arxiv.org/abs/1606.08447`

Contact: `arh@strw.leidenuniv.nl`

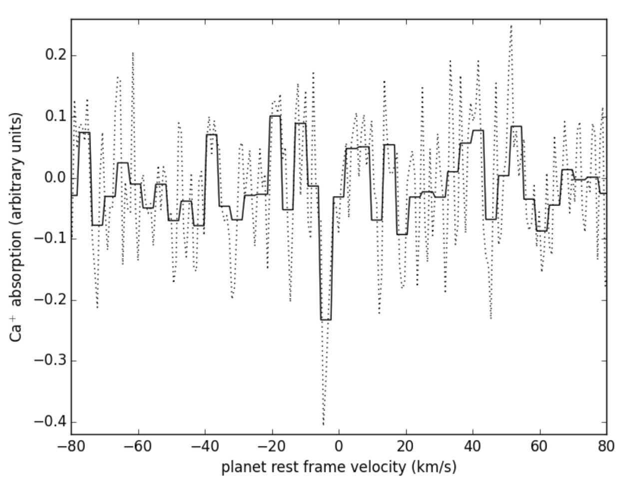

Figure 3: (Ridden-Harper et al.) The signal of ionized calcium from the HARPS A data set both not binned (dotted line) and binned (solid black line) every 0.05Å or 3.8 km sec^{-1}. This binning regime results in a detection that has a S/n of $\sim$4.9σ.

First detection of gas-phase methanol in a protoplanetary disk

Catherine Walsh[1], *Ryan A. Loomis*[2], *Karin I. Öberg*[2], *Mihkel Kama*[1], *Merel L. R. van 't Hoff*[1], *Tom J. Millar*[3], *Yuri Aikawa*[4], *Eric Herbst*[5], *Susanna L. Widicus Weaver*[6], *Hideko Nomura*[7]

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Astrophysical Journal Letters, published, 2016ApJ...823L..10W

The first detection of gas-phase methanol in a protoplanetary disk (TW Hya) is presented. In addition to being one of the largest molecules detected in disks to date, methanol is also the first disk organic molecule with an unambiguous ice chemistry origin. The stacked methanol emission, as observed with ALMA, is spectrally resolved and detected across six velocity channels ($> 3\sigma$), reaching a peak signal-to-noise of 5.5σ, with the kinematic pattern expected for TW Hya. Using an appropriate disk model, a fractional abundance of $3 \times 10^{-12} - 4 \times 10^{-11}$ (with respect to H_2) reproduces the stacked line profile and channel maps, with the favoured abundance dependent upon the assumed vertical location (midplane versus molecular layer). The peak emission is offset from the source position suggesting that the methanol emission has a ring-like morphology: the analysis here suggests it peaks at ≈ 30 AU reaching a column density $\approx 3 - 6 \times 10^{12}$ cm^{-2}. In the case of TW Hya, the larger (up to mm-sized) grains, residing in the inner 50 AU, may thus host the bulk of the disk ice reservoir. The successful detection of cold gas-phase methanol in a protoplanetary disk implies that the products of ice chemistry can be explored in disks, opening a window to studying complex organic chemistry during planetary system formation.

Download/Website: `http://cdsads.u-strasbg.fr/abs/2016ApJ...823L..10W`

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3 As seen on astro-ph

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

astro-ph/1606.00023 : **HATS-25b through HATS-30b: A Half-dozen New Inflated Transiting Hot Jupiters from the HATSouth Survey** by *N. Espinoza, et al.*

astro-ph/1606.00432 : **An optical transmission spectrum of the transiting hot Jupiter in the metal-poor WASP-98 planetary system** by *L. Mancini, et al.*

astro-ph/1606.00440 : **Dynamical mass and multiplicity constraints on co-orbital bodies around stars** by *Dimitri Veras, Thomas R. Marsh, Boris T. Gaensicke*

astro-ph/1606.00442 : **ALMA Observations of HD141569's Circumstellar Disk** by *J.A. White, et al.*

astro-ph/1606.00565 : **Properties of microlensing events by wide separation planets with a moon** by *Sun-Ju Chung, Yoon-Hyun Ryu*

astro-ph/1606.00848 : **HATS-18 b: An Extreme Short–Period Massive Transiting Planet Spinning Up Its Star** by *Kaloyan M. Penev, et al.*

astro-ph/1606.01103 : **A combined transmission spectrum of the Earth-sized exoplanets TRAPPIST-1 b and c** by *Julien de Wit, et al.*

astro-ph/1606.01105 : **Direct Measure of Radiative and Dynamical Properties of an Exoplanet Atmosphere** by *Julien de Wit, et al.*

astro-ph/1606.01247 : **A self-consistent model for the evolution of the gas produced in the debris disc of Pictoris** by *Quentin Kral, et al.*
astro-ph/1606.01264 : **Transiting exoplanet candidates from K2 Campaigns 5 and 6** by *Benjamin J. S. Pope, Hannu Parviainen, Suzanne Aigrain*
astro-ph/1606.01336 : **Space-based Microlens Parallax Observation As a Way to Resolve the Severe Degeneracy between Microlens-parallax and Lens-orbital Effect** by *C. Han, et al.*
astro-ph/1606.01744 : **Transit Timing Observations from Kepler. IX. Catalog of the Full Long-Cadence Data Set** by *Tomer Holczer, et al.*
astro-ph/1606.01846 : **Possibility for albedo estimation of exomoons: Why should we care about M dwarfs?** by *Vera Dobos, et al.*
astro-ph/1606.01895 : **Calibration of quasi-static aberrations in exoplanet direct-imaging instruments with a Zernike phase-mask sensor. II. Concept validation with ZELDA on VLT/SPHERE** by *M. N'Diaye, et al.*
astro-ph/1606.02292 : **First simultaneous microlensing observations by two space telescopes:** $Spitzer$ **&** $Swift$ **reveal a brown dwarf in event OGLE-2015-BLG-1319** by *Y. Shvartzvald, et al.*
astro-ph/1606.02299 : **Gap Opening in 3D: Single Planet Gaps** by *Jeffrey Fung, Eugene Chiang*
astro-ph/1606.02398 : **Search for light curve modulations among Kepler candidates. Three very low-mass transiting companions** by *J. Lillo-Box, et al.*
astro-ph/1606.02701 : **H-alpha Variability in PTFO8-8695 and the Possible Direct Detection of Emission from a 2 Million Year Old Evaporating Hot Jupiter** by *Christopher M. Johns-Krull, et al.*
astro-ph/1606.02761 : **Deep LMT/AzTEC millimeter observations of Epsilon Eridani and its surroundings** by *M. Chavez-Dagostino, et al.*
astro-ph/1606.02962 : **Transit timing variation and transmission spectroscopy analyses of the hot Neptune GJ3470b** by *S. Awiphan, et al.*
astro-ph/1606.02993 : **A Wide-Field Survey for Transiting Hot Jupiters and Eclipsing Pre-Main-Sequence Binaries in Young Stellar Associations** by *Ryan J. Oelkers, et al.*
astro-ph/1606.03012 : **On the survival of zombie vortices in protoplanetary discs** by *Geoffroy Lesur, Henrik Latter*
astro-ph/1606.03030 : **Analytical investigation of the decrease in the size of the habitable zone due to limited CO_2 outgassing rate** by *Dorian S. Abbot*
astro-ph/1606.03072 : **Long term evolution of planetary systems with a terrestrial planet and a giant planet** by *Nikolaos Georgakarakos, Ian Dobbs-Dixon, Michael J. Way*
astro-ph/1606.03118 : **A Dwarf Protoplanetary Disk around XZ Tau B** by *Mayra Osorio, et al.*
astro-ph/1606.03134 : **Limits on Planetary Companions from Doppler Surveys of Nearby Stars** by *Andrew W. Howard, Benjamin J. Fulton*
astro-ph/1606.03522 : **A Simple Analytical Model for Rocky Planet Interior** by *Li Zeng, Stein B. Jacobsen*
astro-ph/1606.03523 : **Variational Principle for Planetary Interiors** by *Li Zeng, Stein B. Jacobsen*
astro-ph/1606.03997 : **Stellar wind-magnetosphere interaction at exoplanets: computations of auroral radio powers** by *J. D. Nichols, S. E. Milan*
astro-ph/1606.04047 : **EPIC201702477b: A Long Period Transiting Brown Dwarf from K2** by *D. Bayliss, et al.*
astro-ph/1606.04162 : **The properties of heavy elements in giant planet envelopes** by *Francois Soubiran, Burkhard Militzer*
astro-ph/1606.04485 : **Kepler-108: A Mutually Inclined Giant Planet System** by *Sean M. Mills, Daniel C. Fabrycky*
astro-ph/1606.04509 : **The magnetorotational instability in debris-disc gas** by *Quentin Kral, Henrik Latter*
astro-ph/1606.04510 : **The Origin and Evolution of Saturn, with Exoplanet Perspective** by *Sushil K. Atreya, et al.*
astro-ph/1606.04556 : **HAT-P-47b AND HAT-P-48b: Two Low Density Sub-Saturn-Mass Transiting Planets**

on the Edge of the Period–Mass Desert by *G.A. Bakos et al.*
astro-ph/1606.05187 : **Origin and evolution of two-component debris discs and an application to the q^1 Eridani system** by *Christian Schüppler, et al.*
astro-ph/1606.05196 : **A Goldilocks principle for modeling radial velocity noise** by *Fabo Feng, et al.*
astro-ph/1606.05247 : **Search for giant planets in M67 III: excess of hot Jupiters in dense open clusters** by *A. Brucalassi, et al.*
astro-ph/1606.05474 : **HELIOS: An Open-Source, GPU-Accelerated Radiative Transfer Code For Self-Consistent Exoplanetary Atmospheres** by *Matej Malik, et al.*
astro-ph/1606.05549 : **Is the activity level of HD 80606 influenced by its eccentric planet?** by *P. Figueira, et al.*
astro-ph/1606.05678 : **Benford's distribution in extrasolar world: Do the exoplanets follow Benford's distribution?** by *Abhishek Shukla, Ankit Kumar Pandey, Anirban Pathak*
astro-ph/1606.05714 : **Ionization of protoplanetary disks by galactic cosmic rays, solar protons, and by supernova remnants** by *Ryuho Kataoka, Tatsuhiko Sato*
astro-ph/1606.05812 : **Zodiacal Exoplanets in Time (ZEIT) II. A "Super-Earth" Orbiting a Young K Dwarf in the Pleiades Neighborhood** by *E. Gaidos, et al.*
astro-ph/1606.05818 : **EPIC 211351816.01: A (Re-?)Inflated Planet Orbiting a Red Giant Star** by *Samuel K. Grunblatt, et al.*
astro-ph/1606.05828 : **Candidate Water Vapor Lines to Locate the H_2O Snowline through High-Dispersion Spectroscopic Observations I. The Case of a T Tauri Star** by *Shota Notsu, et al.*
astro-ph/1606.05952 : **On the Detection of Non-Transiting Exoplanets with Dusty Tails** by *John DeVore, et al.*
astro-ph/1606.06236 : **A hot Jupiter orbiting a 2-Myr-old solar-mass T Tauri star** by *J.F. Donati, et al.*
astro-ph/1606.06243 : **Tidal evolution of CoRoT massive planets and brown dwarfs and of their host stars** by *Sylvio Ferraz-Mello*
astro-ph/1606.06492 : **First detection of gas-phase methanol in a protoplanetary disk** by *Catherine Walsh et al.*
astro-ph/1606.06654 : **Characterizing HR3549B using SPHERE** by *D. Mesa, et al.*
astro-ph/1606.06729 : **A Neptune-sized transiting planet closely orbiting a 5-10-million-year-old star** by *Trevor J. David, et al.*
astro-ph/1606.06740 : **Atmosphere-interior exchange on hot rocky exoplanets** by *Edwin S. Kite, et al.*
astro-ph/1606.06744 : **Searching for Scatterers: High-Contrast Imaging of Young Stars Hosting Wide-Separation Planetary-Mass Companions** by *Marta L. Bryan, et al.*
astro-ph/1606.06824 : **Planetesimal Formation by Gravitational Instability of a Porous-Dust Disk** by *Shugo Michikoshi, Eiichiro Kokubo*
astro-ph/1606.06882 : **Qatar Exoplanet Survey : Qatar-3b, Qatar-4b and Qatar-5b** by *Khalid A. Alsubai, et al.*
astro-ph/1606.06945 : **The microlensing rate and distribution of free-floating planets towards the Galactic bulge** by *M. Ban, E. Kerins, A.C. Robin*
astro-ph/1606.07027 : **Modeling Stellar Proton Event-induced particle radiation dose on close-in exoplanets** by *Dimitra Atri*
astro-ph/1606.07068 : **Debris Disks in the Scorpius-Centaurus OB Association Resolved by ALMA** by *Jesse Lieman-Sifry, et al.*
astro-ph/1606.07102 : **Friends of Hot Jupiters. IV. Stellar companions beyond 50 AU might facilitate giant planet formation, but most are unlikely to cause Kozai-Lidov migration** by *Henry Ngo, et al.*
astro-ph/1606.07218 : **A Cloudiness Index for Transiting Exoplanets Based on the Sodium and Potassium Lines: Tentative Evidence for Hotter Atmospheres Being Less Cloudy at Visible Wavelengths** by *Kevin Heng*
astro-ph/1606.07266 : **The abundance and thermal history of water ice in the disk surrounding HD142527 from the DIGIT Herschel Key Program** by *M. Min, et al.*
astro-ph/1606.07438 : **Secular dynamics of multiplanet systems: implications for the formation of hot and**

warm Jupiters via high-eccentricity migration by *Adrian S. Hamers, et al.*
astro-ph/1606.07546 : **The Spin-Orbit Evolution of GJ 667C System: The Effect of Composition and Other Planet's Perturbations** by *P. Cuartas-Restrepo, et al.*
astro-ph/1606.07743 : **Orbital stability of coplanar two-planet exosystems with high eccentricities** by *Kyriaki I. Antoniadou, George Voyatzis*
astro-ph/1606.07819 : **Long-term stability of the HR 8799 planetary system without resonant lock** by *Ylva Gotberg, et al.*
astro-ph/1606.08027 : **Star-planet interactions: II. Is planet engulfment the origin of fast rotating red giants?** by *Giovanni Privitera, et al.*
astro-ph/1606.08088 : **In Situ and Ex Situ Formation Models of Kepler 11 Planets** by *Gennaro D'Angelo, Peter Bodenheimer*
astro-ph/1606.08441 : **Five Planets Transiting a Ninth Magnitude Star** by *Andrew Vanderburg, et al.*
astro-ph/1606.08447 : **Search for an exosphere in sodium and calcium in the transmission spectrum of exoplanet 55 Cancri e** by *A.R. Ridden-Harper, et al.*
astro-ph/1606.08498 : **Sparse aperture masking at the VLT II. Detection limits for the eight debris disks stars β Pic, AU Mic, 49 Cet, η Tel, Fomalhaut, g Lup, HD181327 and HR8799** by *L. Gauchet, et al.*
astro-ph/1606.08622 : **Probing TRAPPIST-1-like systems with K2** by *Brice-Olivier Demory, et al.*
astro-ph/1606.08623 : **Tides and angular momentum redistribution inside low-mass stars hosting planets: a first dynamical model** by *A. F. Lanza, S. Mathis*
astro-ph/1606.08846 : **A novel high-contrast imaging technique based on optical tunneling to search for faint companions around bright stars at the limit of diffraction** by *Dominik Derigs, et al.*
astro-ph/1606.08448 : **Relative Likelihood for Life as a Function of Cosmic Time** by *Abraham Loeb, Rafael A. Batista, David Sloan*
astro-ph/1606.08855 : **Hiding Planets Behind a Big Friend: Mutual Inclinations of Multi-Planet Systems with External Companions** by *Dong Lai, Bonan Pu*
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