ExoPlanet News
An Electronic Newsletter

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Editors: J. Venturini, L. Mishra, H. L. Capelo, , & D. Angerhausen
NCCR PlanetS, Gesellschaftsstrasse 6, CH-3012 Bern, Switzerland

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

Contents

1 Editorial

Dear readers,

Welcome to the July 2022 edition of the ExoPlanet News!

In this issue you will find abstracts of scientific papers, job advertisements, conference announcements, and an overview of exoplanet-related articles on astro-ph.

For the next month, we look forward to your paper abstracts, job ads or meeting announcements. Also special announcements are welcome. As always, we would be happy to receive feedback concerning the newsletter. The Latex template for submitting contributions, as well as all previous editions of ExoPlanet News, can be found on the ExoPlanet News webpage (http://nccr-planets.ch/exoplanetnews/).

The next issue will appear on August 9, 2022.

Julia Venturini
Daniel Angerhausen
Holly Capelo
Lokesh Mishra
Timm-Emanuel Riesen

2 Abstracts of refereed papers

Analytic Approach to the Late Stages of Giant Planet Formation

F. C. Adams[1,2] *and K. Batygin*[3]

[1] Physics Department, University of Michigan, Ann Arbor, MI 48109
[2] Astronomy Department, University of Michigan, Ann Arbor, MI 48109
[3] Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125

The Astrophysical Journal, in press, arXiv:2206.10089

This paper constructs an analytic description for the late stages of giant planet formation. During this phase of evolution, the planet gains the majority of its final mass through gas accretion at a rapid rate. This work determines the density and velocity fields for material falling onto the central planet and its circumplanetary disk, and finds the corrsponding column density of this infalling envelope. We derive a steady-state solution for the surface density of the disk as a function of its viscosity (including the limiting case where no disk accretion occurs). Planetary magnetic fields truncate the inner edge of the disk and determine the boundary conditions for mass accretion onto the planet from both direct infall and from the disk. The properties of the forming planet and its circumplanetary disk are determined, including the luminosity contributions from infall onto the planet and disk surfaces, and from disk viscosity. The radiative signature of the planet formation process is explored using a quasi-spherical treatment of the emergent spectral energy distributions. The analytic solutions developed herein show how the protoplanet properties (envelope density distribution, velocity field, column density, disk surface density, luminosity, and radiative signatures) vary with input parameters (instantaneous mass, orbital location, accretion rate, and planetary magnetic field strength).

Contact: `fca@umich.edu`

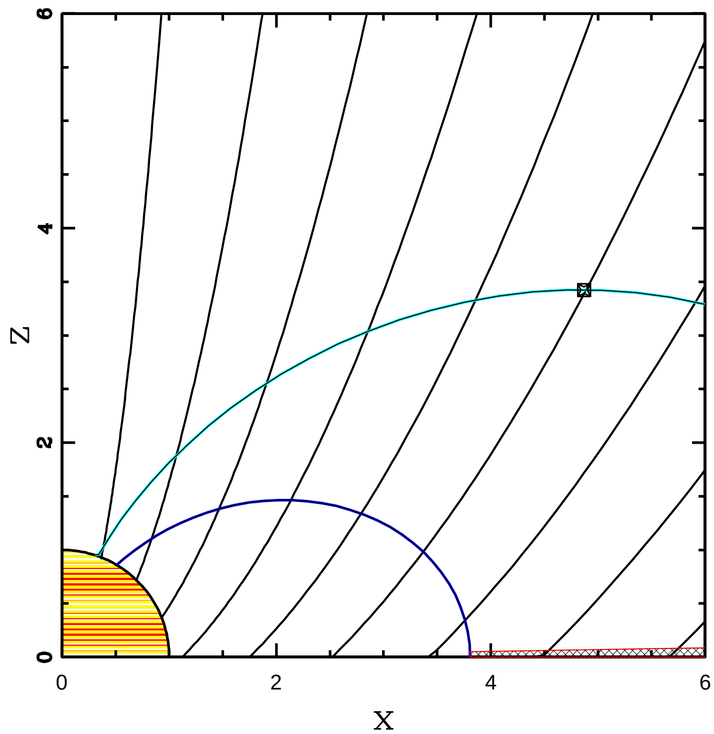

Figure 1: Inner infall region near the planet (for mass $M_\mathrm{p} = 1 M_J$, accretion rate $\dot{M}_\mathrm{p} = 1 M_J$/Myr, and field strength $B_\mathrm{p} = 500$ gauss). The black solid curves show the projected incoming trajectories for parcels of gas with starting conditions near the pole. The planet is depicted as the (partial) circular region in the lower left. Two magnetic field lines are shown, with the lower blue curve connecting to the magnetic truncation radius R_X of the disk (in the equatorial plane) and the upper cyan curve defining the capture radius R_σ, (marked by the square symbol). The horizontal point of the upper curve, $x_\mathrm{hor} = R_\sigma \sin\theta$, is roughly coincident with the disk truncation radius defined by the lower curve. The length scales are given in units of the planetary radius R_p, so that the disk radius $R_\mathrm{d} = R_C \approx 180$ and the Hill radius $R_H \approx 540$.

Large Interferometer For Exoplanets (LIFE): V. Diagnostic potential of a mid-infrared space interferometer for studying Earth analogs

E. Alei [1,2], *B. S. Konrad* [1,2], *D. Angerhausen* [1,2,3], *J. L. Grenfell* [4], *P. Mollière* [5], *S. P. Quanz* [1,2], *S. Rugheimer* [6], *F. Wunderlich* [4], *and the* LIFE *collaboration* [7]

[1] ETH Zurich, Institute for Particle Physics & Astrophysics, Wolfgang-Pauli-Str. 27, 8093 Zurich, Switzerland
[2] National Center of Competence in Research PlanetS (www.nccr-planets.ch)
[3] Blue Marble Space Institute of Science, Seattle, United States
[4] Department of Extrasolar Planets and Atmospheres (EPA), Institute for Planetary Research (PF), German Aerospace Centre (DLR), Rutherfordstr. 2, 12489 Berlin
[5] Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, Germany
[6] Department of Physics, University of Oxford, Oxford, OX1 3PU, UK
[7] www.life-space-mission.com

Astronomy & Astrophysics, in press (10.1051/0004-6361/202243760 - arXiv:2204.10041)

An important future goal in exoplanetology is to detect and characterize potentially habitable planets. Concepts for future space missions have already been proposed: from a large UV-optical-infrared space mission for studies in reflected light, to the Large Interferometer for Exoplanets (LIFE) for analyzing the thermal portion of the planetary spectrum. Using nulling interferometry, LIFE will allow us to constrain the radius and effective temperature of (terrestrial) exoplanets, as well as provide unique information about their atmospheric structure and composition.
We explore the potential of LIFE for characterizing emission spectra of Earth at various stages of its evolution. This allows us (1) to test the robustness of Bayesian atmospheric retrieval frameworks when branching out from a modern Earth scenario while still remaining in the realm of habitable (and inhabited) exoplanets, and (2) to refine the science requirements for LIFE for the detection and characterization of habitable, terrestrial exoplanets.
We performed Bayesian retrievals on simulated spectra of eight different scenarios, which correspond to cloud-free and cloudy spectra of four different epochs of the evolution of the Earth. Assuming a distance of 10 pc and a Sun-like host star, we simulated observations obtained with LIFE using its simulator LIFEsim, considering all major astrophysical noise sources.
With the nominal spectral resolution (R $=50$) and signal-to-noise ratio (assumed to be S/N $=10$ at 11.2 μm), we can identify the main spectral features of all the analyzed scenarios (most notably CO_2, H_2O, O_3, and CH_4). This allows us to distinguish between inhabited and lifeless scenarios. Results suggest that O_3 and CH_4 in particular yield an improved abundance estimate by doubling the S/N from 10 to 20. Neglecting clouds in the retrieval still allows for a correct characterization of the atmospheric composition. However, correct cloud modeling is necessary to avoid biases in the retrieval of the correct thermal structure.
From this analysis, we conclude that the baseline requirements for R and S/N are sufficient for LIFE to detect O_3 and CH_4 in the atmosphere of an Earth-like planet with an O_2 abundance of around 2% in volume mixing ratio. Doubling the S/N would allow a clearer detection of these species at lower abundances. This information is relevant in terms of the LIFE mission planning. We also conclude that cloud-free retrievals of cloudy planets can be used to characterize the atmospheric composition of terrestrial habitable planets, but not the thermal structure of the atmosphere. From the inter-model comparison performed, we deduce that differences in the opacity tables (caused by, e.g., a different line wing treatment) may be an important source of systematic errors.

Download/Website: `https://arxiv.org/abs/2204.10041`

Contact: `elalei@phys.ethz.ch`

The Coherent Differential Imaging on Speckle Area Nulling (CDI-SAN) Method for High-contrast Imaging under Speckle Variation

J. Nishikawa[1,2,3]

[1] TMT project, National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo, 181-8588, Japan
[2] School of Physical Sciences, The Graduate University for Advanced Studies, 2-21-1 Osawa, Mitaka, Tokyo, 181-8588, Japan
[3] Astrobiology Center, 2-21-1 Osawa, Mitaka, Tokyo, 181-8588, Japan

The Astrophysical Journal, published (Bibcode:2022ApJ...930..163N)

The coherent differential imaging on speckle area nulling (CDI-SAN) method was developed to detect a faint exoplanet lying beneath residual speckles of a host star. It utilizes image acquisitions faster than the stellar speckle variation synchronized with five shapes of a deformable mirror repeatedly. By using only the integrated values of each of the five images and square differences for a long interval of observations, the light of the exoplanet could be separated from the stellar light. The achievable contrast would reach almost the photon-noise limit of the residual speckle intensities under appropriate conditions. CDI-SAN can be applied to both ground-based and space telescopes.

Download/Website: `https://doi.org/10.3847/1538-4357/ac5f44`

Contact: `jun.nishikawa@nao.ac.jp`

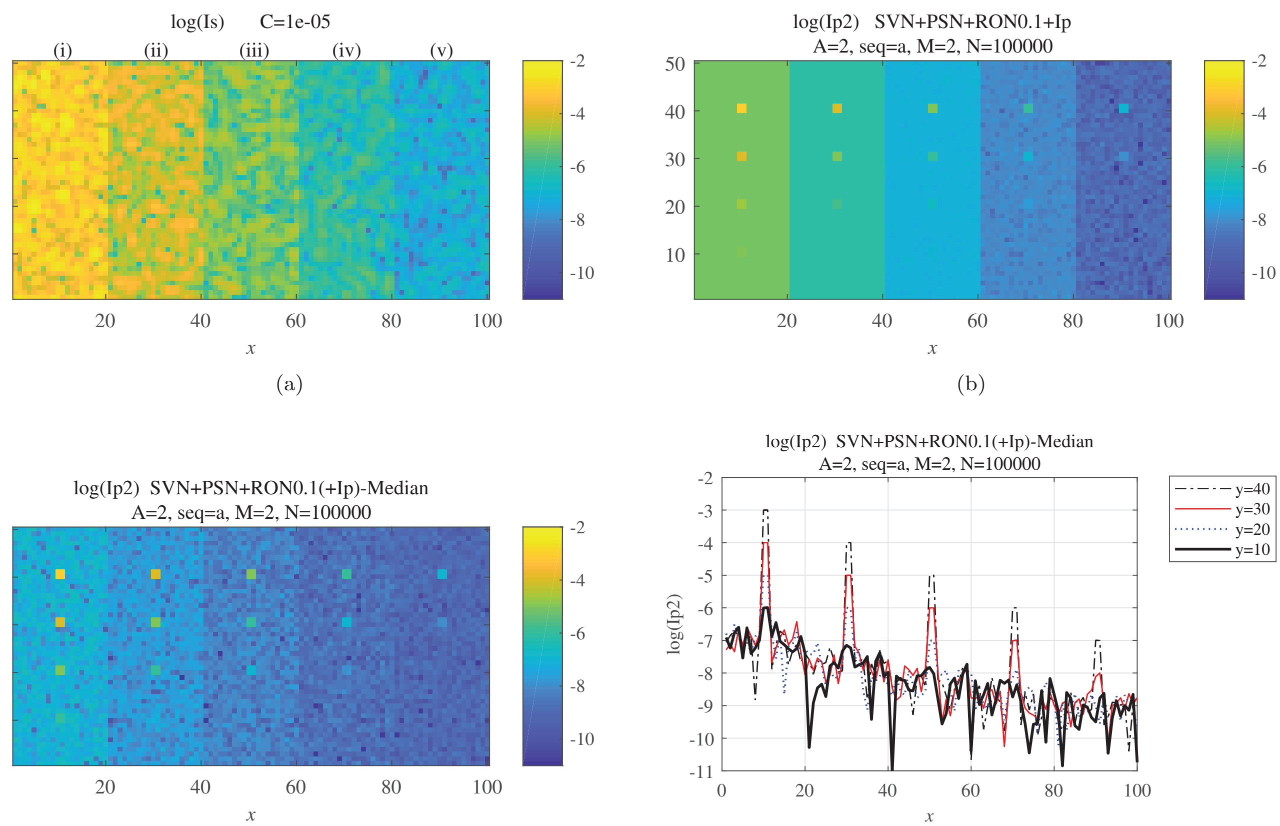

Figure 2: Simulation images and profiles. (a) An example of the initial focal plane speckle image with $C = 1\times10^{-5}$. (b) I_{p2} with M=2 and N=100000 estimated with SVN, PSN and RON=0.1. The artificial planets were included at two central pixels on x in each region and whose intensities were $BC(\sim \langle\langle I_0\rangle\rangle)$, $BC/10$, $BC/100$, and $BC/1000$ at $y = 40-41, 30-31, 20-21$, and $10-11$, respectively. (c) I_{p2} image bias-subtracted from (b). (d) horizontal profiles of (c) at $y = 40$(dot-dashed black line), 30(solid red line), 20(blue dot line), and 10(thick black line). The values in all panels were shown by log absolute.

A CHEOPS Search for Massive, Long-Period Companions to the Warm Jupiter K2-139 b

Alexis M. S. Smith & Szilárd Csizmadia

Department of Extrasolar Planets and Atmospheres, Institute of Planetary Research, German Aerospace Center (DLR), Rutherfordstraße 2, 12489 Berlin, Germany

The Astronomical Journal, published (2022AJ....164...21S)

K2-139 b is a warm Jupiter with an orbital period of 28.4 d, but only three transits of this system have previously been observed, in the long-cadence mode of *K2*, limiting the precision with which the orbital period can be determined, and future transits predicted. We report photometric observations of four transits of K2-139 b with ESA's CHaracterising ExOPlanet Satellite (CHEOPS), conducted with the goal of measuring the orbital obliquity via spot-crossing events. We jointly fit this CHEOPS data alongside the three previously-published transits from the *K2* mission, considerably increasing the precision of the ephemeris of K2-139 b. The transit times for this system can now be predicted for the next decade with a 1σ precision less than 10 minutes, compared to over one hour previously, allowing the efficient scheduling of observations with *Ariel*. We detect no significant deviation from a linear ephemeris, allowing us to exclude the presence of a massive outer planet orbiting with a period less than 150 d, or a brown dwarf with a period less than one year. We also determine the scaled semi-major axis, the impact parameter, and the stellar limb-darkening with improved precision. This is driven by the shorter cadence of the CHEOPS observations compared to that of *K2*, and validates the sub-exposure technique used for analysing long-cadence photometry. Finally, we note that the stellar spot configuration has changed from the epoch of the *K2* observations; unlike the *K2* transits, we detect no evidence of spot-crossing events in the CHEOPS data.

Download/Website: `https://ui.adsabs.harvard.edu/abs/2022AJ....164...21S/abstract`

Contact: `alexis.smith@dlr.de`

The GAPS Programme at TNG XL: A puffy and warm Neptune-sized planet and an outer Neptune-mass candidate orbiting the solar-type star TOI-1422

L. Naponiello[1,2], L. Mancini[1,3,4], M. Damasso[3], A. S. Bonomo[3], A. Sozzetti[3], D. Nardiello[6,7], K. Biazzo[5], R. G. Stognone[8], J. Lillo-Box[9], A. F. Lanza[14], E. Poretti[18,19], J. J. Lissauer[35,36], L. Zeng[10,11], A. Bieryla[32], G. Hébrard[21,22], et al.

[1] Department of Physics, University of Rome "Tor Vergata", Via della Ricerca Scientifica 1, 00133, Rome, Italy
[2] Department of Physics and Astronomy, University of Florence, Largo Enrico Fermi 5, 50125 Firenze
[3] INAF – Turin Astrophysical Observatory, via Osservatorio 20, 10025, Pino Torinese, Italy
[4] Max Planck Institute for Astronomy, Königstuhl 17, 69117 – Heidelberg, Germany
[5] INAF – Osservatorio Astronomico di Roma, via Frascati 33, 00040, Monte Porzio Catone (RM), Italy
[6] Aix-Marseille Université, CNRS, CNES, LAM, Marseille, France
[7] INAF – Osservatorio Astronomico di Padova, Vicolo dell'Osservatorio 5, 35122, Padova, Italy
[8] Dipartimento di Fisica, Universitá degli Studi di Torino, via Pietro Giuria 1, 10125, Torino, Italy
[9] Centro de Astrobiología, Depto. de Astrofísica, ESAC campus, 28692, Villanueva de la Cañada (Madrid), Spain
[10] Center for Astrophysics | Harvard & Smithsonian, 60 Garden Street, Cambridge, MA 02138, USA
[11] Department of Earth and Planetary Sciences, Harvard University, 20 Oxford Street, Cambridge, MA 02138, USA
[14] INAF – Osservatorio Astrofisico di Catania, via S. Sofia 78, 95123, Catania, Italy
[18] INAF – Osservatorio Astronomico di Brera, Via E. Bianchi 46, 23807, Merate (LC), Italy
[19] Fundación Galileo Galilei - INAF, Rambla José Ana Fernandez
[21] Institut d'Astrophysique de Paris, CNRS, UMR 7095 & Sorbonne Université, UPMC Paris 6, 98bis Bd Arago, 75014 Paris, France
[22] Observatoire de Haute-Provence, CNRS, Université d'Aix-Marseille, 04870 Saint-Michel-l'Observatoire, France
[32] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[35] SETI Institute, Mountain View, CA 94043, USA
[36] Space Science & Astrobiology Division MS 245-3

Astronomy & Astrophysics, Accepted (arXiv:2207.03293)

Neptunes represent one of the main types of exoplanets and have chemical-physical characteristics halfway between rocky and gas giant planets. Therefore, their characterization is important for understanding and constraining both the formation mechanisms and the evolution patterns of planets. We investigate the exoplanet candidate TOI-1422 b, which was discovered by the *TESS* space telescope around the high proper-motion G2 V star TOI-1422 ($V = 10.6$ mag), 155 pc away, with the primary goal of confirming its planetary nature and characterising its properties. We monitored TOI-1422 with the HARPS-N spectrograph for 1.5 years to precisely quantify its radial velocity variation. We analyze these radial velocity measurements jointly with *TESS* photometry and check for blended companions through high-spatial resolution images using the AstraLux instrument. We estimate that the parent star has a radius and a mass of $R_\star = 1.019^{+0.014}_{-0.013}\,R$, $M_\star = 0.981^{+0.062}_{-0.065}\,M$, respectively. Our analysis confirms the planetary nature of TOI-1422 b and also suggests the presence of a Neptune-mass planet on a more distant orbit, the candidate TOI-1422 c, which is not detected in *TESS* light curves. The inner planet, TOI-1422 b, orbits on a period $P_\mathrm{b} = 12.9972 \pm 0.0006$ days and has an equilibrium temperature $T_\mathrm{eq,b} = 867 \pm 17$ K. With a radius of $R_\mathrm{b} = 3.96^{+0.13}_{-0.11}\,R_\oplus$, a mass of $M_\mathrm{b} = 9.0^{+2.3}_{-2.0}\,M_\oplus$ and, consequently, a density of $\rho_\mathrm{b} = 0.795^{+0.290}_{-0.235}\,\mathrm{g\,cm^{-3}}$, it can be considered a warm Neptune-size planet. Compared to other exoplanets of similar mass range, TOI-1422 b is among the most inflated ones and we expect this planet to have an extensive gaseous envelope that surrounds a core with a mass fraction around $10\% - 25\%$ of the total mass of the planet. The outer non-transiting planet candidate, TOI-1422 c, has an orbital period of $P_\mathrm{c} = 29.29^{+0.21}_{-0.20}$ days, a minimum mass, $M_\mathrm{c}\sin i$, of $11.1^{+2.6}_{-2.3}\,M_\oplus$, an equilibrium temperature of $T_\mathrm{eq,c} = 661 \pm 13$ K and, therefore, if confirmed, it could be considered as another warm Neptune.

Download/Website: `https://arxiv.org/abs/2207.03293`

Contact: `luca.naponiello@unifi.it`

3 Jobs and Positions

PhD Position in Experimental Space Research

Physics Institute, University of Bern, Switzerland

Deadline: 29 July 2022,

The Space Research and Planetology Division of the University of Bern (WP, http://space.unibe.ch) is seeking a PhD student to join its Space Science Group. The division participates in a large range of international space missions covering many planetary objects of the solar system. The open PhD position is for the ESA's JUICE mission to Jupiter and its icy moons. We are participating in the JUICE mission with a neutral gas and ion mass spectrometer (NIM) that is part of the particle environment package (PEP) experiment. NIM will measure the chemical composition of the atmospheres of Jupiter's icy moons: Europa, Ganymede, and Callisto.

To support the science phase of JUICE several tests, measurements, and calibrations have to be undertaken with the NIM flight spare instrument and the NIM ground reference instrument. This includes measurements with fast neutral beams, and low-energy ion beams emulating the measurement conditions in space. Measurement modes will have to be defined, operations will have to be planned, on the one hand based on modelling of the respective atmospheres and on the other hand considering the actual spacecraft trajectories in the Jupiter system. Existing test and calibration facilities will have to be adapted to the measurement needs.

We are looking for a talented and motivated person who enjoys experimental physics. Experience with electronics, measurement techniques, vacuum instrumentation, ion-optical simulation, and mass spectrometry would be of advantage but is not required. Work is within a large team at the University of Bern, and is connected to an international collaboration within the JUICE mission.

The position is available from 1 October 2022. Proficiency in spoken and written English is required, German language skills are an asset. Candidates with demonstrated experience in experimental work will be favoured. The salary is in accordance with the personnel regulations of the Canton of Bern. Please submit an application as a single pdf file consisting of a cover letter in which you describe your motivation and qualifications for the position, a CV, list of your publications, and a list with names of three references.

Applicants should contact:

Prof. Dr. Peter Wurz +41 31 684 44 26 peter.wurz@space.unibe.ch
Dr. Martina Föhn +41 31 684 59 16 martina.foehn@unibe.ch

Contact: peter.wurz@space.unibe.ch

4 Conferences and Workshops

AGU 2022 Session #158628: Atmospheres, Climate, and Potential Habitability of Rocky Exoplanets

Session Conveners: Mark Hammond[1]*, Daniel Koll*[2]*, Thaddeus Komacek*[3]*, Jun Yang*[2]

[1] University of Oxford, Oxford, UK
[2] Peking University, Beijing, China
[3] University of Maryland, College Park, USA

Chicago, IL, USA and Everywhere Online, December 12-16, 2022

Exoplanet discoveries of the past decade have shown that every star hosts at least 0.1-1 roughly Earth-sized, or rocky, planets. Our galaxy therefore contains billions of rocky worlds, vastly outnumbering the four rocky planets of our own Solar System. What are these worlds like?

This session invites submissions that probe the nature of rocky exoplanets, including: What can our Solar System teach us about rocky exoplanets? How different are atmospheres and climates on rocky planets around other stars, on rocky planets in exotic orbital states, or on rocky planets with radically different formation histories? How can we characterize such planets via observations? And could the processes that kept Earth habitable over billions of years also occur elsewhere?

Submissions that use observation, experiment, or theory are all welcome. The abstract link is below, and the abstract submission deadline is August 3, 2022.

Download/Website: `https://go.umd.edu/cSo`

Contact: `tkomacek@umd.edu`

5 As seen on astro-ph

The following list contains exoplanet related entries appearing on astro-ph in June 2022.

June 2022

astro-ph/2206.00012: **Are there any pristine comets? Constraints from pebble structure** by *Uri Malamud et al.*

astro-ph/2206.00017: **Solar-to-supersolar sodium and oxygen absolute abundances for a "hot Saturn" orbiting a metal-rich star** by *Nikolay K. Nikolov et al.*

astro-ph/2206.00028: **The Role of Atmospheric Exchange in False-Positive Biosignature Detection** by *Ryan C. Felton et al.*

astro-ph/2206.00030: **Searching for technosignatures in exoplanetary systems with current and future missions** by *Jacob Haqq-Misra et al.*

astro-ph/2206.00053: **Generalized Peas-in-a-Pod: Extending Intra-System Mass Uniformity to Non-TTV Systems via the Gini Index** by *Armaan Goyal, Songhu Wang*

astro-ph/2206.00425: **In-depth direct imaging and spectroscopic characterization of the young Solar System analog HD 95086** by *C. Desgrange et al.*

astro-ph/2206.00687: **Improved Orbital Constraints and H? Photometric Monitoring of the Directly Imaged Protoplanet Analog HD 142527 B** by *William O. Balmer et al.*

astro-ph/2206.00732: **Energetics govern ocean circulation on icy ocean worlds** by *Malte F. Jansen, Wanying Kang, Edwin Kite*

astro-ph/2206.00943: **Proximity of exoplanets to first-order mean-motion resonances** by *Carolina Charalambous, Jean Teyssandier, Anne-Sophie Libert*

astro-ph/2206.01023: **A Multi-Fluid Dust Module in Athena++: Algorithms and Numerical Tests** by *Pinghui Huang, Xue-Ning Bai*

astro-ph/2206.01037: **Impact drag force exerting on a projectile penetrating into a hierarchical granular bed** by *F. Okubo, H. Katsuragi*

astro-ph/2206.01126: **Collisional Charging in the Low Pressure Range of Protoplanetary Disks** by *T. Becker et al.*

astro-ph/2206.01219: **Establishing Dust Rings and Forming Planets Within Them** by *Eve J. Lee, J. R. Fuentes, Philip F. Hopkins*

astro-ph/2206.01259: **Spectroscopy of TOI-1259B – an unpolluted white dwarf companion to an inflated warm Saturn** by *Evan Fitzmaurice et al.*

astro-ph/2206.01548: **Dust Formation in Astrophysical Environments: The Importance of Kinetics** by *A.G.G.M. Tielens*

astro-ph/2206.01755: **Dynamical Instability in Multi-Orbiter Systems with Gas Friction** by *Jiaru Li, Laetitia Rodet, Dong Lai*

astro-ph/2206.01770: **A Unified Spectroscopic and Photometric Model to Infer Surface Inhomogeneity: Application to Luhman 16B** by *Michael K. Plummer, Ji Wang*

astro-ph/2206.01785: **Seismology in the Solar System** by *Simon C. Stähler, Martin Knapmeyer*

astro-ph/2206.02071: **Transit least-squares survey IV. Earth-like transiting planets expected from the PLATO mission** by *René Heller et al.*

astro-ph/2206.02505: **Can Gaia find planets around white dwarfs?** by *Hannah Sanderson, Amy Bonsor, Alexander J Mustill*

astro-ph/2206.02818: **The growth and migration of massive planets under the influence of external photoevaporation** by *Andrew J. Winter et al.*

astro-ph/2206.03057: **Efficient Dust Radial Drift Around Young Intermediate-mass Stars** by *Paola Pinilla, Antonio Garufi, Matías Gárate*

astro-ph/2206.03115: **Orbital characterization of superbolides observed from space: dynamical association with near-Earth objects, meteoroid streams and identification of hyperbolic projectiles** by *E. Peña-*

Asensio, J. M. Trigo-Rodríguez, A. Rimola

astro-ph/2206.03236: **The Doppler-flip in HD100546 as a disk eruption: the elephant in the room of kinematic protoplanet searches** by *Simon Casassus et al.*

astro-ph/2206.03432: **Implicit biases in transit models using stellar pseudo-density** by *Gregory J. Gilbert, Mason G. MacDougall, Erik A. Petigura*

astro-ph/2206.03496: **The GAPS Programme with HARPS-N at TNG. XXXVII. A precise density measurement of the young ultra-short period planet TOI-1807 b** by *D. Nardiello et al.*

astro-ph/2206.03502: **Adaptive Optics Imaging Breaks the Central Caustic Cusp Approach Degeneracy in High Magnification Microlensing Events** by *Sean K. Terry et al.*

astro-ph/2206.03517: **Atmospheric Characterization of Hot Jupiter CoRoT-1 b Using the Wide Field Camera 3 on the Hubble Space Telescope** by *Kayli Glidic et al.*

astro-ph/2206.03595: **Limits on the Auroral Generation of H+3 in Brown Dwarf and Extrasolar Giant Planet Atmospheres with Keck/NIRSPEC** by *Aidan Gibbs, Michael Fitzgerald*

astro-ph/2206.03840: **Wavelike nature of the vertical shear instability in global protoplanetary disks** by *Eleonora Svanberg, Can Cui, Henrik N. Latter*

astro-ph/2206.03899: **A new third planet and the dynamical architecture of the HD33142 planetary system** by *Trifon Trifonov et al.*

astro-ph/2206.03989: **Pterodactyls: A Tool to Uniformly Search and Vet for Young Transiting Planets In TESS Primary Mission Photometry** by *Rachel B. Fernandes et al.*.

astro-ph/2206.04096: **Col-OSSOS: Evidence for a compositional gradient inherited from the protoplanetary disk?** by *Michael Marsset et al.*

astro-ph/2206.04136: **On the time evolution of the Md?M? and M??M? correlations for protoplanetary discs: the viscous timescale increases with stellar mass** by *Alice Somigliana et al.*

astro-ph/2206.04265: **HCN snowlines in protoplanetary disks: constraints from ice desorption experiments** by *Jennifer B. Bergner, Mahesh Rajappan, Karin I. Oberg*

astro-ph/2206.04370: **Tidal insights into rocky and icy bodies: An introduction and overview** by *Amirhossein Bagheri et al.*

astro-ph/2206.04427: **The morphology of CSCha circumbinary disk suggesting the existence of a Saturn-mass planet** by *N. T. Kurtovic et al.*

astro-ph/2206.04526: **A numerical study of the 1/2, 2/1 and 1/1 retrograde mean motion resonances in planetary systems** by *G.A. Caritá, A. C. Signor, M.H.M. Morais*

astro-ph/2206.04628: **On retrograde orbits, resonances and stability** by *M.H.M. Morais, F. Namouni*

astro-ph/2206.04810: **Apsidal Alignment and Anti-Alignment of Planets in Mean-Motion Resonance: Disk-Driven Migration and Eccentricity Driving** by *JT Laune et al.*

astro-ph/2206.05151: **EOS-ESTM: A flexible climate model for habitable exoplanets** by *L. Biasiotti et al.*

astro-ph/2206.05233: **Characterizing and Mitigating Telluric Absorption in Precise Radial Velocities II: A Study of an M2 Type Star** by *Natasha Latouf et al.*

astro-ph/2206.05439: **Gaia DR3 astrometric orbit determination with Markov Chain Monte Carlo and Genetic Algorithms. Systems with stellar, substellar, and planetary mass companions** by *B. Holl et al.*

astro-ph/2206.05561: **Data Release 3: the Solar System survey** by *P. Tanga et al.*

astro-ph/2206.05815: **Gemini-LIGHTS: Herbig Ae/Be and massive T-Tauri protoplanetary disks imaged with Gemini Planet Imager** by *Evan A. Rich et al.*

astro-ph/2206.05856: **ALMA Images the Eccentric HD 53143 Debris Disk** by *Meredith A. MacGregor et al.*

astro-ph/2206.06030: **Exoplanet two square degree survey with SAO RAS robotic facilities** by *O. Ya. Yakovlev et al.*

astro-ph/2206.06236: **Study of atmospheres in the solar system, from stellar occultation or planetary transit** by *Bruno Sicardy*

astro-ph/2206.06967: **The Fermi paradox: Impact of astrophysical processes and dynamical evolution** by *Dominik R.G. Schleicher, Stefano Bovino*

astro-ph/2206.07097: **Do Tides Destabilize Trojan Exoplanets?** by *Anthony R. Dobrovolskis, Jack J. Lissauer*
astro-ph/2206.07211: **Revealing the Mysteries of Venus: The DAVINCI Mission** by *James B. Garvin et al.*
astro-ph/2206.07249: **Atmospheric Overturning Circulation on Dry, Tidally-locked Rocky Planets is Mainly Driven by Radiative Cooling** by *Shuang Wang, Jun Yang*
astro-ph/2206.07287: **Characterizing and Mitigating the Impact of Telluric Absorption in Precise Radial Velocities** by *Sharon Xuesong Wang et al.*
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