ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Welcome to Edition 169 of the ExoPlanet News!

As usual, we bring you abstracts of scientific papers, job ads, conference announcements, and an overview of exoplanet-related articles on astro-ph. Thanks a lot to all of you who contributed to this issue of the newsletter!

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 also be happy to receive feedback concerning the newsletter. The Latex template (v2.0) 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 8, 2023.

Thanks again for your support, and best regards from the editorial team,

Eleonora Alei
Haiyang Wang
Jeanne Davoult
Daniel Angerhausen
Timm-Emanuel Riesen

2 Abstracts of refereed papers

Redox state and interior structure control on the long-term habitability of stagnant-lid planets

Philipp Baumeister[1,2], Nicola Tosi[1], Caroline Brachmann[1,3], John Lee Grenfell[1], and Lena Noack[3]

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Astronomy & Astrophysics, in press (arXiv:2301.03466)

A major goal in the search for extraterrestrial life is the detection of liquid water on the surface of exoplanets. On terrestrial planets, volcanic outgassing is a significant source of atmospheric and surface water and a major contributor to the long-term evolution of the atmosphere. The rate of volcanism depends on the interior evolution and on numerous feedback processes between the atmosphere and interior, which continuously shape atmospheric composition, pressure, and temperature.
We explore how key planetary parameters, such as planet mass, interior structure, mantle water content, and redox state, shape the formation of atmospheres that permit liquid water on the surface of planets. We present the results of a comprehensive 1D model of the coupled evolution of the interior and atmosphere of rocky exoplanets that combines central feedback processes between these two reservoirs. We carried out more than 280 000 simulations over a wide range of mantle redox states and volatile content, planetary masses, interior structures, and orbital distances in order to robustly assess the emergence, accumulation, and preservation of surface water on rocky planets. To establish a conservative baseline of which types of planets can outgas and sustain water on their surface, we focus here on stagnant-lid planets.
We find that only a narrow range of the mantle redox state around the iron-wüstite buffer allows the formation of atmospheres that lead to long-term habitable conditions. At oxidizing conditions similar to those of the Earth's mantle, most stagnant-lid planets end up in a hothouse regime akin to Venus due to strong CO_2 outgassing. At more reducing conditions, the amount of outgassed greenhouse gases is often too low to keep surface water from freezing. In addition, Mercury-like planets with large metallic cores are able to sustain habitable conditions at an extended range of orbital distances as a result of lower volcanic activity.

Download/Website: `https://arxiv.org/abs/2301.03466`

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ExoMDN: Rapid characterization of exoplanet interior structures with mixture density networks

Philipp Baumeister[1,2] *and Nicola Tosi*[1]

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[2] Department of Astronomy and Astrophysics, Technische Universität Berlin, Hardenbergstraße 36, D-10623 Berlin, Germany

Astronomy & Astrophysics, in press (arXiv:2306.09002)

Characterizing the interior structure of exoplanets is essential for understanding their diversity, formation, and evolution. As the interior of exoplanets is inaccessible to observations, an inverse problem must be solved, where numerical structure models need to conform to observable parameters such as mass and radius. This is a highly degenerate problem whose solution often relies on computationally expensive and time-consuming inference methods such as Markov chain Monte Carlo.
We present ExoMDN, a machine-learning model for the interior characterization of exoplanets based on mixture density networks (MDN). The model is trained on a large dataset of more than 5.6 million synthetic planets below 25 Earth masses consisting of an iron core, a silicate mantle, a water and high-pressure ice layer, and a H/He atmosphere. We employ log-ratio transformations to convert the interior structure data into a form that the MDN can easily handle.
Given mass, radius, and equilibrium temperature, we show that ExoMDN can deliver a full posterior distribution of mass fractions and thicknesses of each planetary layer in under a second on a standard Intel i5 CPU. Observational uncertainties can be easily accounted for through repeated predictions from within the uncertainties. We used ExoMDN to characterize the interiors of 22 confirmed exoplanets with mass and radius uncertainties below 10% and 5%, respectively, including the well studied GJ 1214 b, GJ 486 b, and the TRAPPIST-1 planets. We discuss the inclusion of the fluid Love number k_2 as an additional (potential) observable, showing how it can significantly reduce the degeneracy of interior structures. Utilizing the fast predictions of ExoMDN, we show that measuring k_2 with an accuracy of 10% can constrain the thickness of core and mantle of an Earth analog to $\approx 13\%$ of the true values.

Download/Website: `https://arxiv.org/abs/2306.09002`

Contact: philipp.baumeister@dlr.de

Oblique rings from migrating exomoons: A possible origin for long-period exoplanets with enlarged radii

M. Saillenfest[1], *S. Sulis*[2], *P. Charpentier*[3], *A. Santerne*[2]

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[3] Université de Toulouse, IRAP, Toulouse, France

Astronomy & Astrophysics, in press (arXiv:2306.07348)

Context. The extremely low density of several long-period exoplanets in mature systems is still unexplained – with HIP 41378 f being archetypical of this category. It has been proposed that such planets could actually have normal densities but be surrounded by a ring observed approximately face on, mimicking the transit depth of a puffy planet. This would imply that the equator of the planet is nearly perpendicular to its orbit plane, which is at odds with the formation process of gas giants. Yet, in the context of the Solar System planets, it has been shown that after gigayears of evolution, the tidal migration of a moon can naturally lead to a very tilted planet with a ring. Aims. As exomoons are expected to be ubiquitous around giant exoplanets, this mechanism may be responsible for the anomalous radii of some observed exoplanets. In preparation for the future discoveries of the PLATO mission, we present a simple method for checking the plausibility of this mechanism for a given exoplanet. Methods. Analytical formulas give the probability density function of the relevant precession harmonics of the planet. For each harmonic, simple criteria set the moon mass and other properties required for the mechanism to operate. Results. We applied this methodology to HIP 41378 f, and we show that in order to reproduce the observed configuration, a hypothetical former moon should have had a moon-to-planet mass ratio of a few times 10^{-4} (i.e. roughly the mass of our Moon) and have migrated over a distance of a few planet's radii on a gigayear timescale. These orders of magnitude match the properties of moons expected to exist around gaseous exoplanets. Conclusions. We conclude that the migration of a former moon is a viable formation pathway for the proposed ring and tilt of HIP 41378 f. This example strengthens the ring hypothesis and motivates its application to other targets.

Download/Website: `https://arxiv.org/abs/2306.07348`

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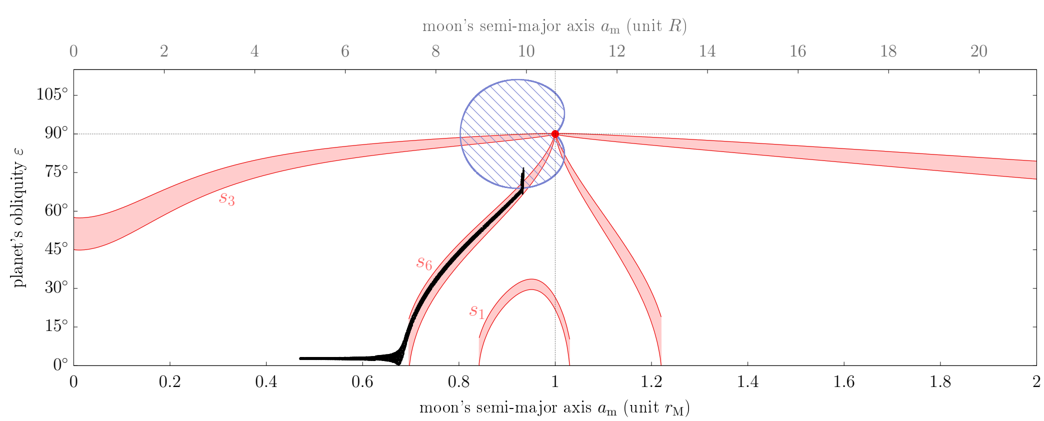

Figure 1: Numerical simulation of the tidal evolution of HIP 41378 f and a hypothetical former moon (black curve). The trajectory goes from left to right in about 1.3 Gyr. The system follows a resonance labelled s_6 (in pink) up to the hatched region, where the moon becomes unstable and may be disrupted into a ring a debris. The distance of the moon is shown both in unit of the planet's Laplace radius (bottom axis) and physical radius (top axis).

Radiative Transfer and Inversion codes for characterizing planetary atmospheres: an overview

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Frontiers in Astronomy and Space Sciences, published (2023FrASS..1076740R)

The study of planetary atmospheres is crucial for understanding the origin, evolution, and processes that shape celestial bodies like planets, moons and comets. The interpretation of planetary spectra requires a detailed understanding of radiative transfer (RT) and its application through computational codes. With the advancement of observations, atmospheric modelling, and inference techniques, diverse RT and retrieval codes in planetary science have been proliferated. However, the selection of the most suitable code for a given problem can be challenging. To address this issue, we present a comprehensive mini-overview of the different RT and retrieval codes currently developed or available in the field of planetary atmospheres. This study serves as a valuable resource for the planetary science community by providing a clear and accessible list of codes, and offers a useful reference for researchers and practitioners in their selection and application of RT and retrieval codes for planetary atmospheric studies.

Download/Website: `https://www.frontiersin.org/articles/10.3389/fspas.2023.1176740/full`

Contact: rengel@mps.mpg.de

Revisiting equilibrium condensation and rocky planet compositions: Introducing the ECCOplanets Code

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Astronomy & Astrophysics, in press/arXiv:2307.00914

Context. The bulk composition of exoplanets cannot yet be directly observed. Equilibrium condensation simulations help us better understand the composition of the planets' building blocks and their relation to the composition of their host star.
Aims. We introduce ECCOPLANETS, an open-source Python code that simulates condensation in the protoplanetary disk. Our aim is to analyse how well a simplistic model can reproduce the main characteristics of rocky planet formation. For this purpose, we revisited condensation temperatures (T_c) as a means to study disk chemistry, and explored their sensitivity to variations in pressure (p) and elemental abundance pattern. We also examined the bulk compositions of rocky planets around chemically diverse stars.
Methods. Our T-p-dependent chemical equilibrium model is based on a Gibbs free energy minimisation. We derived condensation temperatures for Solar System parameters with a simulation limited to the most common chemical species. We assessed their change (ΔT_c) as a result of p-variation between 10^{-6} and 0.1 bar. To analyse the influence of the abundance pattern, key element ratios were varied, and the results were validated using solar neighbourhood stars. To derive the bulk compositions of planets, we explored three different planetary feeding-zone (FZ) models and compared their output to an external n-body simulation.
Results. Our model reproduces the external results well in all tests. For common planet-building elements, we derive a T_c that is within ±5 K of literature values, taking a wider spectrum of components into account. The T_c is sensitive to variations in p and the abundance pattern. For most elements, it rises with p and metallicity. The tested pressure range (10^{-6} – 0.1 bar) corresponds to $\Delta T_c \approx +350$ K , and for $-0.3 \leq [\mathrm{M/H}] \leq 0.4$ we find $\Delta T_c \approx +100$ K. An increase in C/O from 0.1 to 0.7 results in a decrease of $\Delta T_c \approx -100$ K. Other element ratios are less influential. Dynamic planetary accretion can be emulated well with any FZ model. Their width can be adapted to reproduce gradual changes in planetary composition.

Download/Website: `https://arxiv.org/pdf/2307.00914.pdf`

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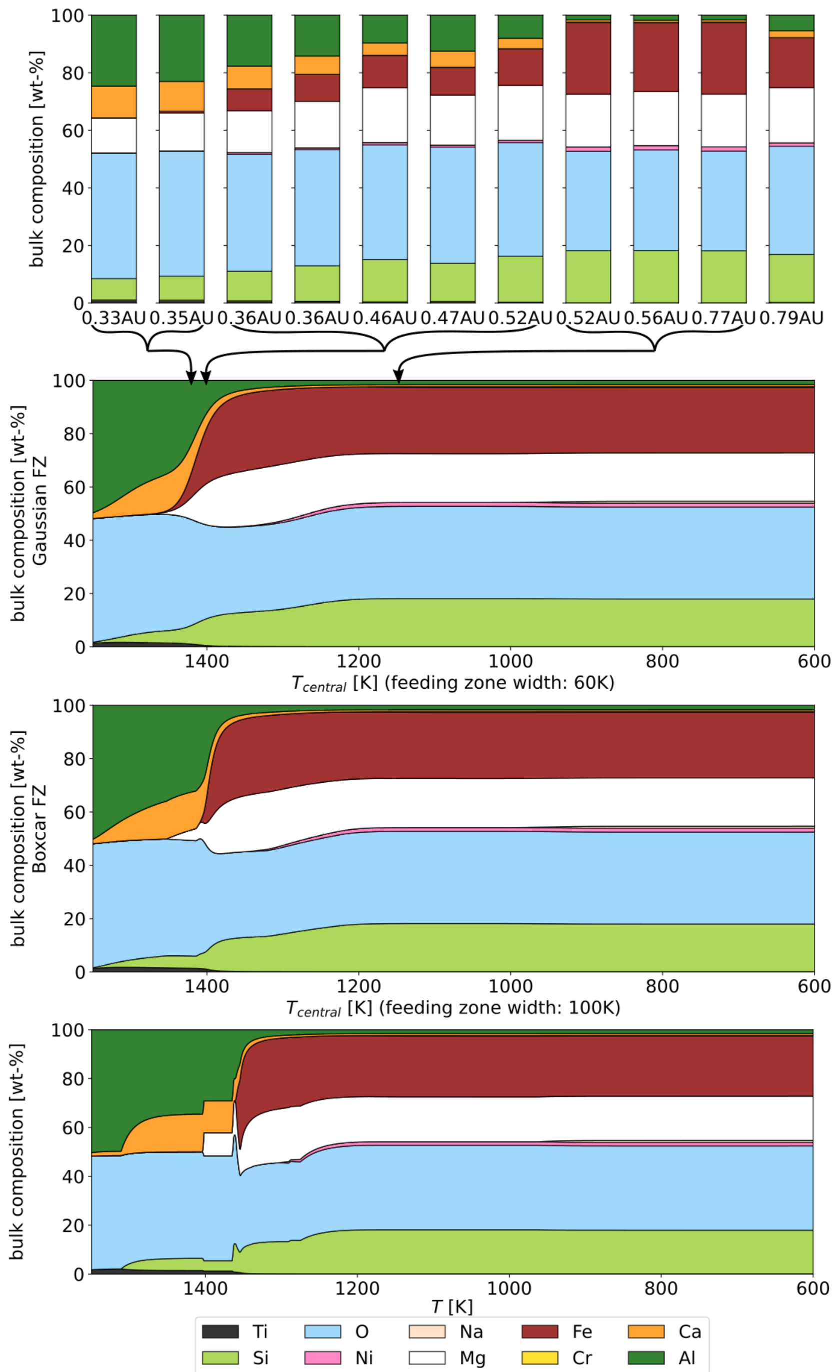

Figure 2: Predicted bulk composition (in wt − %) of a rocky planet simulated for the elemental abundance of HD27442 (low carbon system). *Top panel*: Bond et al. (2010) planet composition results from four separate simulation runs. We also show our simulations: with a Gaussian feeding-zone (FZ) (*second panel*), a boxcar FZ (*third panel*), and no FZ (*bottom panel*). The arrows between the first two panels indicate roughly the location of the best correspondence between the Bond simulation and ours.

Influence of planets on debris discs in star clusters - I. The 50 au Jupiter

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Monthly Notices of the Royal Astronomical Society, published (2023MNRAS.tmp.1683W)

Although debris disks may be common in exoplanet systems, only a few systems are known in which debris disks and planets coexist. Planets and the surrounding stellar population can have a significant impact on debris disk evolution. Here we study the dynamical evolution of debris structures around stars embedded in star clusters, aiming to determine how the presence of a planet affects the evolution of such structures. We combine `NBODY6++GPU` and `REBOUND` to carry out N-body simulations of planetary systems in star clusters ($N = 8\,000$; $R_{\rm h} = 0.78$ pc) for a period of 100 Myr, in which 100 solar-type stars are assigned 200 test particles. Simulations are carried out with and without a Jupiter-mass planet at 50 au. We find that the planet destabilizes test particles and speeds up their evolution. The planet expels most particles in nearby and resonant orbits. Remaining test particles tend to retain small inclinations when the planet is present, and fewer test particles obtain retrograde orbits. Most escaping test particles with speeds smaller than the star cluster's escape speed originate from cold regions of the planetary system or from regions near the planet. We identify three regions within planetary systems in star clusters: (i) the private region of the planet, where few debris particles remain ($40 - 60$ au), (ii) the reach of the planet, in which particles are affected by the planet ($0 - 400$ au), and (iii) the territory of the planetary system, most particles outside which will eventually escape ($0 - 700$ au).

Download/Website: `https://arxiv.org/abs/2306.01283`

Contact: `kaiwu.astro@gmail.com`

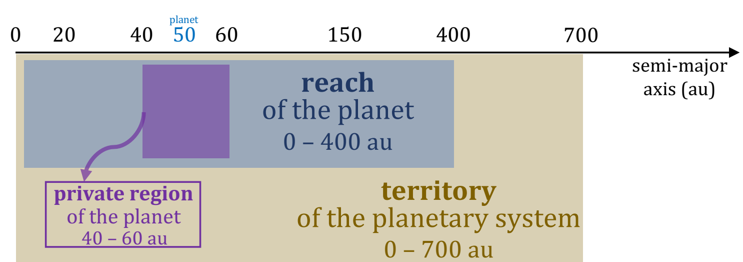

Figure 3: Classification of regions. (i) The private region of the planet (40-60 au), where the 50-au-Jupiter clears all particles near its orbit. (ii) The reach of the planet (0-400 au), within which the planet has a notable influence. Particles outside 400 au remain unaffected by the presence of the 50-au-Jupiter. (iii) The territory of the planetary system (0-700 au), the region in which most particles remain part of the planetary system. Most particles outside this region are rapidly removed by stellar flybys.

Oort cloud (exo)planets

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Monthly Notices of the Royal Astronomical Society, published (2023MNRAS.524L..72R)

Dynamical instabilities among giant planets are thought to be nearly ubiquitous, and culminate in the ejection of one or more planets into interstellar space. Here we perform N-body simulations of dynamical instabilities while accounting for torques from the galactic tidal field. We find that a fraction of planets that would otherwise have been ejected are instead trapped on very wide orbits analogous to those of Oort cloud comets. The fraction of ejected planets that are trapped ranges from 1-10%, depending on the initial planetary mass distribution. The local galactic density has a modest effect on the trapping efficiency and the orbital radii of trapped planets. The majority of Oort cloud planets survive for Gyr timescales. Taking into account the demographics of exoplanets, we estimate that one in every 200-3000 stars could host an Oort cloud planet. This value is likely an overestimate, as we do not account for instabilities that take place at early enough times to be affected by their host stars' birth cluster, or planet stripping from passing stars. If the Solar System's dynamical instability happened after birth cluster dissolution, there is a $\sim$7% chance that an ice giant was captured in the Sun's Oort cloud.

Download/Website: `https://arxiv.org/abs/2306.11109`

Download/Website: `https://planetplanet.net/2023/06/21/oort-cloud-exoplanets/`

Contact: rayray.sean@gmail.com

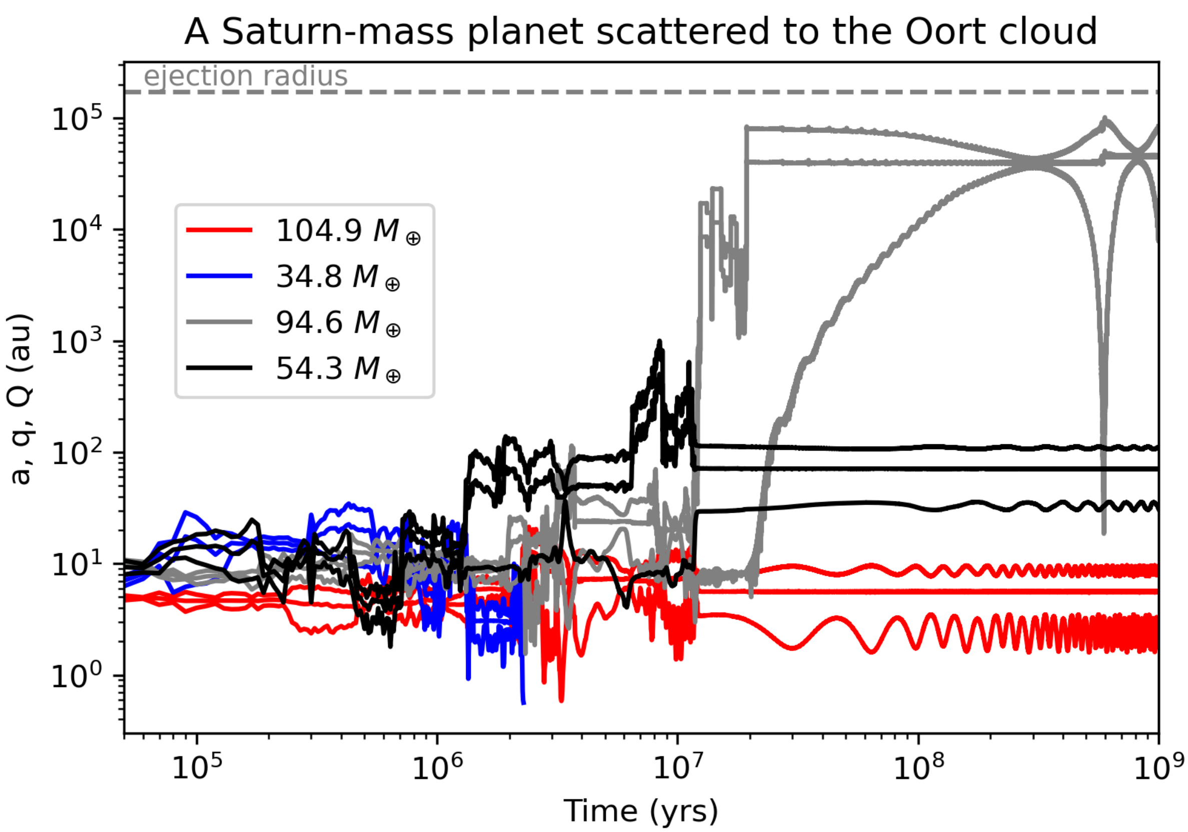

Figure 4: An example simulation from the *mixed2* set in which a roughly Saturn-mass planet was trapped on a very wide orbit. Each planet's semimajor axis a, perihelion distance q, and aphelion distance Q are shown. The dashed line shows the ejection radius at 170,000 au.

3 Jobs and Positions

Postdoc in planet formation

Anders Johansen
Centre for Star and Planet Formation, Globe Institute, University of Copenhagen

Globe Institute, University of Copenhagen, approximate starting date 1/1-2024

The University of Copenhagen invites applications for a 3-year postdoc in planet formation at the Centre for Star and Planet Formation starting 1 January 2024 or soon thereafter. The postdoc supervisor is Professor Anders Johansen.

We are looking for candidates who can lead and participate in original scientific research addressing a broad range of fundamental questions in planet formation. We are particularly interested in candidates who have experience with hydrodynamical simulations of planets embedded in protoplanetary discs or experience with hydrodynamical simulations of convection. Experience with hydrodynamics is nevertheless not essential and we encourage anyone with a background in planet formation to apply.

The place of employment is at the Globe Institute, University of Copenhagen. We offer creative and stimulating working conditions in dynamic and international research environment. Our research facilities include access to modern supercomputers.

Download/Website: https://candidate.hr-manager.net/ApplicationInit.aspx/?cid=1307&departmentId=19217&ProjectId=159555

Contact: anders.johansen@sund.ku.dk

4 Conferences and Workshops

PLATO workshop on 3D climate and clouds

Ludmila Carone

Space Research Institute of the Austrian Academy of Sciences, September 11 – 14, 2023

This is a four day workshop (max 50 people) which is aimed at gathering models and discussing tasks for WP116 700 (Clouds and atmosphere chemistry of exoplanets) and WP 116 800 (3D climate of exoplanets) in conjunction with PLATO observations (represented by WP 112 300). Thus, the main focus of this workshop is in interactive discussions with possibilities of break-out rooms for targeted collaboration.

We invite poster displays and will further select talks for a given topic covered during the workshop.

We will accept registration on first come, first serve basis. **Registration deadline is July 15**. We will collect 75EUR conference fee for lunch and conference dinner.

Download/Website: `https://www.oeaw.ac.at/en/iwf/meetings/plato-workshop`

Contact: `ludmila.carone@oeaw.ac.at`

Workshop on The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys

Yasuhiro Hasegawa, Tim Pearce, Isabel Rebollido, Michael Meyer

Space Telescope Science Institute (STScI), 3700 San Martin Drive, Baltimore, MD 21218, USA,
Friday, September 15, 2023 (hybrid)

The ExoPAG SAG 23 comprises interdisciplinary scientists, who study dust throughout the Solar System and Galaxy. Its aim is to review the gaps in our current knowledge of exo-zodiacal dust, particularly focussing on how this dust could impact future exoplanet-imaging efforts. The intent is to identify areas of exozodi and debris-disk science that should be prioritized in the coming years.

This workshop will bring together both SAG 23 members and researchers in the community. Its aims are to showcase the progress of the SAG efforts so far, and to get community input into its future direction. The meeting will be held without any registration fee and immediately following the The First Year of JWST Science Conference at STScI.

If you plan to attend the meeting, in person or online, please fill out the form at:
`https://forms.gle/Tw11Rf8G6ZqUHWcZ8`

The registration will be open until Aug 1. If you would like to give a presentation on a subject relevant to the SAG (either as a talk or poster), then please add a short title with a 150-200 word abstract when filling out the registration form. Please note that the meeting will be very time-limited and we cannot guarantee individual presentations from all the participants.

For more information about this workshop, please visit the following website:
`https://exoplanets.nasa.gov/exep/events/475/workshop-on-the-impact-of-exo-zodiacal-dust-on-exoplanet-direct-imaging-surveys/`

For more information about SAG 23, please visit our website:
`https://sites.google.com/view/sag23-exozodiacaldust/home`

Contact: `yasuhiro.hasegawa@jpl.nasa.gov`

5 Others

2024A NASA Keck Call for Proposals

Dr. Dawn M. Gelino, NASA Exoplanet Science Institute

The NASA Exoplanet Science Institute is soliciting proposals to use NASA's portion of time on the two 10m Keck Telescopes for the 2024A observing semester (February 1 - July 31, 2024). This semester also includes a call for Key Strategic Mission Support (KSMS) proposals. KSMS proposals directly support the science goals and requirements of NASA missions and are not just larger versions of general science programs.

KSMS projects may support past, present, and/or future NASA-led missions or missions with significant NASA partnerships. Highest priority will be given to operating missions or missions approaching launch, with lower priority given to past missions (e.g. Kepler, WISE) or more distant future missions (e.g. HWO). Required but non-binding Notices of Intent to submit a KSMS proposal are due by August 16.

The opportunity to propose as a Principal Investigator for NASA time on the Keck Telescopes is open to all U.S.-based astronomers (a U.S.-based astronomer has their principal affiliation at a U.S. institution). *Investigators from institutions outside of the U.S. may participate as Co-Investigators on proposals for NASA Keck time*.

NASA intends the use of the Keck telescopes to be highly strategic in support of on-going space missions and/or high priority, long-term science goals. Proposals are sought in the following discipline areas: (1) investigations in support of EXOPLANET EXPLORATION science goals and missions; (2) investigations of our own SOLAR SYSTEM; (3) investigations in support of COSMIC ORIGINS science goals and missions; and (4) investigations in support of PHYSICS OF THE COSMOS science goals and missions. Direct mission support proposals in any of these scientific areas are also encouraged.

The 2024A NASA Keck Call for Proposals will be available by July 20.

Key Dates in 2023:

- July 20: 2024A Call for Proposals available
- August 16: Deadline to submit a non-binding Notice of Intent to submit a KSMS proposal
- September 14: all proposals due to NExScI

Download/Website: `http://nexsci.caltech.edu/missions/KeckSolicitation/index.shtml`

Contact: `KeckCFP@ipac.caltech.edu`

6 As seen on astro-ph

The following list contains exoplanet related entries appearing on astro-ph in June 2023.
Disclaimer: The hyperlinks to the astro-ph articles are provided for the convenience of the reader, but the ExoPlanet News cannot be responsible for their accuracy and perpetuity.

June 2023

astro-ph/2306.00022: **Ephemeris Updates for Seven Selected HATNet Survey Transiting Exoplanets** *by A. Poro et al.*

astro-ph/2306.00131: **Assessment of a Physics-based Retrieval of Exoplanet Atmospheric Temperatures from Infrared Emission Spectra** *by Franz Schreier et al.*

astro-ph/2306.00158: **Porous Dust Particles in Protoplanetary Disks: Application to the HL Tau Disk** *by Shangjia Zhang et al.*

astro-ph/2306.00251: **The TESS-Keck Survey. XV. Precise Properties of 108 TESS Planets and Their Host Stars** *by Mason G. MacDougall et al.*

astro-ph/2306.00276: **Humid Evolution of Haze in the Atmosphere of Super-Earths in the Habitable Zone** *by Julien Maillard et al.*

astro-ph/2306.00799: **Active Stars in the Spectroscopic Survey of Mid-to-Late M Dwarfs Within 15pc** *by Emily K Pass et al.*

astro-ph/2306.01119: **Ultracool Dwarfs Observed with the Spitzer Infrared Spectrograph – III. Dust Grains in Young L Dwarf Atmospheres Are Heavier** *by Genaro Suárez, Stanimir Metchev*

astro-ph/2306.01653: **In-situ enrichment in heavy elements of hot Jupiters** *by A. Morbidelli et al.*

astro-ph/2306.01834: **Spectral analogues of Barbarian asteroids among CO and CV chondrites** *by Max Mahlke et al.*

astro-ph/2306.01283: **Influence of planets on debris disks in star clusters I: the 50 AU Jupiter** *by Kai Wu et al.*

astro-ph/2306.01225: **Experimental Verification of a One-Dimensional Diffraction-Limit Coronagraph** *by Satoshi Itoh et al.*

astro-ph/2306.02452: **Gaia Search for stellar Companions of TESS Objects of Interest IV** *by M. Mugrauer et al.*

astro-ph/2306.07287: **Improved temperature dependence of rate coefficients for rotational state-to-state transitions in H_2O + H_2O collisions** *by Bikramaditya Mandal, Dmitri Babikov*

astro-ph/2306.03004: **Stratospheric dayside-to-nightside circulation drives the 3-D ozone distribution on synchronously rotating rocky exoplanets** *by Marrick Braam et al.*

astro-ph/2306.02951: **Precise Transit Photometry Using TESS: Updated Physical Properties for 28 Exoplanets Around Bright Stars** *by Suman Saha*

astro-ph/2306.02897: **Prebiosignature Molecules Can Be Detected in Temperate Exoplanet Atmospheres with JWST** *by Alastair Claringbold et al.*

astro-ph/2306.02610: **Understanding the Planetary Formation and Evolution in Star Clusters(UPiC)-I: Evidence of Hot Giant Exoplanets Formation Timescales** *by Yuan-Zhe Dai et al.*

astro-ph/2306.02663: **A T-Dwarf Candidate from JWST Early Release NIRCam data** *by Po-Ya Wang et al.*

astro-ph/2306.02657: **The post-disk (or primordial) spin distribution of M dwarf stars** *by L. Gehrig et al.*

astro-ph/2306.02922: **Warm Jupiters Beyond the Tidal Synchronization Limit May Exhibit a Wide Range of Secondary Eclipse Depths** *by Emily Rauscher et al.*

astro-ph/2306.03913: **Giant Tidal Tails of Helium Escaping the Hot Jupiter HAT-P-32 b** *by Zhoujian Zhang et al.*

astro-ph/2306.03673: **Temperature-chemistry coupling in the evolution of gas giant atmospheres driven by stellar flares** *by Harrison Nicholls et al.*

astro-ph/2306.03737: **orbitN: A symplectic integrator for planetary systems dominated by a central mass – Insight into long-term solar system chaos** *by Richard E. Zeebe* astro-ph/2306.03614: **Simulations of idealised 3D atmospheric flows on terrestrial planets using LFRic-Atmosphere** *by Denis E. Sergeev et al.*

astro-ph/2306.03520: **Dynamically coupled kinetic chemistry in brown dwarf atmospheres I. Performing global scale kinetic modelling** *by Elspeth K. H. Lee et al.*

astro-ph/2306.04676: **Exoplanet Spectroscopy with JWST NIRISS: Diagnostics and Case Studies** *by Måns Holmberg, Nikku Madhusudhan*

astro-ph/2306.04572: **The Near Infrared Imager and Slitless Spectrograph for the James Webb Space Telescope – III. Single Object Slitless Spectroscopy** *by Loic Albert et al.*

astro-ph/2306.04509: **Asteroseismic modelling strategies in the PLATO era I. Mean density inversions and direct treatment of the seismic information** *by Jérôme Bétrisey et al.*

astro-ph/2306.04497: **Data structures for photoabsorption within the ExoMol project** *by Jonathan Tennyson et al.*

astro-ph/2306.04450: **Two Warm Neptunes transiting HIP 9618 revealed by TESS & Cheops** *by Hugh P. Osborn et al.*

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