ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Dear readers,

Welcome to the first edition of the ExoPlanet News in 2022! We hope you had a safe and enjoyable holidays.

Last month, on December 21, 2021, we sadly lost Prof. Dr. Wilhelm Kley. We thank Prof. Dr. Doug Lin for accepting our invitation and sharing his thoughts and highlighting the scientific contributions of Prof. Kley. We offer our deepest condolences to his friends and family.

In this issue you will find abstracts of scientific papers, job advertisements, announcements (conferences, book), the latest exoplanet talks, 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 also 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 February 8, 2022.

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

Figure 1: Prof. Wilhelm Kley, 19 Feb. 1958 – 21 Dec. 2021.
Photograph used with permission from Martina Nehr-Kley.

Some personal reflections on Willy Kley

by Doug Lin

Like many friends and colleagues, I am deeply saddened by the sudden passing of Willy Kley. He was a highly accomplished astrophysicist, an inspirational teacher, a devoted husband of Martina, loving father of three daughters, and a kind, caring friend. I feel privileged to have gotten to know him from close up over the past 33 years. His winning smile, witty sense of humor, insatiable curiosity, dedicated professionalism, and determined spirit are deeply rooted in the recollections of all those around him.

My first glimpses of Willy date back to 1989 when I attended a Theory of Accretion Disk workshop at the Max Planck Institute for Astrophysics. I was mesmerized by a poster describing his state-of-the-art simulations on accretion disk boundary layer which were simply tour de force. In response to his invitation for questions, I immediately asked him if he would like to come to UCSC as a postdoctoral fellow after he completed his PhD thesis. His arrival a year later with several other very active postdocs instantly launched an exuberant theory group on star and planet formation studies. With very little data but no shortage of speculative ideas, our discussion over daily coffee and lunch led to a lot of conceptual exploration which technically prepared us for the later transformative observational characterization of protostellar disks and burgeoning discovery of exoplanets.

These breakthroughs in planetary astrophysics have led to the realization that planets emerge prolifically under a wide-range of conditions and with startling mobility. In the establishment of this new paradigm, Willy Kley led the computational simulation of planet disk interaction from his various home institutions in London, Jena, Heidelberg, and Tübingen. With his natural talent in designing and constructing top-of-the-line computational tools and innovatively applying them to solve technically challenging fundamental problems, he made major impacts including the demonstration of that migrating planets can capture each other into mean motion resonances and that even Earth-mass planets can migrate both towards or away from their host stars. He was inspirational to his students, postdocs, collaborators, and generous in sharing with and helping colleagues to utilize the versatile and advance computational tools he built for their own research projects.

To me and many other who knew him, Willy Kley was a kind and caring friend and a fellow adventurer. The pictures of our first-hand experiences of ice grains and snowline on the ski slopes, Monte Carlo technique over the poker table, Poisson statistics with snorkel in the red sea, inelastic particle collisions on the squash courts, Goethe and Schiller writing inspiration during a tour in Weimar, and elephant seals migration on the año nuevo beach in California flash through my mind. The endearing memories of Willy's kindness, love, kinship, inspiration, and shared passion for life will remain vivid for a long time to come.

2 Abstracts of refereed papers

Characterizing the WASP-4 system with TESS and radial velocity data: Constraints on the cause of the hot Jupiter's changing orbit and evidence of an outer planet

Jake D. Turner[1,2]*, Laura Flagg*[3]*, Andrew Ridden-Harper*[1]*, Ray Jayawardhana*[3]

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[2] NHFP Sagan Fellow
[3] Department of Astronomy, Cornell University, Ithaca, New York 14853, USA

The Astronomical Journal, in press (arXiv:2112.09621)

Orbital dynamics provide valuable insights into the evolution and diversity of exoplanetary systems. Currently, only one hot Jupiter, WASP-12b, is confirmed to have a decaying orbit. Another, WASP-4b, exhibits hints of a changing orbital period that could be caused by orbital decay, apsidal precession, or the acceleration of the system towards the Earth. We have analyzed all data sectors from NASA's Transiting Exoplanet Survey Satellite together with all radial velocity (RV) and transit data in the literature to characterize WASP-4b's orbit. Our analysis shows that the full RV data set is consistent with no acceleration towards the Earth. Instead, we find evidence of a possible additional planet in the WASP-4 system, with an orbital period of $\sim$7000 days and $M_c sin(i)$ of $5.47^{+0.44}_{-0.43} M_{Jup}$. Additionally, we find that the transit timing variations of all of the WASP-4b transits cannot be explained by the second planet but can be explained with either a decaying orbit or apsidal precession, with a slight preference for orbital decay. Assuming the decay model is correct, we find an updated period of 1.338231587$\pm$0.000000022 days, a decay rate of -7.33$\pm$0.71 msec year^{-1}, and an orbital decay timescale of $\tau = P/|\dot{P}|$ = 15.77$\pm$1.57 Myr. If the observed decay results from tidal dissipation, we derive a modified tidal quality factor of $Q_{\star}^{'}$ = 5.1$\pm$0.9 $\times 10^4$, which is an order of magnitude lower than values derived for other hot Jupiter systems. However, more observations are needed to determine conclusively the cause of WASP-4b's changing orbit and confirm the existence of an outer companion.

Download/Website: `https://arxiv.org/abs/2112.09621`

Contact: `jaketurner@cornell.edu`

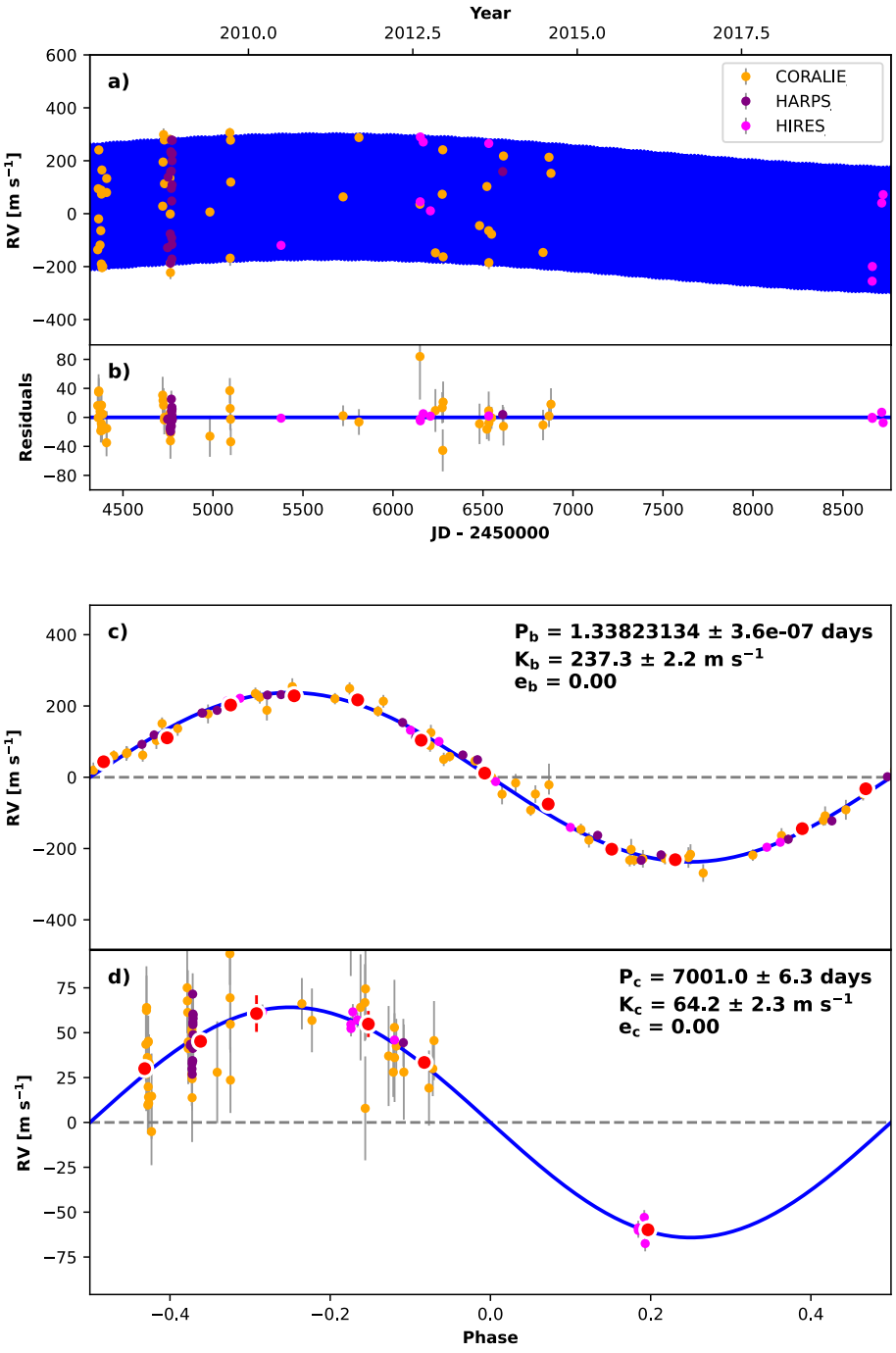


Figure 2: Best-fit 2-planet Keplerian orbital model for the WASP-4 system using `RadVel`. **a panel)** The maximum likelihood model is plotted while the orbital parameters are the median values of the posterior distributions. The thin blue line is the best fit model. We add in quadrature the RV jitter terms with the measurement uncertainties for all RVs. **b panel)** Residuals to the best fit model. The error bars of the residuals reflect both the measurement error and the jitter from the MCMC fit. **c panel)** RVs phase-folded to the ephemeris of WASP-4b. The phase-folded model for WASP-4b is shown as the blue line. The Keplerian orbital models for all other planets (panels d, WASP-4c) have been subtracted. **d panel)** RVs phase-folded to the ephemeris of the second planet WASP-4c. The Keplerian orbital model for the other planet (panels c, WASP-4b) has been subtracted. Red circles are the velocities binned in 0.08 units of orbital phase.

A Readily Implemented Atmosphere Sustainability Constraint for Terrestrial Exoplanets Orbiting Magnetically Active Stars

E. Samara[1,2], *S. Patsourakos*[3], *M. K. Georgoulis*[4]

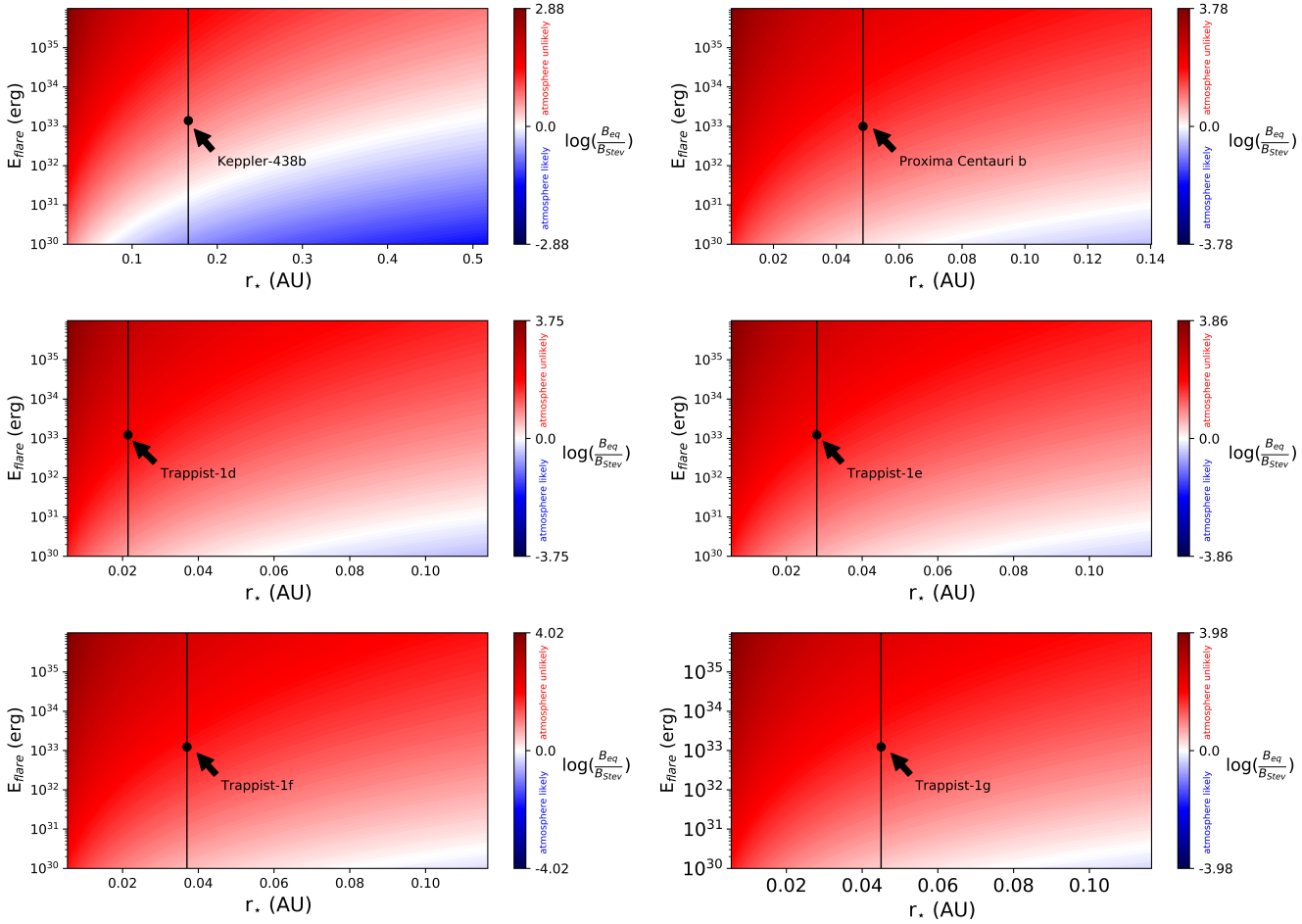
[1] Royal Observatory of Belgium, 1180 Brussels, Belgium
[2] Centre for Mathematical Plasma Astrophysics, KU Leuven, 3001 Leuven, Belgium
[3] Department of Physics, University of Ioannina, 45110 Ioannina, Greece
[4] Research Center of Astronomy and Applied Mathematics (RCAAM) of the Academy of Athens, 11527 Athens, Greece

Astrophysical Journal Letters, published (2021ApJ...909L..12S)

With more than 4,300 confirmed exoplanets and counting, the next milestone in exoplanet research is to determine which of these newly found worlds could harbor life. Coronal Mass Ejections (CMEs), spawn by magnetically active, superflare-triggering dwarf stars, pose a direct threat to the habitability of terrestrial exoplanets as they can deprive them from their atmospheres. Here we develop a readily implementable atmosphere sustainability constraint for terrestrial exoplanets orbiting active dwarfs, relying on the magnetospheric compression caused by CME impacts. Our constraint focuses on a systems understanding of CMEs in our own heliosphere that, applying to a given exoplanet, requires as key input the observed bolometric energy of flares emitted by its host star. Application of our constraint to six famous exoplanets, (Kepler-438b, Proxima-Centauri b, and Trappist-1d, -1e, -1f and -1g), within or in the immediate proximity of their stellar host's habitable zones, showed that only for Kepler-438b might atmospheric sustainability against stellar CMEs be likely. This seems to align with some recent studies that, however, may require far more demanding computational resources and observational inputs. Our physically intuitive constraint can be readily and *en masse* applied, as is or generalized, to large-scale exoplanet surveys to detect planets that could be sieved for atmospheres and, perhaps, possible biosignatures at higher priority by current and future instrumentation.

Download/Website: `https://iopscience.iop.org/article/10.3847/2041-8213/abe416/meta`

Contact: `evangelia.samara@kuleuven.be`


Keppler-438b
Proxima Centauri b
Trappist-1d
Trappist-1e
Trappist-1f
Trappist-1g
E_flare (erg)
r⋆ (AU)
log(B_eq / B_Stev)
atmosphere unlikely
atmosphere likely
2.88
3.78
3.75
3.86
4.02
3.98
0.0
-2.88
-3.78
-3.75
-3.86
-4.02
-3.98

Stellar and substellar companions from Gaia EDR3 - Proper-motion anomaly and resolved common proper-motion pairs

P. Kervella[1]*, F. Arenou*[2]*, F. Thévenin*[3]

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[2] GEPI, Observatoire de Paris, Université PSL, CNRS, 5 Place Jules Janssen, 92190 Meudon, France
[3] Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Lagrange UMR 7293, CS 34229, 06304, Nice, France

Astronomy & Astrophysics, 2022A&A...657A...7K

The multiplicity fraction of stars, down to the substellar regime, is a parameter of fundamental importance for stellar formation, evolution, and planetology. The census of multiple stars in the solar neighborhood is however incomplete. Our study is aimed at detecting companions of Hipparcos catalog stars from the proper motion anomaly (PMa) they induce on their host star, namely, the difference between their long-term Hipparcos-Gaia and short-term Gaia proper motion vectors. We also aim to detect resolved, gravitationally bound companions of the Hipparcos catalog stars ($117,955$ stars) and of the Gaia EDR3 stars closer than 100 pc (542,232 stars). Using the Hipparcos and EDR3 data, we revised the PMa catalog for the Hipparcos stars. In order to identify gravitationally bound visual companions of our sample, we searched the Gaia EDR3 catalog for common proper-motion (CPM) candidates. The detection of tangential velocity anomalies with a median accuracy of $\sigma(\Delta v_{\rm T}) = 26\,{\rm cm\,s^{-1}}$ per parsec of distance is demonstrated with the EDR3. This improvement by a factor 2.5 in accuracy, as compared to Gaia DR2, results in PMa detection limits on companions that are well into the planetary mass regime for many targets. We identify 37,515 Hipparcos stars presenting a PMa at significant level (S/N larger than 3), namely, a fraction of 32% (compared to 30% for the DR2) and 12,914 (11%) hosting CPM bound candidate companions. After including the Gaia EDR3 renormalised unit weight error (RUWE larger than 1.4) as an additional indicator, 50,720 stars of the Hipparcos catalog (43%) exhibit at least one signal of binarity. Among the Gaia EDR3 stars located within 100 pc, we find CPM bound candidate companions for 39,490 stars (7.3% of the sample). The search for companions using a combination of the PMa, CPM, and RUWE indicators significantly improves the exhaustivity of the multiplicity survey. The detection of CPM companions of very bright stars (heavily saturated on the Gaia detectors) that are classical benchmark objects for stellar physics provides a useful proxy for estimating their distance with a higher accuracy than with Hipparcos.

Download/Website: `https://www.aanda.org/articles/aa/fullhtml/2022/01/aa42146-21`

Download/Website: `http://cdsarc.u-strasbg.fr/viz-bin/cat/J/A+A/657/A7`

Contact: `pierre.kervella@observatoiredeparis.psl.eu`

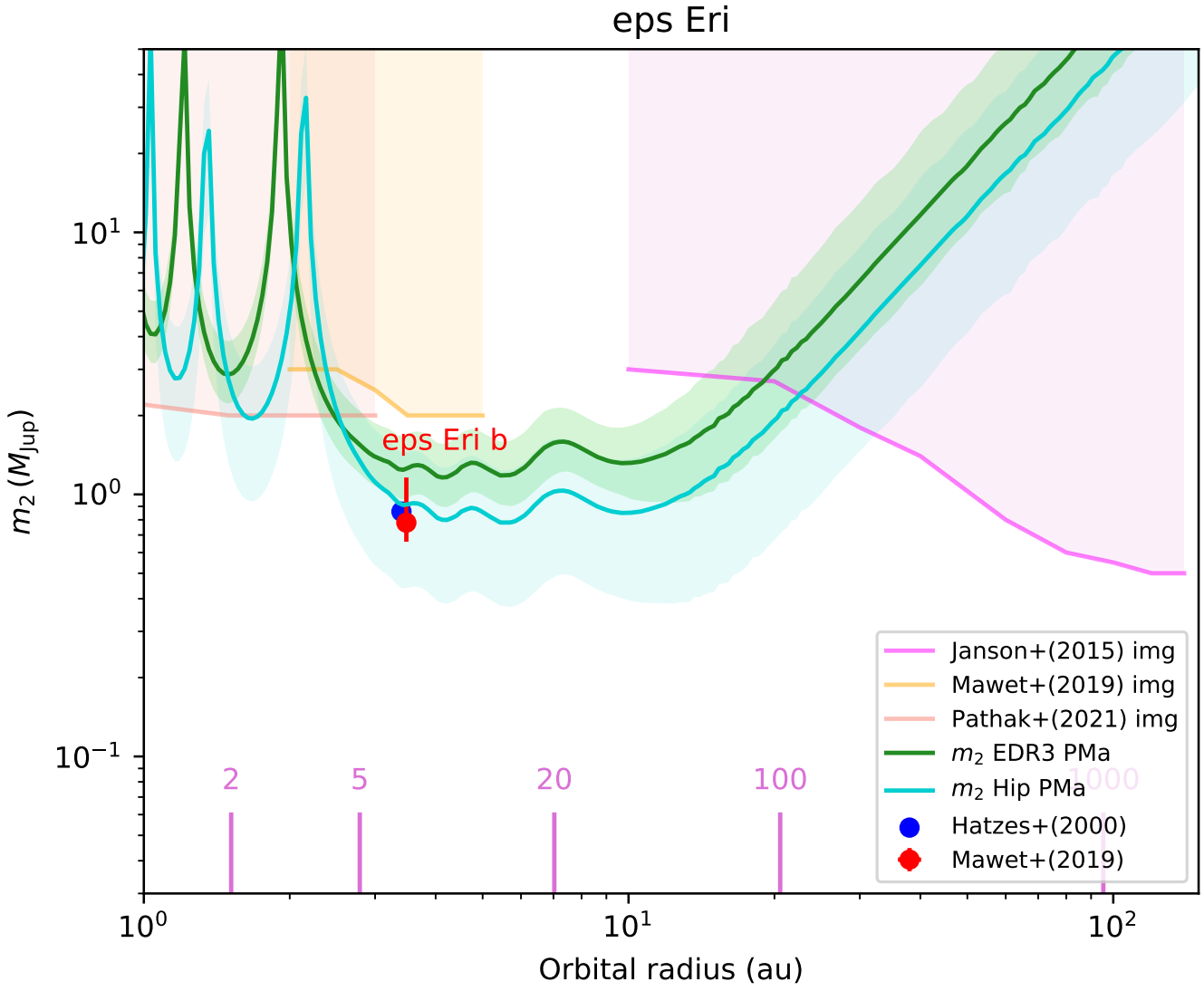

Figure 3: Proper motion anomaly sensitivity diagram of ϵ Eridani for the Hipparcos (cyan) and Gaia EDR3 (green) measurements. The red and blue points show the properties of planet ϵ Eri b determined from radial velocity measurements, while the color shaded regions are excluded by direct imaging searches.

Extreme ultraviolet and X-ray driven photochemistry of gaseous exoplanets

D. Locci[1], *A. Petralia*[1], *G. Micela*[1], *A. Maggio*[1], *A. Ciaravella*[1], *C. Cecchi-Pestellini*[1]
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The Planetary Science Journal, in press (arXive:2112.02942v2)

The interaction of exoplanets with their host stars causes a vast diversity in bulk and atmospheric compositions, and physical and chemical conditions. Stellar radiation, especially at the shorter wavelengths, drives the chemistry in the upper atmospheric layers of close orbiting gaseous giants, providing drastic departures from equilibrium. In this study, we aim at unfolding the effects caused by photons in different spectral bands on the atmospheric chemistry, with particular emphasis on the molecular synthesis induced by X-rays. This task is very difficult because the characteristics of chemical evolution emerge from many feedbacks on a wide range of time scales, and because of the existing correlations among different portions of the stellar spectrum.
The weak X-ray photoabsorption cross-sections of the atmospheric constituents boost the gas ionization to pressures inaccessible to vacuum and extreme ultraviolet photons. Although X-rays interact preferentially with metals, they produce a secondary electron cascade able to ionize efficiently hydrogen and helium bearing species, giving rise to a distinctive chemistry.

Download/Website: `https://arxiv.org/abs/2112.02942v2`

Contact: `daniele.locci@inaf.it`

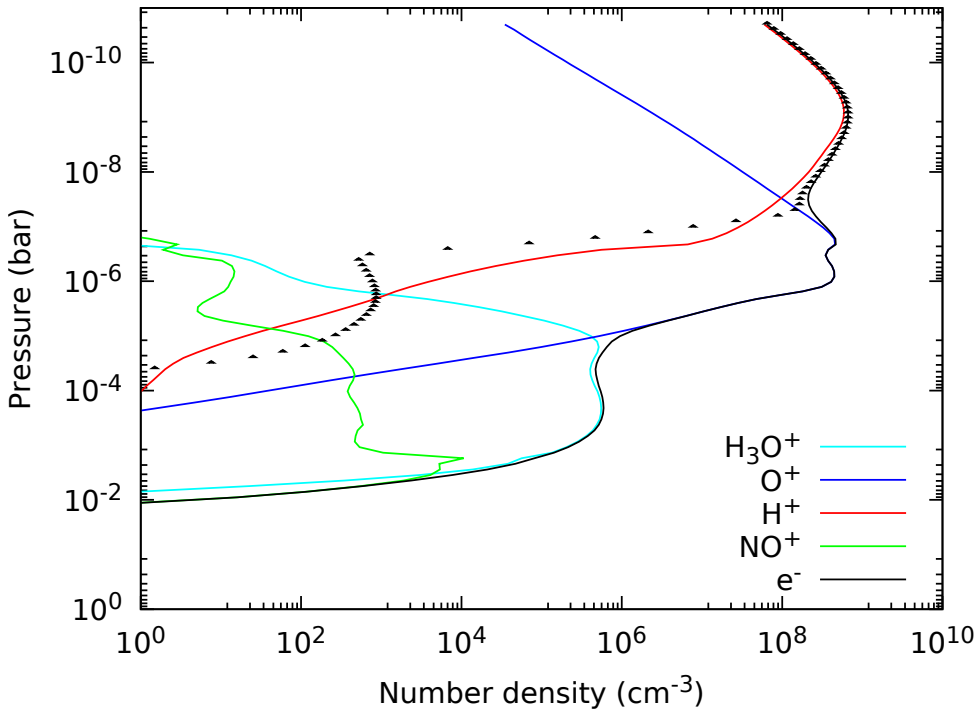

Figure 4: Vertical density profiles of electrons and their major contributors under the conditions of the RF model (solid lines). Black dots indicate the distribution of the electron density suppressing X-rays (NX model).

Terrestrial Planet Optical Phase Curves. I. Direct Measurements of the Earth

R. De Cock[1], *T. A. Livengood*[2,3], *D. M. Stam*[1], *C. M. Lisse*[4], *T. Hewagama*[3], *L. Drake Deming* [2,5]

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Delft, The Netherlands
[2] Department of Astronomy, University of Maryland,

College Park, Maryland USA
[3] Center for Research and Exploration in Space Science and Technology, NASA/GSFC,

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[4] Johns Hopkins University Applied Physics Laboratory,

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[5] NASA Astrobiology Institute's Virtual Planetary Laboratory

The Astronomical Journal, published (10.3847/1538-3881/ac3234)

NASA's EPOXI mission used the Deep Impact spacecraft to observe the disk-integrated Earth as an analog to terrestial exoplanets' appearance. The mission took five 24 hr observations in 2008–2009 at various phase angles (57fdg7–86fdg4) and ranges (0.11–0.34 au), of which three equatorial (E1, E4, E5) and two polar (P1, North and P2, South). The visible data taken by the HRIV instrument ranges from 0.3 to 1.0 m, taken trough seven spectral filters that have spectral widths of about 100 nm, and which are centered about 100 nm apart, from 350 to 950 nm. The disk-integrated, 24 hr averaged signal is used in a phase angle analysis. A Lambertian-reflecting, spherical planet model is used to estimate geometric albedo for every observation and wavelength. The geometric albedos range from 0.143 (E1, 950 nm) to 0.353 (P2, 350 nm) and show wavelength dependence. The equatorial observations have similar values, while the polar observations have higher values due to the ice in view. Therefore, equatorial observations can be predicted for other phase angles, but (Earth-like) polar views (with ice) would be underestimated.

Download/Website: `https://iopscience.iop.org/article/10.3847/1538-3881/ac3234`

Contact: `roderickdecock@gmail.com`

3 Jobs and Positions

Assistant/Associate Professor position

Sun, Stars & Exoplanet Research Group

University of Birmingham, UK, 31 January 2022

The Sun, Stars and Exoplanets research group at the University of Birmingham is seeking a talented researcher and teacher to join its permanent staff as an Assistant or Associate Professor, particularly individuals with expertise diversifying, but complimentary to, the research already performed. The group's interests currently range from stellar astrophysics to exoplanetary observations and orbital dynamics, and from stellar modelling to exoplanet interior and atmospheric modelling. The group is particularly keen to attract individuals with a strong programme of research likely to attract funding from schemes such as the ERC.
In the image of a diverse universe, the group welcomes applications from all backgrounds to enrich its internal culture and create an environment representative of the wider public.

The Sun, Stars and Exoplanets group is heavily involved in the upcoming PLATO mission, is a long-time member of TASC and KASC, operates a worldwide network of solar telescopes called BiSON, operates a robotic 1m optical telescope at Paranal Observatory as part of the SPECULOOS search for habitable Earth-like planets, and is a partner in ASTEP, a 40cm telescope located within Antarctica. The group currently holds two ERC grants, a Leverhulme Trust grant, a UK Space Agency grant, and several STFC grants and projects. The group benefits from recently renovated offices.
The group currently consists of Prof. Amaury Triaud (Head of Group) who focuses on exoplanet observations, Prof. Bill Chaplin (now Head of the School of Physics & Astronomy at Birmingham), an expert in asteroseismology and helioseismology, and Dr Guy Davies who applies machine learning and advanced statistical methods to asteroseismic and exoplanetary datasets. In addition, the group includes honorary Prof. Yvonne Elsworth (RAS gold medal in 2020), our BiSON Network Manager, one secretary, six postdoctoral researchers, and 8 PhD students. Birmingham's School of Physics & Astronomy also has another research group focussing on extragalactic and gravitational wave astronomy which has nine academics. Both groups interact regularly.

To apply, provide a CV (2 pages max), and include a 2 page document pitching your research interests and how you influence the further research direction of the Sun, Stars and Exoplanets group. Please give the names and contact details of three referees able to provide reference letters.

Closing date for applications: 31 January 2022 for full consideration.
Start date: in place by 01 September 2022
Starting salary: from £42,149 to £51,799, commensurate with experience, and with incremental rise usually in October.

Download/Website: `https://bham.taleo.net/careersection/jobdetail.ftl?job=2100028M&tz=GMT+00:00tzname=Europe/London&lang=en`

Contact: `a.triaud@bham.ac.uk`

4 Announcements

Astrobiology Perspectives on Life of the Universe

R. Gordon[1]*, J. Seckbach*[2]
[1] Gulf Specimen Marine Laboratory & Aquarium, Florida, USA
[2] The Hebrew University of Jerusalem, Israel

Wiley-Scrivener, published

This book series is edited by Richard Gordon and Joseph Seckbach. The main scope of the series is the discovery of extraterrestrial life and understanding of our origins, whether on Earth or elsewhere. The part of the title for this series of books is taken from the pioneering thoughts of Svante Arrhenius, who reviewed this quest in his 1909 book The Life of the Universe as Conceived by Man from the Earliest Ages to the Present Time.

Recently published titles

1. Beech, M., Gordon, R. and Seckbach, J. (eds.) (2021) Terraforming Mars [TMRS, Volume in the series Astrobiology Perspectives on Life of the Universe, Eds. Richard Gordon & Joseph Seckbach]. Wiley-Scrivener, Beverly, Massachusetts, USA.
2. Chon Torres, O.A., Peters, T., Seckbach, J. and Gordon, R. (eds.) (2021) Astrobiology: Science, Ethics and Public Policy[ABET, volume in the series: Astrobiology Perspectives on Life of the Universe (Series editors: Richard Gordon & Joseph Seckbach)]. Wiley-Scrivener, Beverly, Massachusetts, USA.
3. Seckbach, J. and Stan-Lotter, H. (eds.) (2021) Extremophiles as Astrobiological Models [EXAM, Volume in the series Astrobiology Perspectives on Life of the Universe, Eds. Richard Gordon & Joseph Seckbach]. Wiley-Scrivener, Beverly, Massachusetts, USA.
4. Vukotić, B., Seckbach, J. and Gordon, R. (eds.) (2021) Planet Formation and Panspermia: New Prospects for the Movement of Life through Space [PNSP, Volume in the series Astrobiology Perspectives on Life of the Universe, Series Editors: Richard Gordon & Joseph Seckbach]. Wiley-Scrivener, Beverly, Massachusetts, USA.

Download/Website: `https://tinyurl.com/2p8b6j6f`
Contact: `DickGordonCan@xplornet.com, Joseph.Seckbach@mail.huji.ac.il`

CHEOPS AO-3 opens 15 February 2022

Kate Isaak
ESA CHEOPS Project Scientist, European Space Agency/ESTEC, the Netherlands

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Dear Colleagues,

The third Annual Announcement of Opportunity (AO-3) for participation in the CHEOPS Guest Observers Programme will open on 15 February 2022, and close 4 weeks later on 15 March 2022 (midday GMT). AO-3 will be the final call in the nominal mission, and will cover the period from the very end of June 2022 to 24 September 2023

The timeline for the AO is available on the ESA CHEOPS Guest Observers Programme webpage:
https://www.cosmos.esa.int/web/cheops-guest-observers-programme

There are a number of documents, tools and webpages available to help you to familiarise yourselves with the capabilities of CHEOPS, details of which can be found on the following webpage:
https://www.cosmos.esa.int/web/cheops-guest-observers-programme/ao-3

DonÕt hesitate to get in touch with me (at the email address below) directly in case of questions.

Best,

Kate Isaak
(kate.isaak@esa.int)

Download/Website: `https://www.cosmos.esa.int/web/cheops-guest-observers-programme`
`https://www.cosmos.esa.int/web/cheops-guest-observers-programme/ao-3`

Contact: `kate.isaak@esa.int`

COSPAR 2022 Scientific Assembly Exoplanet Event B6.1: exoplanet detection and characterisation: current research, future opportunities and the search for life outside the solar system

(Solicited Speakers: Francois Forget (Université Paris 6, France), Lisa Kaltenegger (Cornell University, USA), Laura Kreidberg (MPIA, Germany), Jonathan Lunine (Cornell University, USA), Christoph Mordasini (University of Bern, Switzerland), Sascha Quanz (ETH, Switzerland), Lauren Weiss (University of Notre Dame, USA)

Athens, Greece, July 16-24, 2022

Abstract submission deadline:, February 11, 2022

Rationale: Exoplanet searches using ground- and space-based facilities have revealed a remarkable variety in observed properties of exoplanets and the planetary systems they are part of. It is clear by now that planetary systems are commonly found in low- and intermediate mass stars. In order to understand the observed diversity in planetary systems we begin to link their architecture to the properties of planet forming disks around young stars, and to trace the present-day properties of exoplanets (mass, radius, chemical composition, atmosphere) to their formation history and evolution to mature planetary systems. Such studies are important to understand which planets in which planetary systems have properties that would support the emergence of life as we know it. The increasing accuracy of mass and radii determinations provides improved constraints on the composition and interior structure of rocky exoplanets. Spectra of increasing quality and resolution enable us to investigate exoplanet rotation, atmospheric chemical composition, the presence of clouds and day to night side differences of large samples of exoplanets, and to study important biomarkers. These more detailed observations require more sophisticated modelling efforts, including understanding potential abiotic origins of biomarkers and evolutionary models of processes such as atmospheric escape. These developments allow an increasingly more quantitative comparison to the properties and formation history of the solar system planets. This COSPAR event aims to bring together the planetary and exoplanetary community to discuss exoplanets in context, and address results of ongoing space missions and future opportunities.

Main Scientific Organizers: Rens Waters (Radboud University/SRON, The Netherlands), Francesca Altieri (INAF-IAPS, Italy), Michael Ireland (Australian National Observatory, Australia) ; SOC: Charles Beichman (NASA Exoplanet Science Institute Caltech/IPAC, USA), Athena Coustenis (LESIA—Observatoire de Paris, France), Yui Kawashima (RIKEN, Japan), Pierre-Olivier Lagage (CEA, France), Yamilla Miguel (Leiden Observatory/SRON, the Netherlands), Nicola Tosi (DLR, Germany) .

Download/Website: `https://www.cospar-assembly.org/`

Contact: `rens.waters@ru.nl`

2022 Sagan Summer Hybrid Workshop: Exoplanet Science in the Gaia Era

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

Hybrid Workshop, July 25-29, 2022

The 2022 Sagan Summer Workshop will take place July 25-29, 2022. We are expecting that this will be a hybrid workshop with both in-person and on-line attendance. In-person attendance may be limited due to L. A. County, City of Pasadena, and California Institute of Technology COVID safety guidelines at the time of the workshop. The workshop website will be updated with this information going forward.

The 2022 Sagan Summer Workshop will focus on the topic of exoplanet science in the Gaia era. The ESA Gaia mission has been mapping the Galaxy for over seven years, measuring very accurate positions and motions of over 1 billion stars. It has already greatly contributed to exoplanet science through the determination of more accurate stellar parameters, which in turn improve planet parameters, the detection of stellar companions, and the identification and characterization of young moving groups. In the near future, the unprecedented astrometric accuracy will result in the discovery of new exoplanets, as well as the characterization of known planets. The workshop will introduce the basics of astrometry, the impact of Gaia astrometry on astrophysics, and the astrometric detection and characterization of exoplanets. The synergy between the different planet detection techniques of astrometry, transits, radial velocities, and imaging will be discussed, as well as future advances in astrometry.

Workshop Topics

- Astrometry Fundamentals
- Impact of Astrometry on Stellar Astrophysics with Implications for Exoplanet Science
- Astrometry and Companion Detectionl
- Characterizing Directly Imaged Planets and Young Brown Dwarfs
- Next Steps in Astrometry

There is no registration fee for this workshop and registration will open in February 2022. In person attendees will be expected to show proof of their COVID vaccination.

Please contact us with any questions or to be added to the email list.

Download/Website: `http://nexsci.caltech.edu/workshop/2022`
Contact: `sagan_workshop@ipac.caltech.edu`

5 Exoplanet Archives

December 2021 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, January 11, 2022

Note: Unless otherwise noted, all planetary and stellar data mentioned in the news are in the Planetary Systems Table (`http://bit.ly/2Pt0tM1`), which provides a single location for all self-consistent planetary solutions, and its companion table the Planetary Systems Composite Parameters (`https://bit.ly/2Fer9NU`), which offers a more complete table of parameters combined from multiple references and calculations. Data can also be found in the Microlensing Planets Table (`https://bit.ly/3urUyZU`) or Direct Imaging Planets Table (`http://bit.ly/3ayD185`).

December 22, 2021

See you in 2022!

The NASA Exoplanet Archive staff will be enjoying a winter break from Dec. 23 through Jan. 2. There will be no data or software updates, and responses to Helpdesk tickets and social media may be delayed.

Our team is grateful for your support this year, whether it was using our tools and data, contacting the Helpdesk to report a bug or request a feature, or reaching out to us on social media. We're fired up to serve you even more exoplanets in 2022. Happy holidays!

December 16, 2021

The Lucky Seven

We're ending this year on a high note! We present seven new planets for our last archive update of 2021: TOI-2109 b, TOI-1842 b, HATS-74 A b, HATS-75 b, HATS-76 b, HATS-77 b, and 2MASS J04372171+2651014 b.

These bring the archive's year-end tally of confirmed planets to **4,884**. We're just 116 discoveries away from reaching 5,000 planets!

December 13, 2021

301 New Kepler Planets Added

We've added hundreds of new Kepler planets that a team from NASA's Ames Research Center discovered by tapping into the power of machine learning. Learn more about ExoMiner, the new deep neural network classifier, in Valizadegan et al. 2021 (`https://bit.ly/3HHZgc7`) and NASA's media release (`https://go.nasa.gov/31zcFDQ`). The new planets have been added to the PS and PS Composite Data tables.

This week's new planets bring the archive's total confirmed planet count to **4,877**. The new Kepler planets are too numerous to list here, so filter the Planetary Parameter Reference column in the PS and PS Composite Data tables on "valizadegan."

December 3, 2021

1 New Planet, 172 New Planet Candidates

This week's new planet, GJ 367 b, is an ultra-light and super-fast terrestrial planet with an eight-hour orbit around a red dwarf star. The planetary system is located just under 31 light-years from Earth. Learn more in Lam et al. 2021 (`https://bit.ly/3r0fbf0`) and in the media release (`https://bit.ly/32WOSys`).

We've also added 172 new K2 planetary candidates from the new catalog by Zink et al. 2021 (`https://bit.ly/3G9WZGq`), which used a fully automated exoplanet-detection system to search archival data from NASA's retired Kepler Space Telescope. Read the Discovery Alert (`https://bit.ly/32S7VtV`) on this exciting result.

Fun fact: The K2 paper's first four co-authors are all past or current NExScI researchers, including Dr. Jessie Christiansen, the Exoplanet Archive's new Science Lead.

Access the new K2 candidate datain our new K2 Planets and Candidates Table. (Pro tip: Filter the Discovery Year with "2021" and Archive Disposition Reference with "zink."

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

Contact: `mharbut@caltech.edu`

6 As seen on astro-ph

The following list contains exoplanet related entries appearing on astro-ph in December 2021.

December 2021

astro-ph/2112.00033: **Sub-Seasonal Variation in Neptune's Mid-Infrared Emission** by *Michael T. Roman et al.*
astro-ph/2112.00041: **Spatially Resolved Modeling of Optical Albedos for a Sample of Six Hot Jupiters** by *Danica Adams et al.*
astro-ph/2112.00044: **Mercury as the relic of Earth and Venus' outward migration** by *Matthew S. Clement, Sean N. Raymond, John E. Chambers*
astro-ph/2112.00123: **Probing inner and outer disk misalignments in transition disks** by *A.J. Bohn et al.*
astro-ph/2112.00135: **The spatial Hill four-body problem I – An exploration of basic invariant sets** by *Jaime Burgos-Garcia, Abimael Bengochea, Luis Franco-Perez*
astro-ph/2112.00140: **Constraints on the production of phosphine by Venusian volcanoes** by *William Bains et al.*
astro-ph/2112.00198: **TOI-1842b: A Transiting Warm Saturn Undergoing Re-Inflation around an Evolving Subgiant** by *Robert A. Wittenmyer et al.*
astro-ph/2112.00634: **Libration-induced Orbit Period Variations Following the DART Impact** by *Alex J. Meyer et al.*
astro-ph/2112.00645: **Effect of MHD wind-driven disk evolution on the observed sizes of protoplanetary disks** by *Leon Trapman et al.*
astro-ph/2112.00744: **Irradiation-driven escape of primordial planetary atmospheres II. Evaporation efficiency of sub-Neptunes through hot Jupiters** by *Andrea Caldiroli et al.*
astro-ph/2112.00747: **Kepler-167e as a Probe of the Formation Histories of Cold Giants with Inner Super-Earths** by *Yayaati Chachan et al.*
astro-ph/2112.00786: **Running The Gauntlet – Survival of Small Circumbinary Planets Migrating Through Destabilising Resonances** by *David V. Martin, Evan Fitzmaurice*
astro-ph/2112.00966: **The Number of Transits Per Epoch for Transiting Misaligned Circumbinary Planets** by *Zirui Chen, David Kipping*
astro-ph/2112.01128: **The impact of intrinsic magnetic field on the absorption signatures of elements probing the upper atmosphere of HD209458b** by *M. L. Khodachenko et al.*
astro-ph/2112.01129: **Exploring fundamental laws of classical mechanics via predicting the orbits of planets based on neural networks** by *Jian Zhang, Yiming Liu, Z.C. Tu*
astro-ph/2112.01309: **GJ 367b: A dense ultra-short period sub-Earth planet transiting a nearby red dwarf star** by *Kristine W. F. Lam et al.*
astro-ph/2112.01410: **The impact of the presence of water ice on the analysis of debris disk observations** by *Thomas A. Stuber (1), Sebastian Wolf (1) ((1) Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel)*
astro-ph/2112.01817: **Dynamics around Non-Spherical Symmetric Bodies: I. The case of a spherical body with mass anomaly** by *G. Madeira et al.*
astro-ph/2112.01928: **HATS-74Ab, HATS-75b, HATS-76b and HATS-77b: Four Transiting Giant Planets around K and M Dwarfs** by *A. Jordán et al.*
astro-ph/2112.02031: **Measuring Elemental Abundances of JWST Target Stars for Exoplanet Characterization I. FGK Stars** by *Jared R. Kolecki, Ji Wang*
astro-ph/2112.02054: **Large Interferometer For Exoplanets (LIFE): III. Spectral resolution, wavelength range and sensitivity requirements based on atmospheric retrieval analyses of an exo-Earth** by *B.S. Konrad et al.*
astro-ph/2112.02167: **The five largest satellites of Uranus: astrometric observations spread over 29 years at the Pico dos Dias Observatory** by *Julio I. B. Camargo et al.*

astro-ph/2112.02168: **The Scorpion Planet Survey: Wide-Orbit Giant Planets Around Young A-type Stars** by *Kevin Wagner et al.*

astro-ph/2112.02176: **The TESS Faint Star Search: 1,617 TOIs from the TESS Primary Mission** by *Michelle Kunimoto et al.*

astro-ph/2112.02396: **Spectroscopic study of Ceres' collisional family candidates** by *Fernando Tinaut-Ruano et al.*

astro-ph/2112.02414: **Systematic KMTNet Planetary Anomaly Search, Paper III: One Wide-Orbit Planet And Two Stellar Binaries** by *Hanyue Wang et al.*

astro-ph/2112.02482: **Non-Trivial Oblique Spin Equilibria of Super-Earths in Multi-planetary Systems** by *Yubo Su, Dong Lai*

astro-ph/2112.02546: **Investigation of the upper atmosphere in ultra-hot Jupiter WASP-76 b with high-resolution spectroscopy** by *Kiyoe Kawauchi et al.*

astro-ph/2112.02687: **Cronomoons: origin, dynamics, and light-curve features of ringed exomoons** by *Mario Sucerquia et al.*

astro-ph/2112.02745: **Potential Habitability as a Stellar Property: Effects of Model Uncertainties and Measurement Precision** by *Noah Tuchow, Jason Wright*

astro-ph/2112.02831: **Determining dispersal mechanisms of protoplanetary disks using accretion and wind mass loss rates** by *Yasuhiro Hasegawa et al.*

astro-ph/2112.02942: **Extreme ultraviolet and X-ray driven photochemistry of gaseous exoplanets** by *Daniele Locci et al.*

astro-ph/2112.02973: **Eccentric debris disc morphologies I: exploring the origin of apocentre and pericentre glows in face-on debris discs** by *Elliot M. Lynch, Joshua B. Lovell*

astro-ph/2112.03063: **Near-Infrared reflectance spectroscopy of sublimating salty ice analogues. Implications for icy moons** by *Romain Cerubini et al.*

astro-ph/2112.03225: **Interior Structure Models Of Venus** by *Oliver Shah et al.*

astro-ph/2112.03248: **On the Stability of Additional Moons Orbiting Kepler-1625 b** by *Ricardo Moraes et al.*

astro-ph/2112.03292: **Mining the Ultra-Hot Skies of HAT-P-70b: Detection of a Profusion of Neutral and Ionized Species** by *Aaron Bello-Arufe et al.*

astro-ph/2112.03297: **The mass and size of Herbig disks as seen by ALMA** by *L. Stapper et al.*

astro-ph/2112.03298: **Automation Of Transiting Exoplanet Detection, Identification and Habitability Assessment Using Machine Learning Approaches** by *Pawel Pratyush, Akshata Gangrade*

astro-ph/2112.03311: **A Simple Time-Dependent Method for Calculating Spirals: Applications to Eccentric Planets in Protoplanetary discs** by *Zhaohuan Zhu, Raymond M. Zhang*

astro-ph/2112.03372: **The Ice Coverage of Earth-like Planets Orbiting FGK Stars** by *Caitlyn Wilhelm et al.*

astro-ph/2112.03399: **The California Legacy Survey III. On The Shoulders of (Some) Giants: The Relationship between Inner Small Planets and Outer Massive Planets** by *Lee J. Rosenthal et al.*

astro-ph/2112.03739: **New constraints on the future evaporation of the young exoplanets in the V1298 Tau system** by *A. Maggio et al.*

astro-ph/2112.03927: **Exoplanets in the Galactic context: Planet occurrence rates in the thin disk, thick disk and stellar halo of Kepler stars** by *Dolev Bashi, Shay Zucker*

astro-ph/2112.03958: **A hot Mars-sized exoplanet transiting an M dwarf** by *Caleb I. Cañas et al.*

astro-ph/2112.04125: **Ground-based HCN submillimetre measurements in Titan's atmosphere: an intercomparison with Herschel observations** by *M. Rengel et al.*

astro-ph/2112.04309: **Geoastronomy: Rocky planets as the Lavosier-Lomonosov Bridge from the non-living to the living world** by *Stephen J. Mojzsis*

astro-ph/2112.04452: **Does the Streaming Instability exist within the Terminal Velocity Approximation?** by *V.V. Zhuravlev*

astro-ph/2112.04587: **Effect of clouds on emission spectra for Super Venus** by *Paulina Wolkenberg, Diego Turrini*

astro-ph/2112.04627: **Hypotheses for Triton's Plumes: New Analyses and Future Remote Sensing Tests** by *Jason D. Hofgartner et al.*
astro-ph/2112.04663: **Atmospheres of Rocky Exoplanets** by *R. Wordsworth, L. Kreidberg*
astro-ph/2112.04672: **The appearance of a 'fresh' surface on 596 Scheila as a consequence of the 2010 impact event** by *Sunao Hasegawa et al.*
astro-ph/2112.04724: **The Transit Timing and Atmosphere of Hot Jupiter HAT-P-37b** by *Napaporn A-thano et al.*
astro-ph/2112.04815: **Atmospheric mass loss and stellar wind effects in young and old systems I: comparative 3D study of TOI-942 and TOI-421 systems** by *Daria Kubyshkina et al.*
astro-ph/2112.04832: **Atmospheric mass loss and stellar wind effects in young and old systems II: Is TOI-942 the past of TOI-421 system?** by *Daria Kubyshkina et al.*
astro-ph/2112.04833: **A wide-orbit giant planet in the high-mass b Centauri binary system** by *Markus Janson et al.*
astro-ph/2112.04930: **Molecular tracers of planet formation in the atmospheres of hot Jupiters** by *Richard Hobbs, Oliver Shorttle, Nikku Madhusudhan*
astro-ph/2112.04970: **The Critical Core Mass of Rotating Planets** by *Wei Zhong, Cong Yu*
astro-ph/2112.05012: **Planet-planet scattering in presence of a companion star** by *Francesco Marzari, Makiko Nagasawa, Krzyszof Goździewski*
astro-ph/2112.05059: **HyDRo: Atmospheric Retrieval of Rocky Exoplanets in Thermal Emission** by *Anjali A. A. Piette, Nikku Madhusudhan, Avi M. Mandell*
astro-ph/2112.05075: **The Terrestrial Planet Formation around M Dwarfs: In-situ, Inward Migration or Reversed Migration** by *Mengrui Pan, Su Wang, Jianghui Ji*
astro-ph/2112.05234: **An Imaging Search for Post-Main-Sequence Planets of Sirius B** by *Miles Lucas et al.*
astro-ph/2112.05337: **An Integrative Analysis of the HD 219134 Planetary System and the Inner Solar System: Extending DYNAMITE with Enhanced Orbital Dynamical Stability Criteria** by *Jeremy Dietrich, Dániel Apai, Renu Malhotra*
astro-ph/2112.05350: **Polarization spectrum of near infrared zodiacal light observed with CIBER** by *Kohji Takimoto et al.*
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astro-ph/2112.09973: **On spectroscopic phase-curve retrievals: H2 dissociation and thermal inversion in the atmosphere of the ultra-hot Jupiter WASP-103 b** by *Quentin Changeat*
astro-ph/2112.10132: **An Accurate 3D Analytic Model for Exoplanetary Photometry, Radial Velocity, and Astrometry** by *Yair Judkovsky, Aviv Ofir, Oded Aharonson*
astro-ph/2112.10144: **Physical Properties and Impact Parameter Variations of Kepler Planets from Analytic Light Curve Modeling** by *Yair Judkovsky, Aviv Ofir, Oded Aharonson*
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astro-ph/2112.10777: **Efficiently Imaging Accreting Protoplanets from Space: Reference Star Differential Imaging of the PDS 70 Planetary System using the HST/WFC3 Archival PSF Library** by *Aniket Sanghi, Yifan Zhou, Brendan P. Bowler*
astro-ph/2112.10850: **Production of Ammonia Makes Venusian Clouds Habitable and Explains Observed Cloud-Level Chemical Anomalies** by *William Bains et al.*
astro-ph/2112.11108: **Atmospheric dynamics of temperate sub-Neptunes. Part I: dry dynamics** by *Hamish Innes, Raymond T. Pierrehumbert*
astro-ph/2112.11179: **The GAPS Programme at TNG. XXXII. The revealing non-detection of metastable HeI in the atmosphere of the hot Jupiter WASP-80b** by *L. Fossati et al.*
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astro-ph/2112.11506: **The fastest routes of approach to dwarf planet Sedna for study its surface and composition at the close range** by *Vladislav Zubko*
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astro-ph/2112.11999: **A rich population of free-floating planets in the Upper Scorpius young stellar association** by *Núria Miret-Roig et al.*
astro-ph/2112.12059: **High-resolution detection of neutral oxygen and non-LTE effects in the atmosphere of KELT-9b** by *Francesco Borsa et al.*
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astro-ph/2112.12222: **Effects of pebble accretion on the growth and composition of planetesimals in the inner Solar System** by *J. Mah et al.*
astro-ph/2112.12460: **Long-term Trends of Regolith Movement on the Surface of Small Bodies** by *Chenyang Huang et al.*
astro-ph/2112.12623: **The origin of the high metallicity of close-in giant exoplanets II The nature of the sweet spot for accretion** by *Sho Shibata, Ravit Helled, Masahiro Ikoma*
astro-ph/2112.12804: **Sensitivity of the Roman Coronagraph Instrument to Exozodiacal Dust** by *Ewan S Douglas et al.*
astro-ph/2112.12821: **Observability of Forming Planets and their Circumplanetary Disks IV. – with JWST**

ELT by *Xueqing Chen, Judit Szulágyi*

astro-ph/2112.13017: **Analysis of Mission Opportunities to Sedna in 2029-2034** by *Vladislav Zubko et al.*

astro-ph/2112.13448: **TOI 560 : Two Transiting Planets Orbiting a K Dwarf Validated with iSHELL, PFS and HIRES RVs** by *Mohammed El Mufti et al.*

astro-ph/2112.13767: **Ellipsoidal equilibrium figure and Cassini states of rotating planets and satellites deformed by a tidal potential in the spatial case** by *Hugo A. Folonier, Gwenaël Boué, Sylvio Ferraz-Mello*

astro-ph/2112.13859: **No Significant Correlation between Line Emission and Continuum Substructures in MAPS** by *Haochang Jiang, Wei Zhu, Chris W. Ormel*

astro-ph/2112.13879: **Catastrophic rupture of lunar rocks: Implications for lunar rock size-frequency distributions** by *O. Ruesch et al.*

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astro-ph/2112.00173: **Elemental abundances of nearby M dwarfs based on high-resolution near-infrared spectra obtained by the Subaru/IRD survey: Proof of concept** by *Hiroyuki Tako Ishikawa et al.*

astro-ph/2112.00512: **Oxygen and Aluminum-Magnesium Isotopic Systematics of Presolar Nanospinel Grains from CI Chondrite Orgueil** by *Nan Liu et al.*

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