ExoPlanet News
An Electronic Newsletter

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`https://nccr-planets.ch/exoplanetnews`

Contents

1 Editorial

Welcome to Edition 183 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 (`https://nccr-planets.ch/exoplanetnews/`).

The next issue will appear on 8 October 2024.

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

Daniel Angerhausen
Jeanne Davoult
Leander Schlarmann
Haiyang Wang
Timm-Emanuel Riesen

PlanetS
Univ. of Bern, Univ. of Geneva, ETH Zürich, Univ. of Zürich, EPF Lausanne
The National Centers of Competence in Research (NCCR) are a research instrument of the Swiss National Science Foundation.

2 Abstracts of refereed papers

Evidence for Nightside Water Emission Found in Transit of Ultra-hot Jupiter WASP- 33 b

Yuanheng Yang[1,2], Guo Chen[1,3], Fei Yan[4], Xianyu Tan[5] & Jianghui Ji[1,3]

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Astrophysical Journal Letters, published (2024ApJ...971L...8Y)

To date, the dayside thermal structure of ultra-hot Jupiters (UHJs) is generally considered to be inverted, but their nightside thermal structure has been less explored. Here, we explore the impact of nightside thermal emission on high-resolution infrared transmission spectroscopy, which should not be neglected, especially for UHJs. We present a general equation for the high-resolution transmission spectrum that includes planetary nightside thermal emission. This provides a new way to infer the thermal structure of the planetary nightside with high-resolution transmission spectroscopy. Using the cross-correlation technique, we find evidence for the presence of an H_2O emission signature on the UHJ WASP-33 b during the transit, indicating an inverted temperature structure on its nightside. Such a result suggests a stronger heat transport through the circulation than currently expected. An alternative explanation is that the rotating visible hemisphere during transit leads to the potential contribution of the limb and dayside atmospheres to the detected emission signature. In the future, the combination of high-resolution, full-phase-curve spectroscopic observations and general circulation models will hopefully solve this puzzle and provide a complete picture of the three-dimensional nature of the chemistry, circulation, and thermal structure of UHJs.

Download/Website: `https://iopscience.iop.org/article/10.3847/2041-8213/ad65cf`

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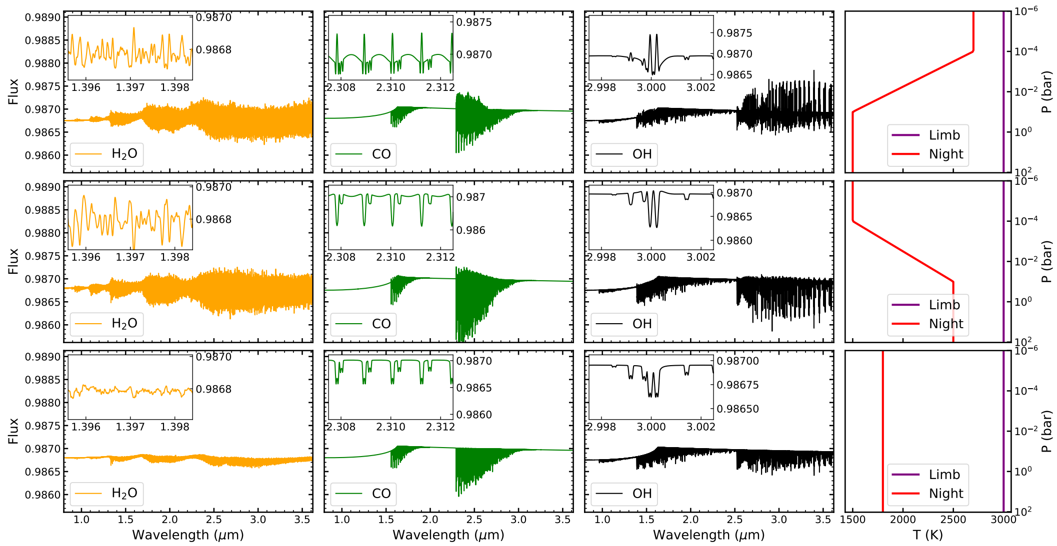

Figure 1: The general transmission spectrum models with three types of nightside T-P profiles for WASP-33b. The first three columns show the general transmission spectra of H_2O, CO, and OH, respectively, while the fourth column shows the T-P profiles. Each inset shows a zoomed view of the spectrum. From top to bottom correspond to the inverted, non-inverted, and isothermal nightside T-P profiles.

High-resolution Transmission Spectroscopy of Ultrahot Jupiter WASP–33b with NEID

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The Astronomical Journal, published (2024AJ....167...36Y)

We report an attempt to detect molecular and atomic species in the atmosphere of the ultrahot Jupiter WASP-33b using the high-resolution echelle spectrograph NEID with a wavelength coverage of 380–930 nm. By analyzing the transmission spectrum of WASP-33b using the line-by-line technique and the cross-correlation technique, we confirm previous detection of Hα, Hβ, Hγ, and Ca II infrared triplets. We find no evidence for a significant day-to-night wind in WASP-33b, taking into account the effects of stellar pulsations using a relatively novel Gaussian process method and poorly constrained systemic velocity measurements. We also detect the previously reported pretransit absorption signal, which may be a pulsation mode induced by the planet. Combined with previous CARMENES and HARPS-N observations, we report the nondetection of TiO, Ti I, and V I in the transmission spectrum, while they were already detected in the dayside atmosphere of WASP-33b. This implies a difference in the chemical compositions and abundances between the dayside and terminator atmospheres of WASP-33b and certainly requires further improvements in the sensitivity of the detection methods.

Download/Website: `https://iopscience.iop.org/article/10.3847/1538-3881/ad10a3`

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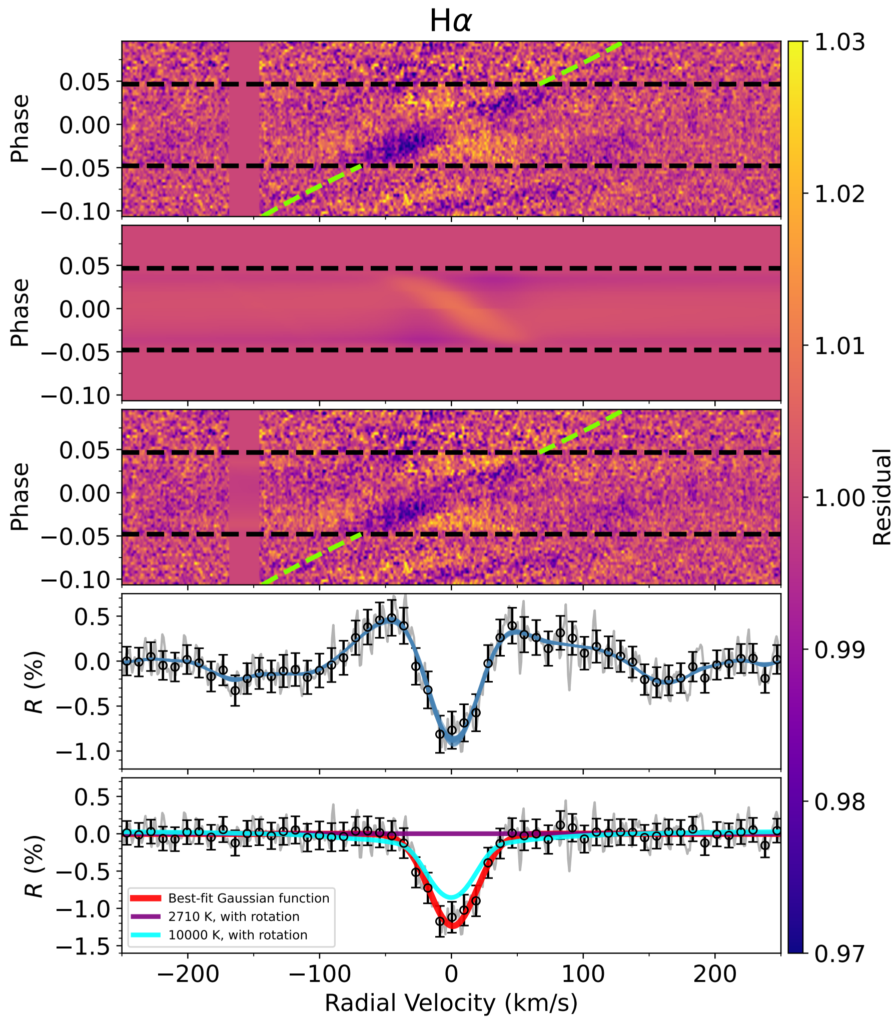

Figure 2: Transmission spectral matrix, CLV+RM model, and one-dimensional transmission spectrum for the Hα line observed with NEID. *First row*: the transmission spectral matrix before correction for the CLV and RM effects in the stellar rest frame. The horizontal black dashed lines indicate the first and fourth contacts of the transit (i.e., the beginning and end of the transit). The slanted green dashed lines mark the radial velocity shift due to the orbital motion of the planet. The radial velocity regions around -158 km s^{-1} (i.e. $\sim$ 6559.35 Å) are masked due to invalid values (NaN). *Second row*: the model for the CLV and RM effects. *Third row*: the observed transmission spectral matrix after correction for the CLV and RM effects. The color bar is indexed to the residual flux. *Fourth row*: phase-folded one-dimensional transmission spectrum. The CLV and RM effects have been corrected. The y-axis shows the relative residual flux minus one in $\%$. The gray line shows the unbinned observed transmission spectrum. The black circles with error bars show the spectrum binned every ten points ($\sim$0.2 $\AA$). The blue line shows the best-fit GP model. *Fifth row*: transmission spectrum after removal of systematic noise using the GP method. The red line shows the best-fit Gaussian line profile. The purple and cyan lines are hydrostatic models of Hα with temperatures of 2,710 K and 10,000 K, respectively, including planetary rotation.

Earth-like-planet-hosting systems: Architecture and properties

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Astronomy & Astrophysics,

The discovery of Earth-like planets is a major focus of current planetology research and faces a significant technological challenge. Indeed, when it comes to detecting planets as small and cold as the Earth, the cost of observation time is massive. Understanding in what type of systems Earth-like planets (ELPs) form and how to identify them is crucial for preparing future missions such as PLATO, LIFE, or others. Theoretical models suggest that ELPs predominantly form within a certain type of system architecture. Therefore, the presence or absence of ELPs could be inferred from the arrangement of other planets within the same system.
This study aims to identify the profile of a typical system that harbours an ELP by investigating the architecture of systems and the properties of their innermost detectable planets. Here, we introduce a novel method for determining the architecture of planetary systems and categorising them into four distinct classes. We then conduct a statistical study to identify the most favourable arrangements for the presence of an ELP.
Using three populations of synthetic planetary systems generated using the Bern model around three different types of stars, we studied the 'theoretical' architecture (the architecture of a complete planetary system) and the 'biased' architecture (the architecture of a system in which only detectable planets are taken into account after applying an observation bias) of the synthetic systems. To describe a typical system hosting an ELP, we initially examined the distribution of ELPs across different categories of architectures, highlighting the strong link between planetary system architecture and the presence of an ELP. A more detailed analysis was then conducted, linking the biased architecture of a system with the physical properties of its innermost observable planet to establish the most favourable conditions for the presence or absence of an ELP in a system.
First, using synthetic systems, we successfully reproduce the distribution of observed multi-planet systems within the five different architectural classes. This demonstrates the relevance, at the system level, of populations of the synthetic systems derived from the Bern model and the observational bias applied. Secondly, the biased architectures (with observation bias) correspond for the most part to the theoretical architectures (without bias) of the same system. Finally, the biased architecture of a system, studied in conjunction with the mass, radius, and period of the innermost detectable planet, appears to correlate with the presence or absence of an ELP in the same system.
We conclude that the detections of ELPs can be predicted thanks to the already known properties of their systems, and we present a list of the properties of the systems most likely to host such a planet.

Download/Website: `https://ui.adsabs.harvard.edu/abs/2024arXiv240812251D/abstract`

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Table 1: Summary of the conditional probabilities of a system to host an ELP depending on its biased architecture (lines), its central star's mass (columns) and the properties of its innermost detectable planet (IDP). M_{IDP}, R_{IDP}, and P_{IDP} refer to the mass, radius, and period respectively of the IDP in the system. Percentages indicate the percentage of systems hosting an ELP. N.A. corresponds to categories with too few systems to conclude. The results in bold highlight the cases with the highest probability of finding an ELP.

	G-pop (1 $M_\odot$)	**earlyM-pop (0.5 $M_\odot$)**	**lateM-pop (0.2 $M_\odot$)**
Low-mass	$M_{IDP} < 10\ M_\oplus \Rightarrow 64.0\%$ $M_{IDP} > 10\ M_\oplus \Rightarrow 49.7\%$ $R_{IDP} < 2.5\ R_\oplus \Rightarrow 55.8\%$ $\mathbf{R_{IDP} > 2.5\ R_\oplus \Rightarrow 87.5\%}$ $P_{IDP} < 10$ days $\Rightarrow 38.0\%$ $\mathbf{P_{IDP} > 10}$ **days** $\mathbf{\Rightarrow 82.7\%}$	$M_{IDP} < 10\ M_\oplus \Rightarrow 68.5\%$ $M_{IDP} > 10\ M_\oplus \Rightarrow 59.2\%$ $R_{IDP} < 2.75\ R_\oplus \Rightarrow 64.1\%$ $\mathbf{R_{IDP} > 2.75\ R_\oplus \Rightarrow 94.6\%}$ $P_{IDP} < 10$ days $\Rightarrow 60.3\%$ $P_{IDP} > 10$ days $\Rightarrow 79.2\%$	88%
Anti-Ordered	$M_{IDP} < 100\ M_\oplus \Rightarrow 37.5\%$ $M_{IDP} > 100\ M_\oplus \Rightarrow 6\%$ $R_{IDP} < 10\ R_\oplus \Rightarrow 34.3\%$ $R_{IDP} > 10\ R_\oplus \Rightarrow 5.3\%$ $P_{IDP} < 30$ days $\Rightarrow 23.3\%$ $P_{IDP} > 30$ days $\Rightarrow 20.2\%$	N.A.	N.A.
Ordered	$M_{IDP} < 10\ M_\oplus \Rightarrow 30.6\%$ $M_{IDP} > 10\ M_\oplus \Rightarrow 7.1\%$ $R_{IDP} < 6\ R_\oplus \Rightarrow 27.8\%$ $R_{IDP} > 6\ R_\oplus \Rightarrow 2.9\%$ $P_{IDP} < 30$ days $\Rightarrow 14.1\%$ $P_{IDP} > 30$ days $\Rightarrow 67.5\%$	$M_{IDP} < 10\ M_\oplus \Rightarrow 50.0\%$ $M_{IDP} > 10\ M_\oplus \Rightarrow 21.6\%$ $R_{IDP} < 2\ R_\oplus \Rightarrow 50.4\%$ $R_{IDP} > 2\ R_\oplus \Rightarrow 33.8\%$ $P_{IDP} < 10$ days $\Rightarrow 40.7\%$ $P_{IDP} > 10$ days $\Rightarrow 60.5\%$	N.A.
Mixed	$M_{IDP} < 10\ M_\oplus \Rightarrow 31.7\%$ $M_{IDP} > 10\ M_\oplus \Rightarrow 13.1\%$ $R_{IDP} < 2.5\ R_\oplus \Rightarrow 27.4\%$ $R_{IDP} > 2.5\ R_\oplus \Rightarrow 8.33\%$ $P_{IDP} < 30$ days $\Rightarrow 13.8\%$ $P_{IDP} > 30$ days $\Rightarrow 49.1\%$	N.A.	N.A.
n = 1	$\mathbf{M_{IDP} < 100\ M_\oplus \Rightarrow 94.8\%}$ $M_{IDP} > 100\ M_\oplus \Rightarrow 3.6\%$ $\mathbf{R_{IDP} < 8\ R_\oplus \Rightarrow 95\%}$ $R_{IDP} > 8\ R_\oplus \Rightarrow 7.6\%$ $P_{IDP} < 30$ days $\Rightarrow 37.0\%$ $\mathbf{P_{IDP} > 30}$ **days** $\mathbf{\Rightarrow 90.6\%}$	$\mathbf{M_{IDP} < 10\ M_\oplus \Rightarrow 92.8\%}$ $M_{IDP} > 10\ M_\oplus \Rightarrow 90.2\%$ $R_{IDP} < 2.75\ R_\oplus \Rightarrow 75.1\%$ $\mathbf{R_{IDP} > 2.75\ R_\oplus \Rightarrow 97.3\%}$ $P_{IDP} < 10$ days $\Rightarrow 49.3\%$ $\mathbf{P_{IDP} > 10}$ **days** $\mathbf{\Rightarrow 95.8\%}$	94%

Obliquities of exoplanet host stars. Nineteen new, updated measurements for the sample of 205 measurements and observed trends

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Astronomy & Astrophysics, in press (arXiv:2408.09793)

Measurements of the obliquities in exoplanet systems have revealed certain remarkable architectures, some of which are very different from those seen in the Solar System. Nearly 200 obliquity measurements have been obtained based on observations of the Rossiter-McLaughlin (RM) effect. Here, we report on observations of 19 planetary systems, which previously led to 17 clear detections of the RM effect and 2 less secure detections. After adding the new measurements to the tally, we used the entire collection of RM measurements to investigate four issues that have arisen in the literature. Here we consider whether: i) the obliquity distribution shows a peak at approximately 90° and ii) the high obliquities are associated with high eccentricities. For the first question, we found tentative evidence that such a peak does exist when restricting attention to the sample of sub-Saturn planets and hot Jupiters orbiting F stars. We find the association to be weaker than previously reported and a stronger association must exist between obliquity and orbital separation, possibly due to tidal obliquity damping at small separations. We also consider iii) how low the lowest known obliquities are; among hot Jupiters around cool stars, we find the dispersion to be $1.4 \pm 0.7^\circ$, smaller than the 6° obliquity of the Sun, which serves as additional evidence for tidal damping. Finally, we investigate iv) how low the obliquities of stars with compact and flat systems of multiple planets are. We find that they generally have obliquities lower than 10°, with several remarkable exceptions possibly caused by wide-orbiting stellar or planetary companions.

Download/Website: `https://arxiv.org/abs/2408.09793`

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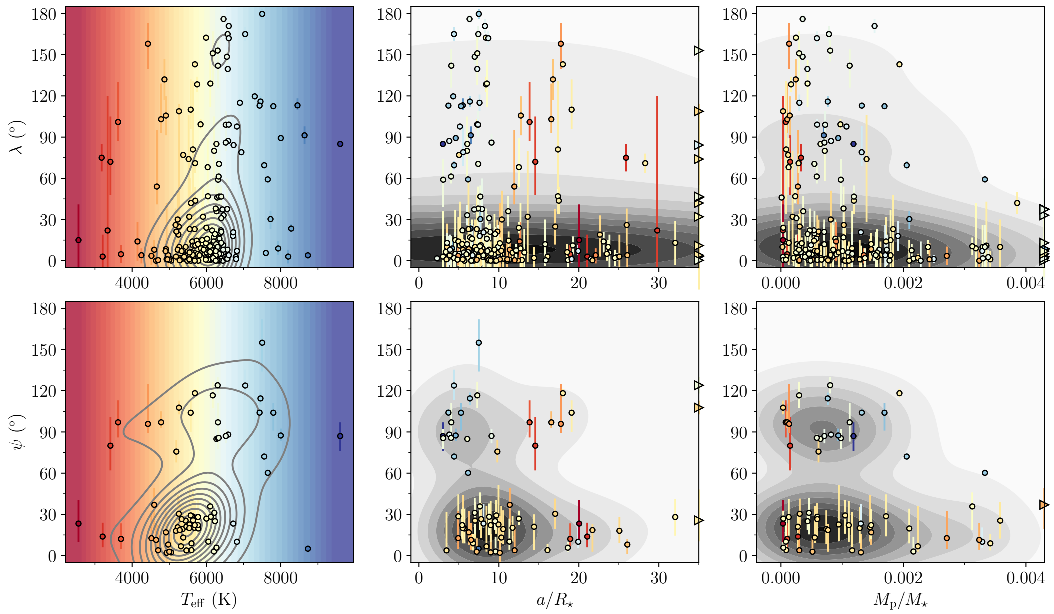

Figure 3: **Obliquities and projected obliquities** as a function of $T_{\rm eff}$ (left), $a/R_\star$ (center), and $M_{\rm p}/M_\star$ (right). Triangles indicate the a measurement whose value is outside of the plotted range. In all panels, the color of each data point conveys $T_{\rm eff}$ using the color scale shown in the lower left panel. The contours are KDEs illustrating the density of measurements in a given parameter space.

The JWST/NIRISS Deep Spectroscopic Survey for Young Brown Dwarfs and Free-Floating Planets

Adam B. Langeveld[1,2], Aleks Scholz[3], Koraljka Mužić[4], Ray Jayawardhana[1], Daniel Capela[4], Loïc Albert[5,6], René Doyon[5,6], Laura Flagg[1], Matthew de Furio[7], Doug Johnstone[8,9], David Lafrèniere[5], Michael Meyer[10]

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The Astronomical Journal, in press (arXiv: 2408.12639)

The discovery and characterization of free-floating planetary-mass objects (FFPMOs) is fundamental to our understanding of star and planet formation. Here we report results from an extremely deep spectroscopic survey of the young star cluster NGC1333 using NIRISS Wide Field Slitless Spectroscopy (WFSS) on the James Webb Space Telescope. The survey is photometrically complete to $K \sim 21$, and includes useful spectra for objects as faint as $K \sim 20.5$. The observations cover 19 known brown dwarfs, for most of which we confirm spectral types using NIRISS spectra. We discover six new candidates with L-dwarf spectral types that are plausible planetary-mass members of NGC1333, with estimated masses between 5–15 $M_{\rm Jup}$. One, at $\sim 5\,M_{\rm Jup}$, shows clear infrared excess emission and is a good candidate to be the lowest mass object known to have a disk. We do not find any objects later than mid-L spectral type ($M \lesssim 4\,M_{\rm Jup}$). The paucity of Jupiter-mass objects, despite the survey's unprecedented sensitivity, suggests that our observations reach the lowest mass objects formed like stars in NGC1333. Our findings put the fraction of FFPMOs in NGC1333 at $\sim 10\,\%$ of the number of cluster members, significantly more than expected from the typical log-normal stellar mass function. We also search for wide binaries in our images and report a young brown dwarf with a planetary-mass companion.

Download/Website: `https://arxiv.org/abs/2408.12639`

Contact: Aleks Scholz: as110@st-andrews.ac.uk

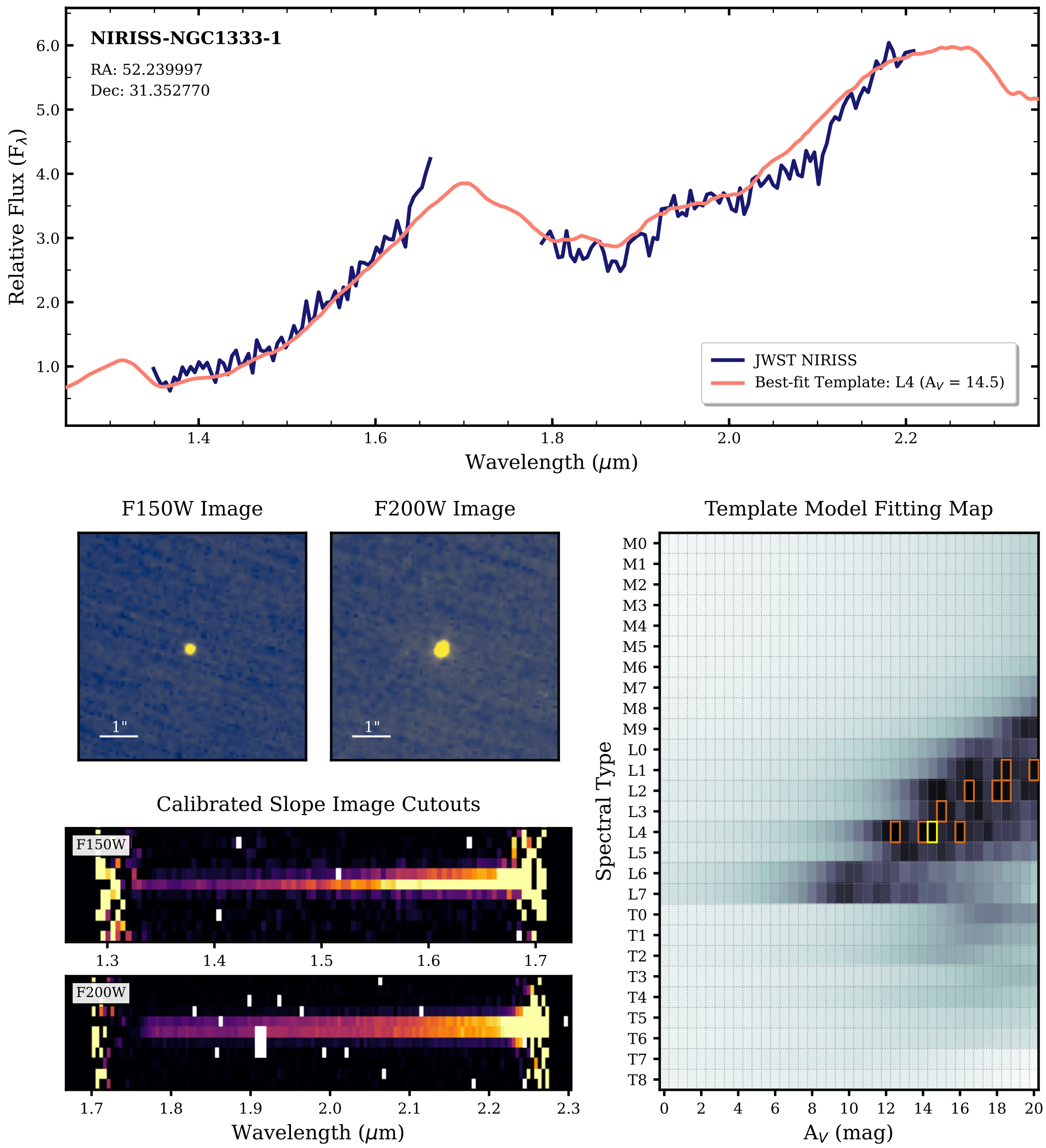

Figure 4: Results of the spectroscopic survey for object NIRISS-NGC1333-1 (NN1). *Top panel:* NIRISS WFSS spectrum (dark blue) with flux scaled to a value of 1 at a wavelength of 1.4 μm, and best-fit template spectrum (salmon pink) that has been smoothed using a Savitzky-Golay filter. *Middle-left panels:* NIRISS images of the object in the F150W and F200W filters with a 1 $''$ scale. *Bottom-left panels:* Calibrated slope image cutouts that are produced by the `calwebb_spec3` pipeline for the NIRISS F150W and F200W filters and modified to apply the background subtraction. *Bottom-right panel:* Map of the metric calculated as part of the spectral fitting. The templates that most closely fit the data are located in the darkest regions. The best solution is marked with a yellow box, and the corresponding template is displayed in the top panel to compare to the observed spectrum. The remaining best nine solutions are marked in orange.

The missing rings around Solar System moons

M. Sucerquia[1,2,3], *J. A. Alvarado Montes*[4,5], *J. I. Zuluaga*[6], *N. Cuello*[2], *J. Cuadra*[1,3], *M. Montesinos*[7]

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Astronomy & Astropishycs, in press (2024arXiv240810643S/arXiv:2408.10643v1)

Rings are complex structures that surround various bodies within the Solar System such as giant planets and certain minor bodies. While some formation mechanisms could also potentially foster their existence around (regular or irregular) satellites, none of these bodies currently bear these structures. We aim to understand the underlying mechanisms that govern the potential formation, stability, and/or decay of hypothetical circumsatellital rings (CSRs), orbiting the largest moons in the Solar System. This extends to the exploration of short-term morphological features within these rings, providing insights into the ring survival time-scales and the interactions that drive their evolution. To conduct this study, we use numerical N-body simulations under the perturbing influence of the host planet and other moon companions. We found that moons with a lower Roche–to–Hill radius can preserve their rings over extended periods. Moreover, the gravitational environment in which these rings are immersed influences the system's morphological evolution (e.g, ring size), inducing gaps through the excitation of eccentricity and inclination of constituent particles. Specifically, our results show that Iapetus' and Rhea's rings experience minimal variations in their orbital parameters, enhancing their long-term stability. This agrees with the hypothesis that some of the features of Iapetus and Rhea were produced by ancient ring systems, for example, the huge ridge in Iapetus equator as a result of a decaying ring. From a dynamical perspective, we found that there are no mechanisms that preclude the existence of CSRs and we attribute their current absence to non-gravitational phenomena. Effects such as stellar radiation, magnetic fields, the influence of magnetospheric plasma, or flyby events can significantly impact the dynamics of constituent particles and trigger their decay. This highlights the importance of future studies on these effects.

Download/Website: `https://arxiv.org/pdf/2408.10643`

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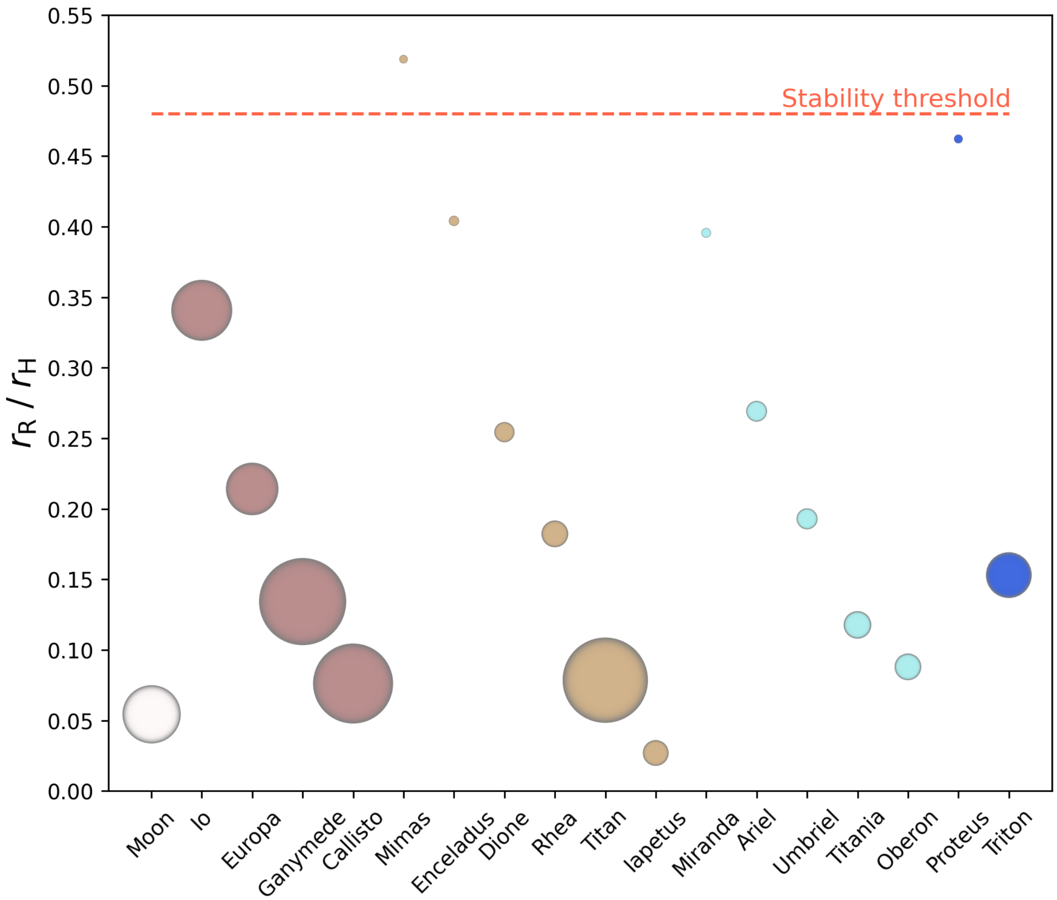

Figure 5: Ratio of the gravitational domain (Hill radius) and the theoretical ring size (Roche limit) for our sample of large moons in the Solar System. Each colour denotes a different host planet. The dashed horizontal red line marks the orbital stability threshold above which ring particles are likely to remain gravitationally bound.

3 Conferences and Workshops

PLATO Workshop on 3D Climate and Clouds

L. Carone[1], *Ch. Helling*[1]
IWF Graz, Schmiedlstr. 6, 8042, Graz, UT

IWF Graz, 7.& 8.10.2024

This meeting aims to discuss projects for the atmosphere characterization of the chemistry, clouds and 3D climates of gas planets with PLATO. The workshop is open for WP member and to all interested parties.
Please send an email to the contact person if you want to join the workshop and are interested to become a new WP member.

Download/Website: `https://www.oeaw.ac.at/iwf/events/plato-workshops`

Contact: `carone@oeaw.ac.at`

4 As seen on astro-ph

The following list contains exoplanet related entries appearing on astro-ph in August 2024.
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.

August 2024

astro-ph/2408.00070: **Chemical abundance gradients of organic molecules within a protostellar disk** *by Levi G. Walls et al.*

astro-ph/2408.00084: **Approximating Rayleigh Scattering in Exoplanetary Atmospheres using Physics-informed Neural Networks (PINNs)** *by David Dahlbüdding et al.*

astro-ph/2408.00159: **Dust-Gas Coupling in Turbulence- and MHD Wind-Driven Protoplanetary Disks: Implications for Rocky Planet Formation** *by Teng Ee Yap, Konstantin Batygin*

astro-ph/2408.00848: **Photoevaporation of protoplanetary discs with PLUTO+PRIZMO I. Lower X-ray-driven mass-loss rates due to enhanced cooling** *by Andrew D. Sellek et al.*

astro-ph/2408.00725: **SOLES XII. The Aligned Orbit of TOI-2533 b, a Transiting Brown Dwarf Orbiting an F8-type Star** *by Thiago Ferreira et al.*

astro-ph/2408.00709: **TESS discovery of two super-Earths orbiting the M-dwarf stars TOI-6002 and TOI-5713 near the radius valley** *by M. Ghachoui et al.*

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