ExoPlanet News
An Electronic Newsletter

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1 Editorial

Dear readers,

Welcome to Edition 133 of the ExoPlanet News!

In this July-issue you can find, as usual, abstracts of scientific papers, conference announcements/updates, Exoplanet Archive updates, and an overview of exoplanet-related articles on astro-ph.

For next month we look forward to your paper abstract, job ad or meeting announcement. 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 18. August 2020.

Thanks again for your support.
Best healthy wishes from the editorial team,

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

2 Abstracts of refereed papers

Mantle redox state drives outgassing chemistry and atmospheric composition of rocky planets

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Volcanic degassing of planetary interiors has important implications for their corresponding atmospheres. The oxidation state of rocky interiors affects the volatile partitioning during mantle melting and subsequent volatile speciation near the surface. Here we show that the mantle redox state is central to the chemical composition of atmospheres while factors such as planetary mass, thermal state, and age mainly affect the degassing rate. We further demonstrate that mantle oxygen fugacity has an effect on atmospheric thickness and that volcanic degassing is most efficient for planets between 2 and 4 Earth masses. We show that outgassing of reduced systems is dominated by strongly reduced gases such as H_2, with only smaller fractions of moderately reduced/oxidised gases (CO, H_2O). Overall, a reducing scenario leads to a lower atmospheric pressure at the surface and to a larger atmospheric thickness compared to an oxidised system. Atmosphere predictions based on interior redox scenarios can be compared to observations of atmospheres of rocky exoplanets, potentially broadening our knowledge on the diversity of exoplanetary redox states.

Download/Website: `https://doi.org/10.1038/s41598-020-67751-7`

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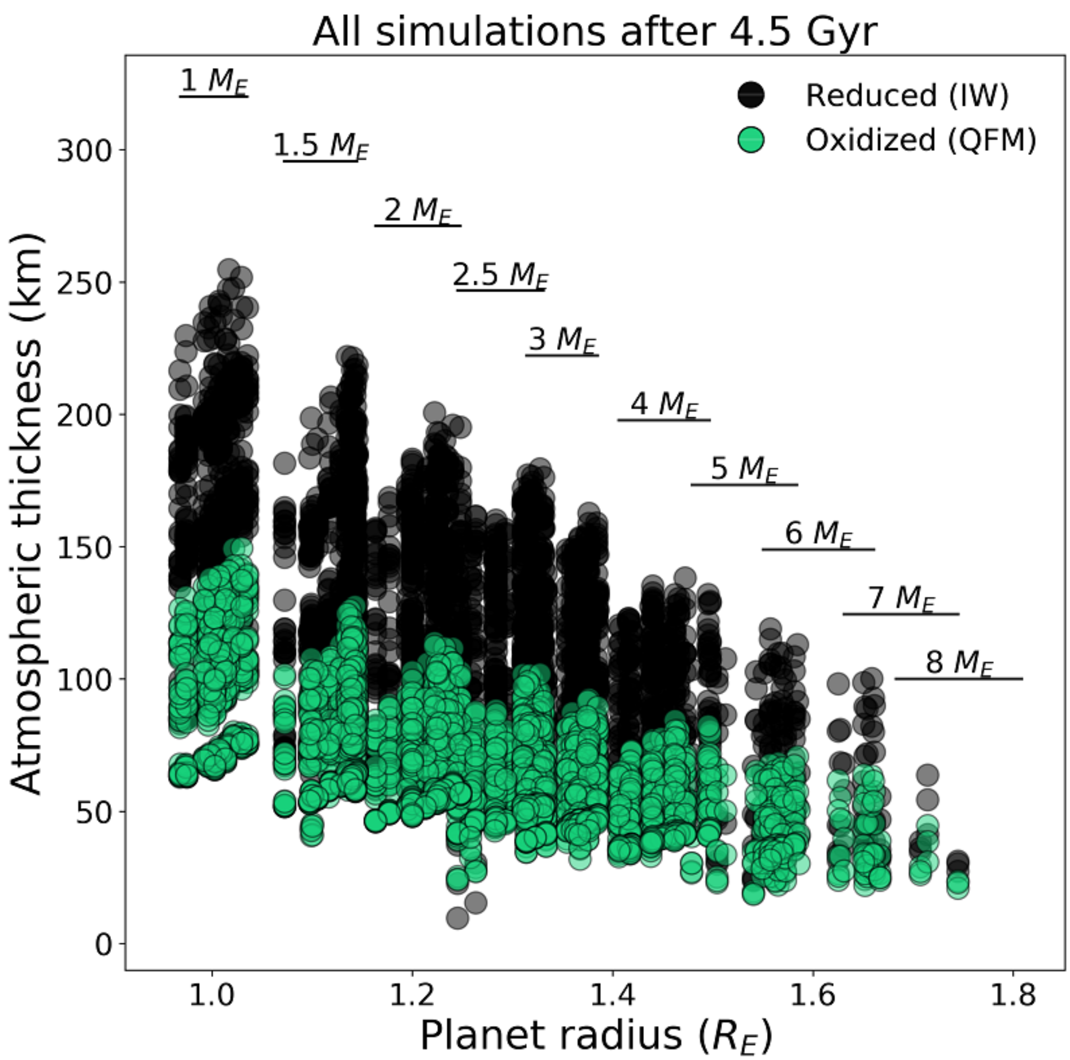

Figure 1: Scatter plot showing calculated atmospheric thicknesses versus planetary radii of all of our scenarios which result in outgassing. Colours indicate mantle redox buffers. The investigated range of planetary radii corresponding to individual input planetary masses and different planet compositions are marked with horizontal lines.

Parameterisations of interior properties of rocky planets
An investigation of planets with Earth-like compositions but variable iron content

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Astronomy & Astrophysics, published (doi:10.1051/0004-6361/202037723)

Context. Observations of Earth-sized exoplanets are mostly limited to information on their masses and radii. Simple mass-radius relationships have been developed for scaled-up versions of Earth or other planetary bodies such as Mercury and Ganymede, as well as for one-material spheres made of pure water(-ice), silicates, or iron. However, they do not allow a thorough investigation of composition influences and thermal state on a planet's interior structure and properties.
Aims. In this work, we investigate the structure of a rocky planet shortly after formation and at later stages of thermal evolution assuming the planet is differentiated into a metal core and a rocky mantle (consisting of Earth-like minerals, but with a variable iron content).
Methods. We derived possible initial temperature profiles after the accretion and magma ocean solidification. We then developed parameterisations for the thermodynamic properties inside the core depending on planet mass, composition, and thermal state.
Results. We provide the community with robust scaling laws for the interior structure, temperature profiles, and core- and mantle-averaged thermodynamic properties for planets composed of Earth's main minerals but with variable compositions of iron and silicates.
Conclusions. The scaling laws make it possible to investigate variations in thermodynamic properties for different interior thermal states in a multitude of applications such as deriving mass-radius scaling laws or estimating magnetic field evolution and core crystallisation for rocky exoplanets.

Download/Website: https://doi.org/10.1051/0004-6361/202037723

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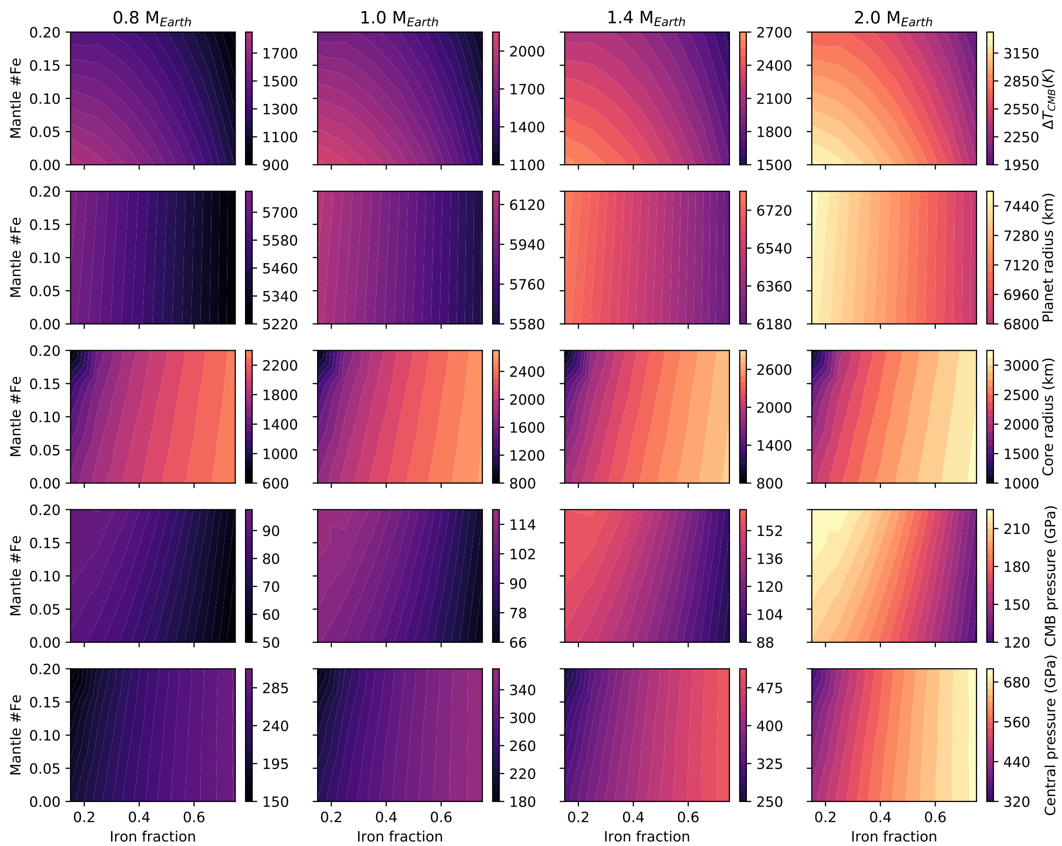

Figure 2: Main planetary parameters for depending on planet mass (different columns), planet iron content, and iron number in mantle, assuming an Mg-Si-O ratio similar to Earth. Each row shows a different planet parameter: temperature jump at core-mantle boundary, planet radius, core radius, and pressure at the core-mantle boundary and in the centre of the planet. Each row uses a fixed colour scale to highlight the variation with planet mass.

GJ 273: On the formation, dynamical evolution and habitability of a planetary system hosted by an M dwarf at 3.75 parsec

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Astronomy & Astrophysics, in press (arXive:2006.09403.)

Planets orbiting low-mass stars such as M dwarfs are now considered a cornerstone in the search for life-harbouring planets. GJ273 is a planetary system orbiting an M dwarf only 3.75 pc away, composed of two confirmed planets, GJ273b and GJ273c, and two promising candidates, GJ273d and GJ273e. Planet GJ273b resides in the habitable zone. Currently, due to a lack of observed planetary transits, only the minimum masses of the planets are known. Despite being an interesting system, the GJ273 planetary system is still poorly studied. We aim at precisely determine the physical parameters of the individual planets, in particular to break the mass–inclination degeneracy to accurately determine the mass of the planets. Moreover, we present thorough characterisation of planet GJ273b in terms of its potential habitability. We explored the planetary formation and hydration phases of GJ273 during the first 100 Myr. Then, we analysed the stability of the system. We also searched for regions which may harbour minor bodies such as an asteroid belt and Kuiper belt analogues. We found that the four-planet configuration of the system allows us to break the mass–inclination degeneracy with the following masses: $2.89 \leq M_b \leq 3.03\,M_\oplus$, $1.18 \leq M_c \leq 1.24\,M_\oplus$, $10.80 \leq M_d \leq 11.35\,M_\oplus$ and $9.30 \leq M_e \leq 9.70\,M_\oplus$. That is a super-Earth planet, an Earth-mass and two mini-Neptunes. Moreover, GJ273b is found to be an efficient water captor and GJ273c likely a dry planet. Several stable regions are predicted where minor bodies might reside. We comprehensively discuss the habitability of GJ273b.

Download/Website: `https://arxiv.org/pdf/2006.09403.pdf`

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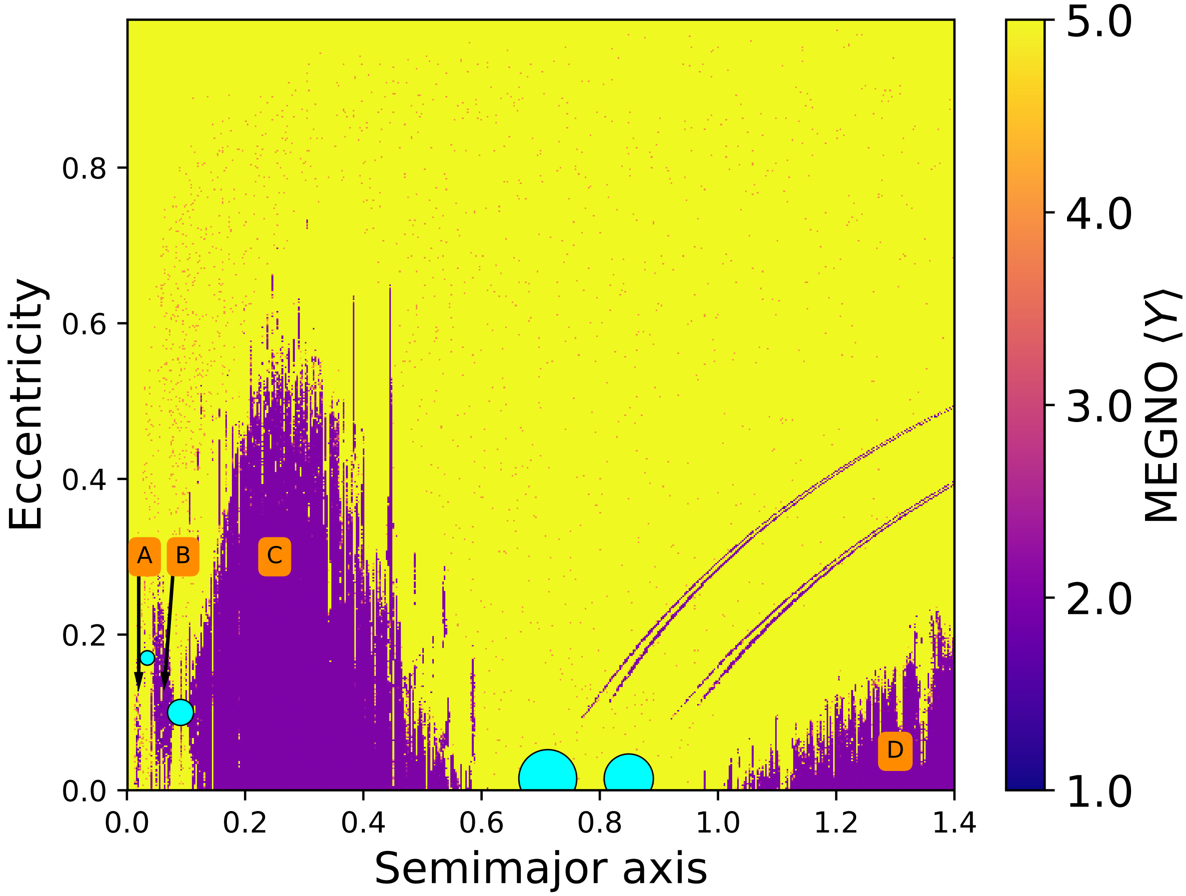

Figure 3: Stability map in the a–e parameter space for the most likely four-planet configuration of the system. The dark-purple areas correspond to stable regions which may contain minor bodies reservoirs such as asteroid belt and Kuiper belt analogues (A, B, C and D). On the other hand, yellow areas correspond to unstable regions from which a minor body such an asteroid or comet would be expelled. In this configuration the planet GJ273b (which is in the habitable zone of the system) resides in between two main asteroid belt analogues.

Deep Atmosphere Composition, Structure, Origin, and Exploration, with Particular Focus on Critical in situ Science at the Icy Giants

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Space Science Reviews, published (2020arXiv200613869A)

A comprehensive exploration of Uranus and Neptune is essential to understand the formation and evolution of the giant planets, in particular, solar system, in general, and, by extension, a vast proportion of confirmed exoplanets. Though core accretion is generally favored over gravitational instability as the model of the formation of the gas giants, Jupiter and Saturn, observational constraints are presently lacking to make a compelling case for either in the case of the icy giants, Uranus and Neptune. Abundances of the heavy elements with mass greater than that of helium provide the best constraints to the formation and migration models. Only the C elemental abundance has been determined from methane measurements of the icy giants, but it should be considered as a lower limit considering methane is a condensible gas on those planets. Well-mixed water, ammonia and hydrogen sulfide to determine O, N and S elemental abundances, respectively, are too deep to measure by any observational techniques in the foreseeable future. However, a precise measurement of the noble gases, He, Ne, Ar, Kr and Xe, together with their isotopic ratios, would circumvent the need for determining the above elements. Only entry probes are capable of measuring the noble gases, but those measurements can be done at relatively shallow pressure levels of 5-10 bars. Complementary observations from an orbiter, especially on the interior (gravity and magnetic field) and the depth profiles of water and ammonia, would greatly enhance the dataset for constraining the formation models. No new technology is required to carry out an orbiter-probe mission to either Uranus or Neptune in the next decade.

Download/Website: `https://ui.adsabs.harvard.edu/abs/2020arXiv200613869A/abstract`

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Discovery and characterization of the exoplanets WASP-148b and c. A transiting system with two interacting giant planets

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Astronomy & Astrophysics, in press (doi.org/10.1051/0004-6361/202038296 / arXiv:2004.14645)

We present the discovery and characterization of WASP-148, a new extrasolar system that includes at least two giant planets. The host star is a slowly rotating inactive late-G dwarf with a $V = 12$ magnitude. The planet WASP-148b is a hot Jupiter of $0.72\,\mathrm{R_{Jup}}$ and $0.29\,\mathrm{M_{Jup}}$ that transits its host with an orbital period of 8.80 days. We found the planetary candidate with the SuperWASP photometric survey, then characterized it with the SOPHIE spectrograph. Our radial velocity measurements subsequently revealed a second planet in the system, WASP-148c, with an orbital period of 34.5 days and a minimum mass of $0.40\,\mathrm{M_{Jup}}$. No transits of this outer planet were detected. The orbits of both planets are eccentric and fall near the 4:1 mean-motion resonances. This configuration is stable on long timescales, but induces dynamical interactions so that the orbits differ slightly from purely Keplerian orbits. In particular, WASP-148b shows transit-timing variations of typically 15 minutes, making it the first interacting system with transit-timing variations that is detected on ground-based light curves. We establish that the mutual inclination of the orbital plane of the two planets cannot be higher than $35°$, and the true mass of WASP-148c is below $0.60\ \mathrm{M_{Jup}}$. We present photometric and spectroscopic observations of this system that cover a time span of ten years. We also provide their Keplerian and Newtonian analyses; these analyses should be significantly improved through future TESS observations.

Download/Website: `https://doi.org/10.1051/0004-6361/202038296`

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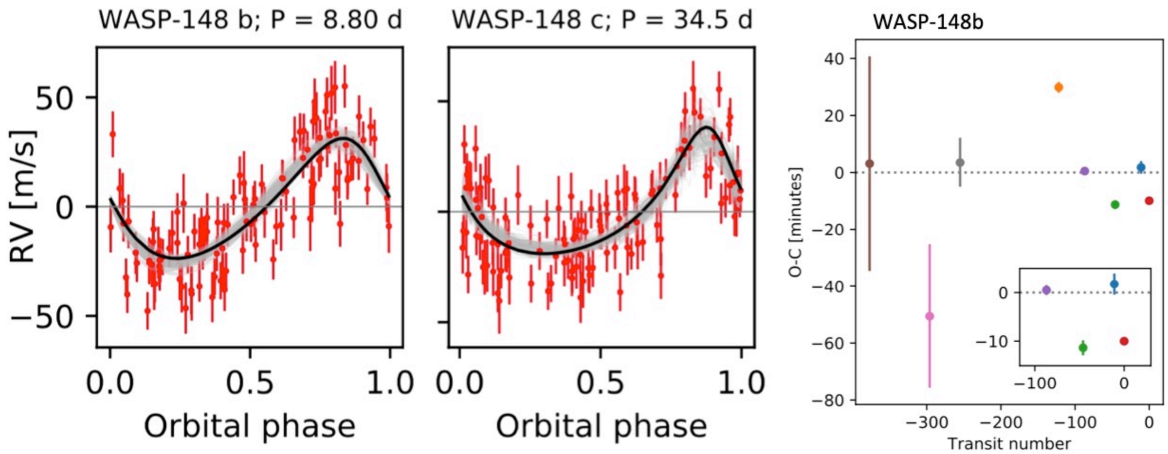

Figure 4: The two left panels show the phase-folded SOPHIE radial velocities for planets WASP-148b ($P = 8.80\,\mathrm{d}$) and WASP-148c ($P = 34.5\,\mathrm{d}$) after the effect of the other planet is removed. The solid black curve is the maximum-a-posteriori model and the gray thin curves are 100 models drawn randomly from the posterior distribution The right panel shows the timing residuals of a linear regression model to the eight available WASP-148b transit times. The inset is a zoom into the region of the last four transits.

Dynamical instabilities in systems of multiple short-period planets are likely driven by secular chaos: a case study of Kepler-102

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The Astronomical Journal, in press (arXiv:2003.05040)

We investigated the dynamical stability of high-multiplicity *Kepler* and *K2* planetary systems. Our numerical simulations find instabilities in $\sim 20\%$ of the cases on a wide range of timescales (up to 5×10^9 orbits) and over an unexpectedly wide range of initial dynamical spacings. To identify the triggers of long-term instability in multi-planet systems, we investigated in detail the five-planet Kepler-102 system. Despite having several near-resonant period ratios, we find that mean motion resonances are unlikely to directly cause instability for plausible planet masses in this system. Instead, we find strong evidence that slow inward transfer of angular momentum deficit (AMD) via secular chaos excites the eccentricity of the innermost planet, Kepler-102 b, eventually leading to planet-planet collisions in $\sim 80\%$ of Kepler-102 simulations. Kepler-102 b likely needs a mass $\gtrsim 0.1 M_{earth}$, hence a bulk density exceeding about half Earth's, in order to avoid dynamical instability. To investigate the role of secular chaos in our wider set of simulations, we characterize each planetary system's AMD evolution with a "spectral fraction" calculated from the power spectrum of short integrations ($\sim 5 \times 10^6$ orbits). We find that small spectral fractions ($\lesssim 0.01$) are strongly associated with dynamical stability on long timescales (5×10^9 orbits) and that the median time to instability decreases with increasing spectral fraction. Our results support the hypothesis that secular chaos is the driver of instabilities in many non-resonant multi-planet systems, and also demonstrate that the spectral analysis method is an efficient numerical tool to diagnose long term (in)stability of multi-planet systems from short simulations.

Download/Website: `https://arxiv.org/abs/2003.05040`

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How Jupiters save or destroy inner Neptunes around evolved stars

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ApJL in press, arXiv:2007.04337

In about 6 Giga years our Sun will evolve into a red giant and finally end its life as a white dwarf. This stellar metamorphosis will occur to virtually all known host stars of exo-planetary systems and is therefore crucial for their final fate. It is clear that the innermost planets will be engulfed and evaporated during the giant phase and that planets located farther out will survive. However, the destiny of planets in-between, at $\sim 1-10$ au, has not yet been investigated with a multi-planet tidal treatment. We here combine for the first time multi-planet interactions, stellar evolution, and tidal effects in an N-body code to study the evolution of a Neptune-Jupiter planetary system. We report that the fate of the Neptune-mass planet, located closer to the star than the Jupiter-mass planet, can be very different from the fate of a single Neptune. The simultaneous effects of gravitational interactions, mass loss and tides can drive the planetary system towards mean motion resonances. Crossing these resonances affects particularly the eccentricity of the Neptune and thereby also its fate, which can be engulfment, collision with the Jupiter-mass planet, ejection from the system, or survival at a larger separation.

Download/Website: `https://arxiv.org/abs/2007.04337`

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Hot Exoplanet Atmospheres Resolved with Transit Spectroscopy (HEARTS) V. Detection of sodium on the bloated super-Neptune WASP-166b

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Astronomy & Astrophysics, in press (arXiv:2007.01783)

Planet formation processes or evolution mechanisms are surmised to be at the origin of the hot Neptune desert. Studying exoplanets currently living within or at the edge of this desert could allow disentangling the respective roles of formation and evolution. We present the High Accuracy Radial velocity Planet Searcher (HARPS) transmission spectrum of the bloated super-Neptune WASP-166b, located at the outer rim of the Neptune desert. Neutral sodium is detected at the $3.4\,\sigma$ level ($0.455 \pm 0.135\,\%$), with a tentative indication of line broadening, which could be caused by winds blowing sodium farther into space, a possible manifestation of the bloated character of these highly irradiated worlds. We put this detection into context with previous work claiming a non-detection of sodium in the same observations and show that the high noise in the trace of the discarded stellar sodium lines was responsible for the non-detection. We highlight the impact of this low signal-to-noise ratio remnant on detections for exoplanets similar to WASP-166b.

Download/Website: `http://arxiv.org/abs/2007.01783`

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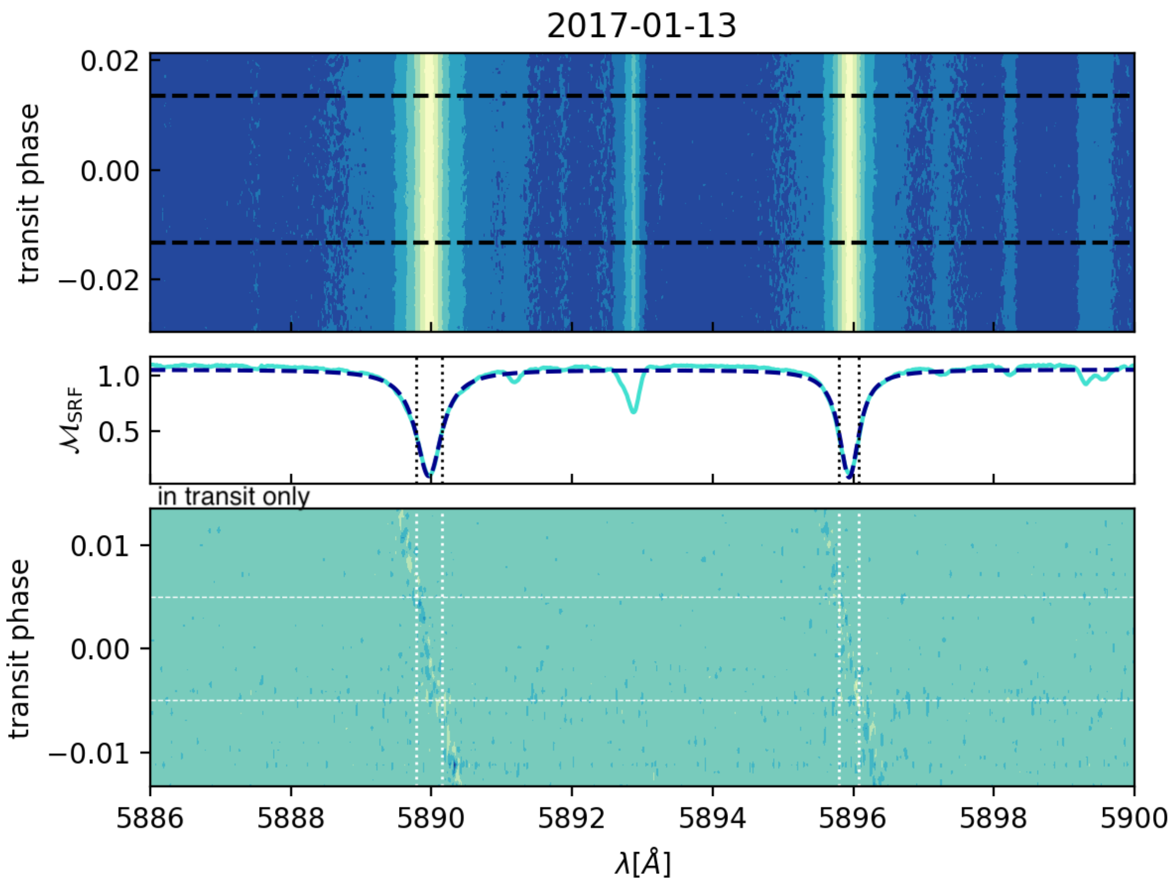

Figure 5: Upper panel: All spectra in the stellar rest frame as a 2D map of wavelength and transit phase for the first transit. The stellar sodium doublet is visible as two horizontal light yellow bands. Transit ingress and egress are shown as black dashed lines. Centre panel: Normalised sum of all spectra with a fit to each line in dashed blue. The FWHM is indicated as dotted vertical lines. Lower panel: Same data, but corrected for the stellar spectrum by the master-out, in the planet rest frame. The dotted lines propagate the position of the FWHM from the central panel. The low S/N remnants are clearly visible, but the S/N is too low to see the planetary trace.

Arid or Cloudy: Characterizing the Atmosphere of the super-Earth 55 Cancri e using High-Resolution Spectroscopy

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The Astronomical Journal, Accepted (arXiv:2007.03115)

The nearby super-Earth 55 Cnc e orbits a bright ($V = 5.95$ mag) star with a period of $\sim$ 18 hours and a mass of $\sim 8\ M_\oplus$. Its atmosphere may be water-rich and have a large scale-height, though attempts to characterize it have yielded ambiguous results. Here we present a sensitive search for water and TiO in its atmosphere at high spectral resolution using the Gemini North telescope and the GRACES spectrograph. We combine observations with previous observations from Subaru and CFHT, improving the constraints on the presence of water vapor. We adopt parametric models with an updated planet radius based on recent measurements, and use a cross-correlation technique to maximize sensitivity. Our results are consistent with atmospheres that are cloudy or contain minimal amounts of water and TiO. Using these parametric models, we rule out a water-rich atmosphere (VMR $\geq 0.1\%$) with a mean molecular weight of $\leq$ 15 g/mol at a 3σ confidence level, improving on the previous limit by a significant margin. For TiO, we rule out a mean molecular weight of $\leq$ 5 g/mol with a 3σ confidence level for a VMR greater than 10^{-8}; for a VMR of greater than 10^{-7}, the limit rises to a mean molecular weight of $\leq$ 10 g/mol. We can rule out low mean-molecular-weight chemical equilibrium models both including and excluding TiO/VO at very high confidence levels ($> 10\sigma$). Overall, our results are consistent with an atmosphere with a high mean molecular weight and/or clouds, or no atmosphere.

Download/Website: `https://arxiv.org/abs/2007.03115`

Contact: `abhinav.jindal@mail.utoronto.ca`

The GAPS Programme at TNG XXI
A GIARPS case study of known young planetary candidates: confirmation of HD 285507 b and refutation of AD Leo b

I. Carleo[1,2], L. Malavolta[3], A. F. Lanza[3], M. Damasso[4], et al. (a complete list of authors can be found in the paper)
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[2] INAF - Osservatorio Astronomico di Padova, Vicolo dell'Osservatorio 5, I-35122, Padova, Italy
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Astronomy & Astrophysics, published (2020A&A...638A...5C)

The existence of hot Jupiters is still not well understood. Two main channels are thought to be responsible for their current location: a smooth planet migration through the protoplanetary disk or the circularization of an initial highly eccentric orbit by tidal dissipation leading to a strong decrease in the semimajor axis. Different formation scenarios result in different observable effects, such as orbital parameters (obliquity and eccentricity) or frequency of planets at different stellar ages.
In the context of the GAPS Young Objects project, we are carrying out a radial velocity survey with the aim of searching and characterizing young hot-Jupiter planets. Our purpose is to put constraints on evolutionary models and establish statistical properties, such as the frequency of these planets from a homogeneous sample.
Since young stars are in general magnetically very active, we performed multi-band (visible and near-infrared) spectroscopy with simultaneous GIANO-B + HARPS-N (GIARPS) observing mode at TNG. This helps in dealing with stellar activity and distinguishing the nature of radial velocity variations: stellar activity will introduce a wavelength-dependent radial velocity amplitude, whereas a Keplerian signal is achromatic. As a pilot study, we present here the cases of two known hot Jupiters orbiting young stars: HD 285507 b and AD Leo b.
Our analysis of simultaneous high-precision GIARPS spectroscopic data confirms the Keplerian nature of the variation in the HD285507 radial velocities and refines the orbital parameters of the hot Jupiter, obtaining an eccentricity consistent with a circular orbit. Instead, our analysis does not confirm the signal previously attributed to a planet orbiting AD Leo. This demonstrates the power of the multi-band spectroscopic technique when observing active stars.

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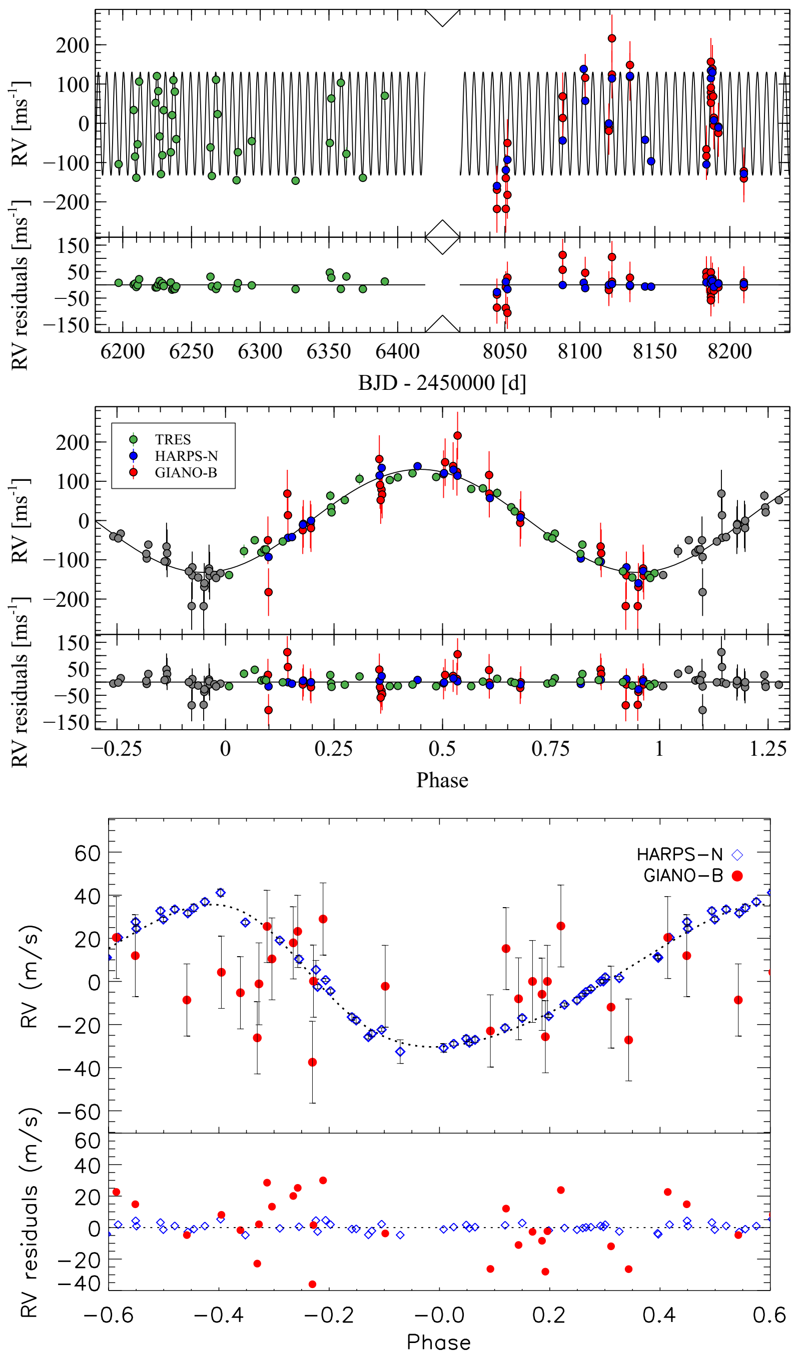

Figure 6: *Top*: Orbital fit (black line) of HD 285507 at 6.0962 days obtained combining the visible data from HARPS-N (blue diamonds), TRES (green dots), and GIANO-B RVs (red dots) in the NIR. *Bottom*: Keplerian fit (black dotted line) at 2.2244 days obtained with the visible data (HARPS-N, blue diamonds), with GIANO-B RVs overplotted (red dots).

The multi-planet system TOI-421 A warm Neptune and a super puffy mini-Neptune transiting a G9 V star in a visual binary

I. Carleo,[1,2] *Davide Gandolfi,*[3] *Oscar Barragán,*[4] *John H. Livingston*[5] *et al. (a complete list of authors can be found in the paper)*

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AJ, in press (2020arXiv200410095C)

We report the discovery of a warm Neptune and a hot sub-Neptune transiting TOI-421 (BD-14 1137, TIC 94986319), a bright (V=9.9) G9 dwarf star in a visual binary system observed by the *TESS* space mission in Sectors 5 and 6. We performed ground-based follow-up observations – comprised of LCOGT transit photometry, NIRC2 adaptive optics imaging, and FIES, CORALIE, HARPS, HIRES, and PFS high-precision Doppler measurements – and confirmed the planetary nature of the 16-day transiting candidate announced by the *TESS* team. We discovered an additional radial velocity signal with a period of 5 days induced by the presence of a second planet in the system, which we also found to transit its host star. We found that the inner mini-Neptune, TOI-421 b, has an orbital period of $\mathrm{P_b}$=5.19672 ± 0.00049 days, a mass of $\mathrm{M_b} = 7.17 \pm 0.66 M_\oplus$ and a radius of $\mathrm{R_b} = 2.68^{+0.19}_{-0.18} R_\oplus$, whereas the outer warm Neptune, TOI-421 c, has a period of $\mathrm{P_c}$=16.06819 ± 0.00035 days, a mass of $\mathrm{M_c} = 16.42^{+1.06}_{-1.04} M_\oplus$, a radius of $\mathrm{R_c} = 5.09^{+0.16}_{-0.15} R_\oplus$ and a density of ρ_c= $0.685^{+0.080}_{-0.072}\,\mathrm{g\,cm^{-3}}$. With its characteristics the outer planet is placed in the intriguing class of the super-puffy mini-Neptunes. TOI-421 b and TOI-421 c are found to be well suitable for atmospheric characterization. Our atmospheric simulations predict significant Ly-α transit absorption, due to strong hydrogen escape in both planets, and the presence of detectable CH_4 in the atmosphere of TOI-421 c if equilibrium chemistry is assumed.

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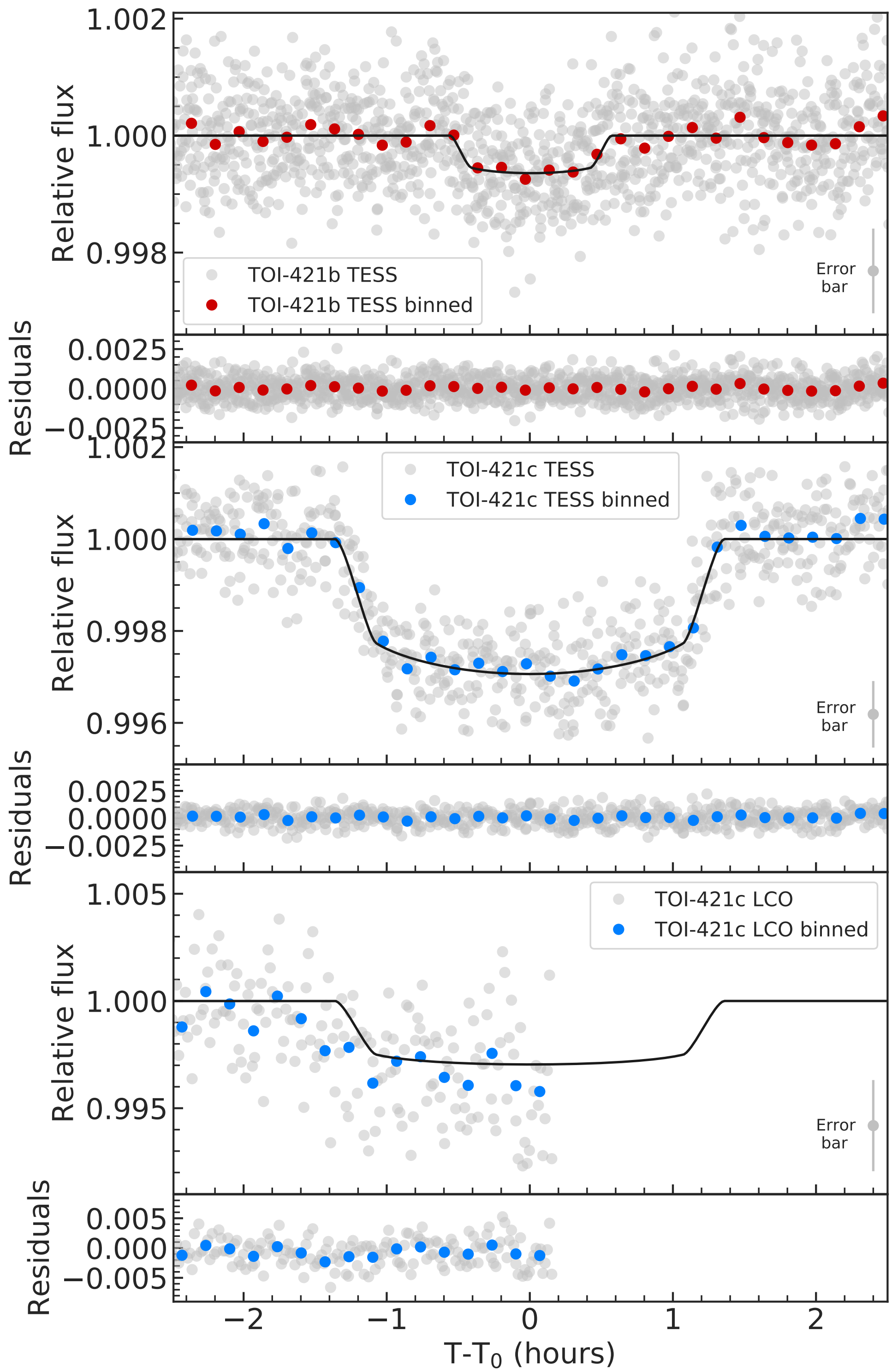

Figure 7: Light curves around the transit with residuals of TOI-421 b (upper and middle panels refer to *TESS* and LCOGT, respectively) and TOI-421 c (*TESS*, lower panel) with inferred transit model over-plotted. Data are shown in the nominal short-cadence mode and binned to 10 min. Typical error bar for nominal data are shown at the bottom right for each panel.

Influence of the Sun-like magnetic cycle on exoplanetary atmospheric escape

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Monthly Notices of the Royal Astronomical Society, in press (10.1093/mnras/staa1815)

Radiation from host stars (e.g., X-ray and Extreme Ultraviolet hereafter XUV) is one of the main sources of driving exoplanetary wind and affecting exoplanetary atmospheric escape. Since most of the stars have magnetic activity cycle and that affects the stellar radiation, we investigate how stellar cycle shapes up the atmospheric escape of close-in giants. First, we consider a hypothetical HD209458b-like planet orbiting the Sun. For that, we implement the observed solar XUV radiation available over one and a half solar cycles in a 1D hydrodynamic escape model of HD209458b. We find that atmospheric escape rates show a cyclic variation (from 7.6 to 18.5 $\times$ 10^{10} g s^{-1}), almost proportional to the incident stellar radiation. To compare this with observations, we compute spectroscopic transits in two hydrogen lines. We find non-detectable cyclic variations in Ly α transits. Given the temperature sensitiveness of the H α line, its equivalent width has an amplitude of 1.9 mÅ variation over the cycle, which could be detectable in exoplanets such as HD209458b. We demonstrate that the XUV flux is linearly proportional to the magnetic flux during the solar cycle. Second, we apply this relation to derive the cyclic evolution of the XUV flux of HD189733 using available magnetic flux observations of the star from Zeeman Doppler Imaging over nearly a decade. The XUV fluxes are then used to model escape in HD189733b, which shows escape rate varying from 2.8 to 6.5 $\times$ 10^{10} g s^{-1}. Like in the HD209458b case, this introduces variations in Ly α and H α transits, with H α variations more likely to be observable. Finally, we show that a strong stellar flare would enhance significantly Ly α and H α transit depths.

Download/Website: `https://arxiv.org/pdf/2006.10634.pdf`

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The dichotomy of atmospheric escape in AU Mic b

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:2006.13606)

Here, we study the dichotomy of the escaping atmosphere of the newly discovered close-in exoplanet AU Mic b. On one hand, the high EUV stellar flux is expected to cause a strong atmospheric escape in AU Mic b. On the other hand, the wind of this young star is believed to be very strong, which could reduce or even inhibit the planet's atmospheric escape. AU Mic is thought to have a wind mass-loss rate that is up to 1000 times larger than the solar wind mass-loss rate ($\dot{M}_\odot$). To investigate this dichotomy, we perform 3D hydrodynamics simulations of the stellar wind–planetary atmosphere interactions in the AU Mic system and predict the synthetic Ly-α transits of AU Mic b. We systematically vary the stellar wind mass-loss rate from a 'no wind' scenario to up to a stellar wind with a mass-loss rate of $1000\ \dot{M}_\odot$. We find that, as the stellar wind becomes stronger, the planetary evaporation rate decreases from 6.5×10^{10} g/s to half this value. With a stronger stellar wind, the atmosphere is forced to occupy a smaller volume, affecting transit signatures. Our predicted Ly-α absorption drops from $\sim 20\%$, in the case of 'no wind' to barely any Ly-α absorption in the extreme stellar wind scenario. Future Ly-α transits could therefore place constraints not only on the evaporation rate of AU Mic b, but also on the mass-loss rate of its host star.

Download/Website: `https://arxiv.org/abs/2006.13606`

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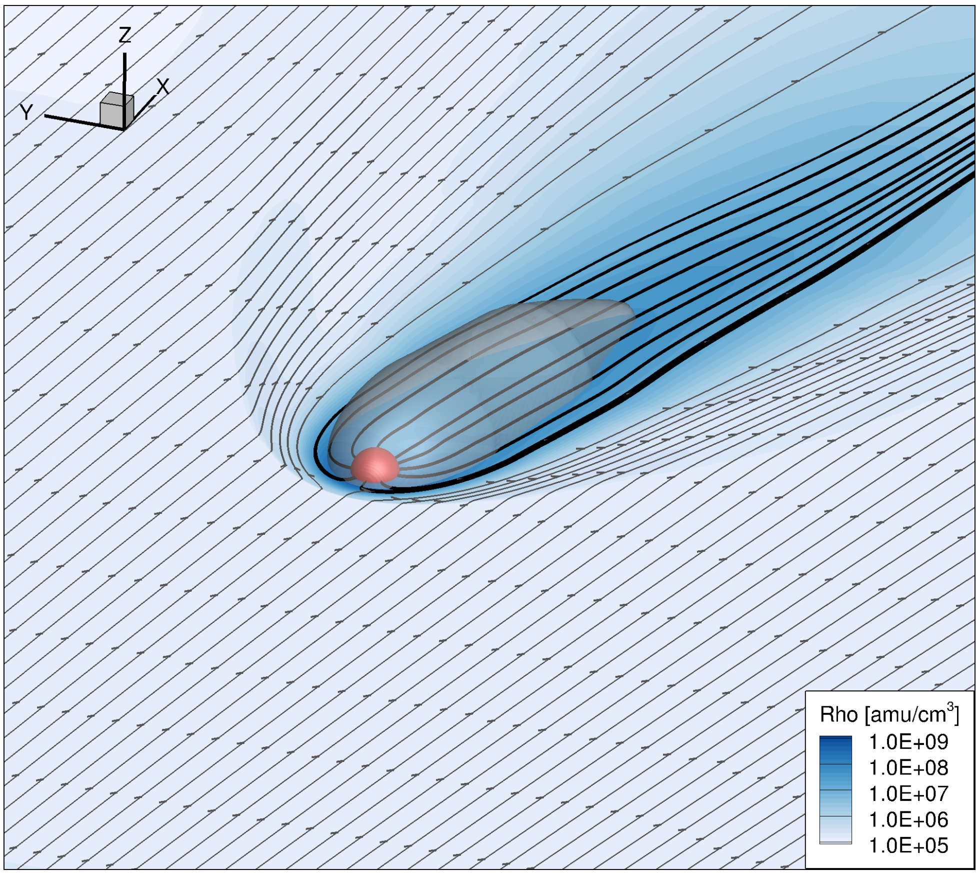

Figure 8: Atmospheric escape of AU Mic b, when it interacts with a stellar wind with $\dot{M} = 100\dot{M}_{\odot}$. The stellar wind is injected in the negative x. Its streamlines are shown in grey, while the black streamlines represent the velocity field of the planetary outflowing atmosphere. The density is shown in the equatorial plane and the grey surface around the planet shows the region used in the synthetic transits

A planet within the debris disk around the pre-main-sequence star AU Microscopii

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Nature, published (2020Natur.582..497P)

AU Microscopii (AU Mic) is the second closest pre-main-sequence star, at a distance of 9.79 parsecs and with an age of 22 million years. AU Mic possesses a relatively rare and spatially resolved edge-on debris disk extending from about 35 to 210 au from the star, and with clumps exhibiting non-Keplerian motion. Detection of newly formed planets around such a star is challenged by the presence of spots, plage, flares and other manifestations of magnetic 'activity' on the star . Here we report observations of a planet transiting AU Mic. The transiting planet, AU Mic b, has an orbital period of 8.46 days, an orbital distance of 0.07 astronomical units, a radius of 0.4 Jupiter radii, and a mass of less than 0.18 Jupiter masses at 3σ confidence. Our observations of a planet co-existing with a debris disk offer the opportunity to test the predictions of current models of planet formation and evolution.

Download/Website: `https://arxiv.org/abs/2006.13248`

Contact: `pplavcha@gmu.edu`

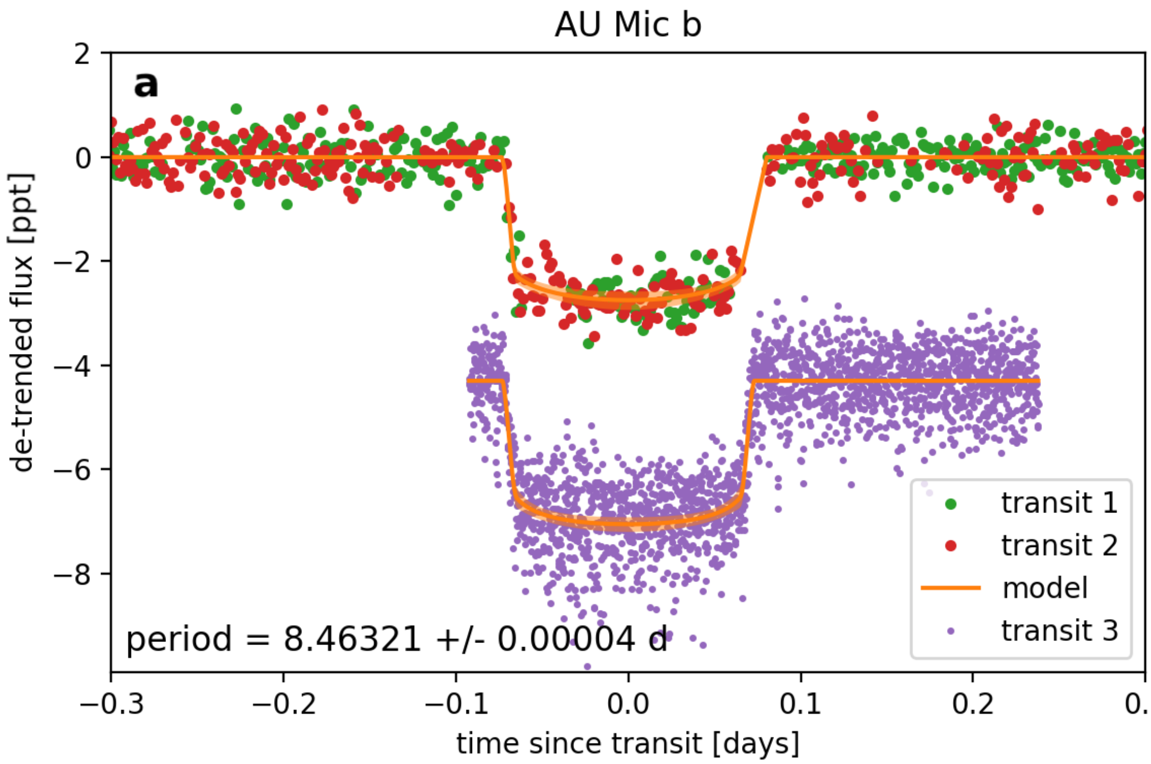

Figure 9: Light curves of the transits of AU Mic b. Data points show light curves from TESS in visible light (green and red filled circles for transits 1 and 2, respectively) and from Spitzer IRAC11 at 4.5 m wavelength (purple filled circles for transit 3). The data for transits of AU Mic b are shown with an arbitrary vertical shift applied for clarity; flux units are p.p.t. The transit model (orange curve) includes a photometric model that accounts for the stellar activity modeled with a Gaussian Process (GP), which is subtracted from the data before plotting. The frequent flares from the stellar surface are removed with an iterative sigma-clipping (see Methods). In particular, flares are observed during the egress of both the TESS transits of AU Mic b, and also just after the ingress of the second transit of AU Mic b. The presence of these flares in the light curve particularly affect our precision in measuring the transit duration and thus the mass/density of the host star AU Mic, and consequently the impact parameter and eccentricity of the orbit of AU Mic b. Model uncertainties shown as shaded regions are 1 confidence intervals. The uncertainty in the out-of-transit baseline is about 0.5 p.p.t. but is not shown for clarity.

Setting the Stage: Planet formation and Volatile Delivery

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[2] Instituto de Astrofísica - Pontificia Universidad Católica de Chile
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Space Science Reviews, in press (arXiv:2006.07127)

The diversity in mass and composition of planetary atmospheres stems from the different building blocks present in protoplanetary discs and from the different physical and chemical processes that these experience during the planetary assembly and evolution. This review aims to summarise, in a nutshell, the key concepts and processes operating during planet formation, with a focus on the delivery of volatiles to the inner regions of the planetary system.

Download/Website: `https://arxiv.org/abs/2006.07127`

Contact: `julia.venturini@issibern.ch`

3 Jobs and Positions

PhD Project on "Physical Properties of Transiting Planetary Systems"

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[2] Max Planck Institute for Astronomy, Königstuhl 17, D-69117, Heidelberg, Germany
[3] INAF – Astrophysical Observatory of Turin, via Osservatorio 20, I-10025, Pino Torinese, Italy

University of Rome "Tor Vergata", October 2020

Five PhD positions in astronomy, astrophysics, and space science are available at the University of Rome "Tor Vergata" in Italy, to work in various research groups within the Department of Physics. In particular, we invite applications for working on the detection of extrasolar planets and their subsequent characterization, which are among the most exciting fields of modern astrophysics. Observations of the diversity of (i) internal structures of both small and giant exoplanets, (ii) properties of their atmospheres, and (iii) global architectures of planetary systems continuously challenge our knowledge of planet formation, evolution, and interiors. By using observations taken with state-of-the-art instruments and space missions such as TESS, LBT, HARPS-N, ESPRESSO, GIARPS, this PhD project aims at furthering our understanding of key aspects of planet formation and evolution processes focusing on a two-fold, highly synergistic, multi-technique observational approach: I) the characterization of hot, warm, and temperate transiting small-size planets to determine their orbital (period, semi-major axis, eccentricity) and physical (radius, mass, density) parameters, and thus investigate their internal structure, formation, and evolution via a combination of high-sensitivity photometric and spectroscopic measurements; II) the study of the atmospheres of hot planets at high spectral resolution to determine their composition, investigate atmospheric dynamics, and possibly reconstruct their formation and migration history. This research project will be in collaboration with the Astrophysical Observatory of Turin. The deadline for applications is on July 23, 2020.

Download/Website:
`https://phd.uniroma1.it/web/ASTRONOMY-ASTROPHYSICS-AND-SPACE-SCIENCE_nD3486_EN.aspx`

Contact: `lmancini@roma2.infn.it, alessandro.sozzetti@inaf.it`

3 PhD positions in planetary science

Y.Alibert & W. Benz
[1] Theoretical Astrophysics and Planetary Science, University of Bern, Switzerland

Bern, Switzerland, Fall 2020

We are seeking qualified candidates to fill three 4-year PhD positions in exoplanet science in the research group of Yann Alibert and Willy Benz (University of Bern). The PhD positions are part of the TAPS (Theoretical Astrophysics and Planetary Science) group of the University of Bern and frequent interactions are foreseen with the Center for Space and Habitability (University of Bern) researchers as well as with the National Center of Competence in Research PlanetS. PlanetS is a large national framework in Switzerland that unifies Swiss efforts in planetary and exoplanetary science across Bern, Geneva, and Zurich. Additional informations on our research group, the CSH and the NCCR can be found using the links provided below.

The ideal candidates have a bachelor's and master's degree in physics, astrophysics, planetary sciences or equivalent. They should be enthusiastic, tenacious, communicative, and willing to integrate into the teams in Bern (TAPS and CSH) and more generally in the Swiss landscape of PlanetS. The research work consists of a combination of numerical modeling (developing and running computer codes mostly in Fortran and python) and analytical work.

The scientific goals of the three PhD projects span a variety of projects in planetary science and in particular aim at:

- studying the correlation between the internal structure of exoplanets orbiting the same star, using CHEOPS observations. CHEOPS is an ESA satellite successfully launched in December 2019 (P.I. Willy Benz). For this project, the PhD candidate will be working in close collaboration with members of the CHEOPS science team.
- developing population synthesis models (known as the Bern model, see e.g. Alibert et al. 2005, 2013, Emsenhuber et al., submitted) to improve the description of the disk of planetesimals. This project will involve building up on existing models of planetesimal growth and dynamical evolution, and studying the effect of these processes on the population of exoplanets.
- studying the formation of planetary systems taking into account the accretion of pebbles and planetesimals, following the scenario proposed in Alibert et al. (2018, Nature Astronomy). This project will involve combining existing models of planet formation by pebble accretion (Brügger et al. 2018, 2020) and by planetesimal accretion (e.g. Alibert et al. 2013, Emsenhuber et al., submitted) in a single framework.

The formal employment will be for 4 years at the University of Bern. There will be a standard first year of probation. The annual salary is set by a predetermined matrix from the Swiss National Fund. Child allowance and maternity/paternity leave are offered. There are ample funds for travel, publications and computers. The successful candidate will participate in group meetings, journal clubs, research discussions, attend seminars and colloquia, interact with research visitors, travel to conferences, etc., both in Bern and in the NCCR PlanetS. The start date is expected to be fall 2020, and is negotiable.

To apply, please send a motivation letter including a personal statement (maximum 1 page), a CV (maximum 2 pages), a list of publications (if applicable), transcripts of your grades of courses obtained during your bachelor's and master's degrees, and a cover letter (1 page). The entire application should be submitted as a single pdf file to Yann Alibert (alibert@space.unibe.ch). It is the responsibility of the applicant to ensure that furthermore, 2-3 letters of recommendation are sent directly by the letter writers to Y. Alibert, by the application deadline of 30. July 2020.

The university of Bern is an equal opportunity employer, and we specially encourage the application of female researchers.

Download/Website: `http://nccr-planets.ch/research/phase2/domain2/project5/`

Download/Website: http://www.csh.unibe.ch
Download/Website: http://nccr-planets.ch
Contact: alibert@space.unibe.ch

4 Conferences

AGU session 'Accretion and differentiation of rocky planets: perspectives from geophysics, geochemistry, & astronomy'

Session conveners: Laura K. Schaefer[1], Rebecca A. Fischer[2], Tim Lichtenberg[3]
[1] Department of Geological Sciences, Stanford University, USA
[2] Department of Earth and Planetary Sciences, Harvard University, USA
[3] Atmospheric, Oceanic and Planetary Physics, University of Oxford, UK

San Francisco/virtual, 7–11 December 2020

We invite contributions to the session *Accretion and differentiation of rocky planets: perspectives from geophysics, geochemistry, & astronomy* at the AGU Fall Meeting from 7-11 December 2020, which will be at least partially virtual this year. We welcome contributions from all disciplines to advance the understanding of the formation and differentiation of rocky planets including, but not limited to, geochemistry, geophysics, cosmochemistry, planetary science, and astronomy. The AGU abstract portal is already open and the *deadline for submissions is Wednesday, 29 July*.

Session description: The simultaneous advent of high-resolution observations of planet-forming disks and enhanced prospects to characterize rocky exoplanets highlights the need for increasing interdisciplinary collaboration to understand the birth and life cycle of terrestrial worlds in our solar system and exoplanetary systems. Therefore, this session welcomes abstracts that address new observational, theoretical, and laboratory constraints on the formation of Earth and other terrestrial planets in the solar system as well as in exoplanetary systems. This includes modeling, observational, and experimental studies related to properties of planetesimals, impacts, pebble accretion, core segregation, moon formation, crust-mantle differentiation, atmosphere formation, or other major geophysical/geochemical/astronomical processes that fundamentally shape the evolution of rocky planetesimals and planets during their formation and early evolution.

Invited Speakers: Jennifer B. Bergner (University of Chicago), Bethany A. Chidester (UC Davis)
Sections: Study of Earth's Deep Interior (primary), Mineral and Rock Physics, Planetary Science
Themes: Origin and evolution, Planetary atmospheres, Planetary interiors, Planetary Geochemistry

Download/Website: `https://agu.confex.com/agu/fm20/prelim.cgi/Session/101356`

Threats from the surroundings: an e-workshop on the importance of environment for the evolution of protoplanetary discs and formation of planets

SOC: Carlo F. Manara[1], Monika Petr-Gotzens[1], Megan Ansdell[2], Thomas Haworth[3], Tim Lichtenberg[4]

[1] European Southern Observatory, Garching, DE
[2] NASA Headquarters, Washington DC, USA
[3] School of Physics and Astronomy, Queen Mary University of London, London, UK
[4] Atmospheric, Oceanic and Planetary Physics, University of Oxford, Oxford, UK

virtual, 10–12 November 2020

Scientific Rationale: Growing evidence indicates that protoplanetary discs (and by extension, forming planets) are significantly affected by the environment in which they form. In particular, the presence of massive stars and the dynamical history of clusters and associations impacts the evolution of discs and can lead to photoevaporation, truncation, and chemical enrichment. We therefore need to move beyond the picture of planet-forming discs as isolated systems. This e-workshop aims to bring together the community to share our current understanding of the different ways that the environment shapes disc evolution and planet formation, to shape the future direction of research in this regard through new ideas and collaborations.

Invited Speakers: Megan Reiter (UK Astronomy Technology Centre), Rachel Akeson (IPAC Caltech), Nelson Ndugu (Mbarara University Of Science And Technology), Andrew Winter (MPIA Heidelberg), J. Serena Kim (University of Arizona), Gavin Coleman (Queen Mary University of London), Maria Lugaro (Konkoly Observatory), Viviana Guzman (Pontificia Universidad Catolica de Chile), Allona Vazan (Hebrew University of Jerusalem/Open University of Israel)

Discussion Leaders: Giovanni Rosotti (Leiden University), Susanne Pfalzner (Max Planck Institute for Radioastronomy, Bonn), Stefano Facchini (ESO Garching), Christoph Mordasini (University of Bern), Joanna Drazkowska (USM Munich), Cathie Clarke (IoA Cambridge)

The meeting will be fully online (see *Format* on the conference website). In order to facilitate the discussion, the number of talking participants will be limited to about 60 persons, selected by the SOC based on scientific relevance to the topic, considering all career stages and reflecting diversity. All other participants will be able to observe, ask questions and comment via chat.

Abstract deadline: 15 September 2020
Programme release: 13 October 2020
Conference website: https://www.eso.org/sci/meetings/2020/tfts2020.html
Contact: `tfts2020@eso.org`

2020 Sagan Summer Virtual Workshop: Extreme Precision Radial Velocity

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

July 20-24, 2020,

Registration is still open for the first virtual Sagan Summer Workshop happening next week! This workshop will provide an introduction to the basics of the PRV technique, a summary of planet demographics from PRV surveys, and an evaluation of the importance of planet masses and orbits to imaging missions and of the challenges in advancing PRV precision by the factor of 10-30 needed to detect terrestrial analogs in orbit around nearby solar type stars.

The workshop will take place via Zoom Webinar from July 20-24, with most of the presentations on July 20-23, earlier in the day Pacific time. The agenda for the virtual meeting is available on the workshop website with links to many pre-recorded talks. We will also using Jupyter notebooks for the modified hands-on sessions and will host virtual ”lunch with the speakers.” Please register to get the complete meeting information.

As in previous years, we will record all talks for posting on the Sagan Summer Workshop YouTube channel: `https://www.youtube.com/channel/UCytsRiMvdj5VTZWfj6dBadQ/`.

Download/Website: `http://nexsci.caltech.edu/workshop/2020`

Contact: `sagan_workshop@ipac.caltech.edu`

Exoplanet Demographics I Conference

J. Christiansen
NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Pasadena, CA, November 9-12, 2020

Registration is available for the first Exoplanet Demographics conference, hosted by the NASA Exoplanet Science Institute. It will be held November 9-12, 2020, and there is no registration fee. The abstract deadline has passed for the meeting however registration is still open. The full agenda will be published in early August.

In light of the global health situation, we have decided to hold this conference as a fully virtual meeting with more details coming in the next few months.

This conference will bring together community members working both theoretically and observationally on understanding exoplanet demographics focusing on the following themes.

- What are the current limitations on our ability to discern the true underlying planet population from the observed distribution?
- What can the size and/or mass distribution of exoplanets teach us about the dominant planet formation, migration, and evolution pathways?
- What properties of stars affect the types of planets that form, and how can we use the properties of stars to study planet formation?
- What can we learn from planetary systems or disks around stellar remnants and substellar objects?
- How will upcoming missions advance our understanding of exoplanet demographics?

Download/Website: `http://nexsci.caltech.edu/workshop/2020`
Contact: `exodem@ipac.caltech.edu`

5 Exoplanet Archive Updates

June 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, July 14, 2020

Note: All new planetary data can be viewed in the Confirmed Planets (`http://bit.ly/2MqFnub`), Composite Planet Data (`http://bit.ly/2l84Qw9`), and Extended Planet Data (`http://bit.ly/2NLy1Ci`) tables. Data can also be found in the Microlensing Data Table (`http://bit.ly/2JQr180`) or Direct Imaging Table (`http://bit.ly/3ayD185`).

Also, the new alpha release of the Planetary Systems table allows you to browse ALL the planet and host star solutions (`http://bit.ly/2Pt0tM1`), and clicking on a planet name in the table takes you to the planet's redesigned System Overview page.

June 24, 2020

First AU Microscopii Confirmed Planet Added

The nearby AU Microscopii system, long suspected to host planets because of its young age and surrounding debris disk, has had its first planet confirmed based on data from NASA's TESS and NASA's Spitzer Space Telescope. Read the discovery paper by Plavchan et al. (`https://go.nature.com/2VUv5ch`) and the media advisory (`https://go.nasa.gov/3gBjHtC`), and view our new System Overview page (`https://bit.ly/2O5BblU`). NASA's Goddard Space Flight Center has also posted a YouTube video (`https://bit.ly/38zyhz7`) illustrating how the planet was detected.

NASA's Exoplanet Exploration Program has also commemorated this exciting news by adding an AU Mic b poster to the Galaxy of Horrors series (`https://go.nasa.gov/2O5o3Nm`). Given the Neptune-sized exoplanet is regularly subjected to X-ray blasts from eruptive and powerful stellar flares, AU Mic b is likely not habitable—at least by life as we know it.

Fun Fact: This discovery was led Dr. Peter Plavchan, who was a staff scientist at the NASA Exoplanet Archive in its early years. Congratulations, Peter!

New Microlensing and Directly Imaged Planet Data

There are also six additional new planets this week, all detected by microlensing: OGLE-2018-BLG-0677L b, OGLE-2015-BLG-1771L b, OGLE-2018-BLG-1700L b, KMT-2018-BLG-0029L b, KMT-2018-BLG-1292L b, and OGLE-2012-BLG-0838L b. Their solutions have been added to the Microlensing Table.

Also, the following planets have additional parameter sets in the Direct Imaging Table: PDS 70 b, GSC 06214-00210 b, HIP 78530 b, 1RXS J160929.1-210524 b, Oph 11 b, and USco CTIO 108 b.

June 9, 2020

We have a new data set contributed by the ASTERIA mission, which was recently in the news for being the smallest telescope to detect an exoplanet.

The new data set, composed of light curves and FITS images, can be downloaded from our ASTERIA Summary page (`https://bit.ly/3e5YmXF`). You can also read JPL's news release about the cubesat's exoplanet detection (`https://go.nasa.gov/38xlvkK`). The planetary parameters for 55 Cnc e are currently being reviewed and will be added to the archive in a future update.

June 4, 2020

We have six new planets this week, including four TESS planets—one of which is the the telescope's first circumbinary planet. There is also a new Kepler planet.

The new planets are: Kepler-88 d, LTT 3780 b & c (TESS), TOI-1235 b (TESS), TOI-1338 b (first TESS circumbinary), and HD 81817 b. We've also added new parameter sets for all TRAPPIST-1 planets.

Also, check out the new emission spectra for WASP-121 b and direct imaging data for ROXs 12 b and ROXs 42 B b.

Download/Website: `https://exoplanetarchive.ipac.caltech.edu`
Contact: `mharbut@caltech.edu`

6 Announcements

Special 2020B Call for Proposals for MINERVA-Australis

D. Ciardi
NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Due July 16, 2020 4 pm PDT,

The NASA Exoplanet Science Institute is announcing a special Call for Proposals to use the MINERVA-Australis facility as part of the NASA/NSF Exoplanet Observational Research Program (NN-EXPLORE). As part of the NN-EXPLORE program, NASA has entered into a partnership with the MINERVA-Australis consortium. MINERVA-Australis is a dedicated exoplanet observatory operated by the University of Southern Queensland (USQ) in Queensland, Australia. The MINERVA-Australis facility is suitable for observation programs requiring precision radial velocities such as individual measurements to constrain orbits and masses, RM-effect, or Doppler tomography, precision photometric observations such as transit observations, and spectroscopic stellar characterization.

NASA has made available to astronomers based at US institutions 285 hours on the Minerva-Australis facility for the 2020B semester. The time is intended for exoplanet research, primarily of TESS targets but other exoplanet science will be considered. Proposed observing time will be allocated in hours and must include all science and calibration observations necessary to accomplish the science.

Please read the Special Call for Proposals for complete guidelines and submission information.

Download/Website: `https://nexsci.caltech.edu/missions/Minerva/index.shtml`
Contact: `nnexplore@ipac.caltech.edu`

Exoplanet Virtual Talk Calendar: Submissions Welcome

Calen B. Henderson
Caltech/IPAC-NExScI, 1200 East California Avenue, Mail Code: 100-22, Pasadena, CA, USA 91125

NExScI, Jul 2020

Dear Fellow Exoplaneteers,

In order to continue to foster the professional and social atmosphere that makes our community so vibrant during this unprecedented time, we at the NASA Exoplanet Science Institute (NExScI) have begun soliciting contributions to our Exoplanet Virtual Talk Calendar. This portal contains user-submitted details regarding exoplanet talks, including colloquia, seminars, and meetings, that are able to be shared and viewed online live, or that have been recorded. If you are interested in contributing presentations to our calendar, please use the Google form provided in link (1) below. For everyone interested in staying tuned to the exciting science that is still happening around the globe, please check out our public website, in link (2), and/or add the corresponding Google calendar, in link (3).

Thank you to those who have already submitted entries, and take care!

Calen B. Henderson, on behalf of NExScI

Links:

1. **Submission Page:** `https://bit.ly/2ZXGSI5`
2. **Public Calendar Website:** `https://bit.ly/3iRqWjd`
3. **Google Calendar:** `https://bit.ly/2Ojxmt6`

Contact: `chenderson@ipac.caltech.edu`

7 As seen on astro-ph

astro-ph/2006.00220: **Near-Infrared Transit Photometry of Extra-Solar Planet HAT-P-54b** by *Haruka Tabata, Yoichi Itoh*

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