ExoPlanet News
An Electronic Newsletter

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1 Editorial

Welcome to Edition 137 of the ExoPlanet News!

In this November issue you will find abstracts of scientific papers, conference announcements/updates, Exoplanet Archive updates, job postings, a proposal call, and an overview of exoplanet-related articles on astro-ph.

We remind you of some guidelines for using our templates. If you follow these guidelines, you will make our job easier:

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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 15 December 2020.

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

2 Abstracts of refereed papers

Transport, destruction and growth of pebbles in the gas envelope of a protoplanet

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The Astrophysical Journal, in press (https://arxiv.org/abs/2009.07837)

We analyse the size evolution of pebbles accreted into the gaseous envelope of a protoplanet growing in a protoplanetary disc, taking into account collisions driven by the relative sedimentation speed as well as the convective gas motion. Using a simple estimate of the convective gas speed based on the pebble accretion luminosity, we find that the speed of the convective gas is higher than the sedimentation speed for all particles smaller than 1 mm. This implies that both pebbles and pebble fragments are strongly affected by the convective gas motion and will be transported by large-scale convection cells both towards and away from the protoplanet's surface. We present a simple scheme for evolving the characteristic size of the pebbles, taking into account the effects of erosion, mass transfer and fragmentation. Including the downwards motion of convective cells for the transport of pebbles with an initial radius of 1 millimeter, we find pebble sizes between 100 microns and 1 millimeter near the surface of the protoplanet. These sizes are generally amenable to accretion at the base of the convection flow. Small protoplanets far from the star ($>$ 30 AU) nevertheless erode their pebbles to sizes below 10 microns; future hydrodynamical simulations will be needed to determine whether such small fragments can detach from the convection flow and become accreted by the protoplanet.

Download/Website: `https://arxiv.org/abs/2009.07837`

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Coupling thermal evolution of planets and hydrodynamic atmospheric escape in MESA

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Monthly Notices of the Royal Astronomical Society, published (2020MNRAS.tmp.2639K)

The long-term evolution of hydrogen-dominated atmospheres of sub-Neptune-like planets is mostly controlled to by two factors: a slow dissipation of the gravitational energy acquired at the formation (known as thermal evolution) and atmospheric mass loss. Here, we use MESA to self-consistently couple the thermal evolution model of lower atmospheres with a realistic hydrodynamical atmospheric evaporation prescription. To outline the main features of such coupling, we simulate planets with a range of core masses (5-20) and initial atmospheric mass fractions (0.5-30%), orbiting a solar-like star at 0.1 au. In addition to our computed evolutionary tracks, we also study the stability of planetary atmospheres, showing that the atmospheres of light planets can be completely removed within 1 Gyr, and that compact atmospheres have a better survival rate. From a detailed comparison between our results and the output of the previous-generation models, we show that coupling between thermal evolution and atmospheric evaporation considerably affects the thermal state of atmospheres for low-mass planets and, consequently, changes the relationship between atmospheric mass fraction and planetary parameters. We, therefore, conclude that self-consistent consideration of the thermal evolution and atmospheric evaporation is of crucial importance for evolutionary modeling and a better characterization of planetary atmospheres. From our simulations, we derive an analytical expression between planetary radius and atmospheric mass fraction at different ages. In particular, we find that, for a given observed planetary radius, the predicted atmospheric mass fraction changes as $age^{0.11}$.

Download/Website: https://doi.org/10.5281/zenodo.4022393

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Earth as an Exoplanet: I. Time variable thermal emission using spatially resolved MODIS data

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The Astrophysical Journal, in press (arXiv:2010.02589)

For the time being, Earth remains the best and only example of a habitable (and inhabited) world. Therefore, it is important to explore and understand the full range of spectral signatures and variability of Earth in order to inform the design of future instruments and missions, and understand their diagnostic power as well as potential limitations. In this work we use Earth observation data collected by the MODIS instrument aboard the Aqua satellite. The complete data set comprises 15 years of thermal emission observations in the 3.66-14.40 microns range for five different locations on Earth (Amazon Rainforest, Antarctica, Arctic, Indian Ocean and the Sahara Desert). We then determine flux levels and variations as a function of wavelength and surface type (i.e. climate zone and surface thermal properties) and investigate whether periodic signals indicating Earth's tilted rotation axis can be detected. Our findings suggest that (1) viewing geometry plays an important role when thermal emission data is analyzed as Earth's spectrum varies by a factor of three and more depending on the dominant surface type underneath; (2) typically strong absorption bands from carbon dioxide (15 microns) and ozone (9.65 microns) are significantly less pronounced and partially absent in data from the polar regions implying that estimating correct abundance levels for these molecules might be challenging in these cases; (3) the time-resolved thermal emission spectrum encodes information about seasons/planetary obliquity, but the significance depends on the viewing geometry and spectral band considered.

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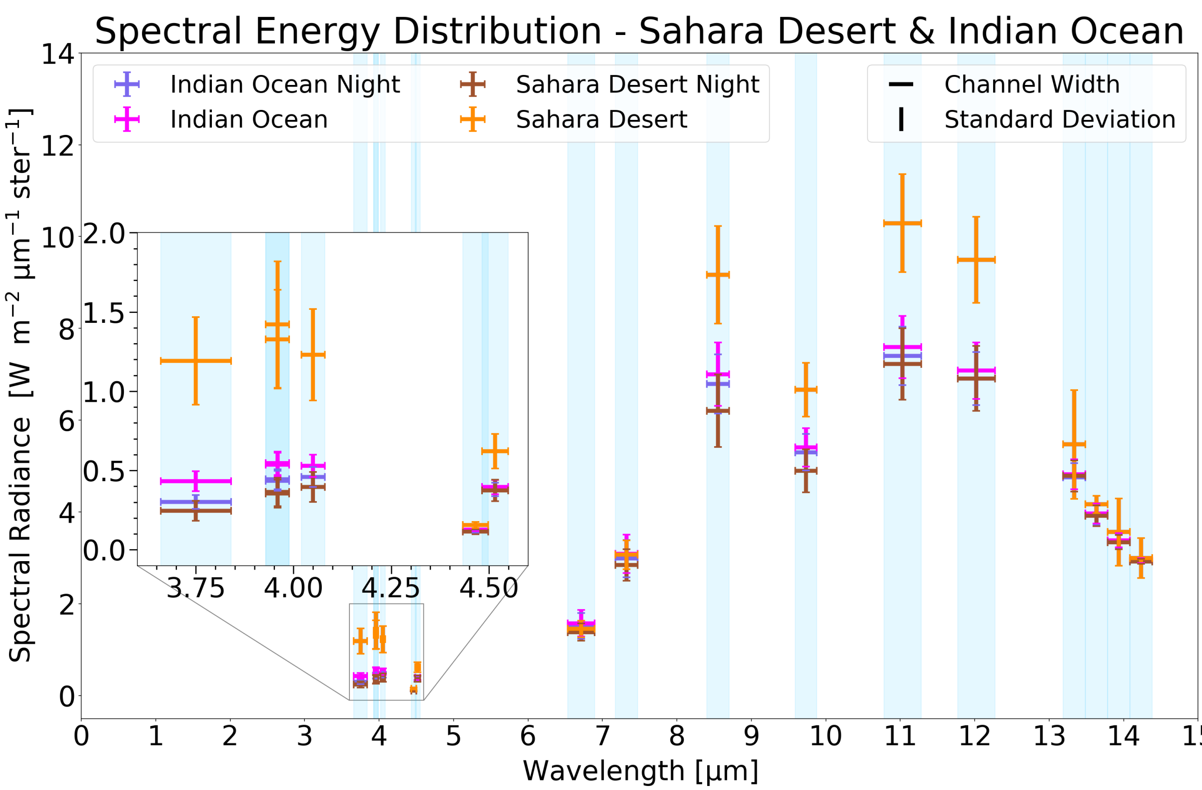

Figure 1: Spectral energy distributions of the Sahara Desert and the Indian Ocean. Their night measurements are shown in sienna and dark green, respectively. The horizontal lines in x-direction correspond to the average radiance measured in every channel over the 15-year observation period and the error bars in y-direction to the standard deviation. The blue shadings indicate the bandwidth of each channel.

Dust trapping around Lagrangian points in protoplanetary disks

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Astronomy & Astrophysics, in press (arxiv:2009.10768)

Trojans are defined as objects that share the orbit of a planet at the stable Lagrangian points L_4 and L_5. In the Solar System, these bodies show a broad size distribution ranging from micrometer(μm) to centimeter(cm) particles (Trojan dust) and up to kilometer (km) rocks (Trojan asteroids). It has also been theorized that earth-like Trojans may be formed in extra-solar systems. The Trojan formation mechanism is still under debate, especially theories involving the effects of dissipative forces from a viscous gaseous environment. We perform hydro-simulations to follow the evolution of a protoplanetary disk with an embedded 1–10 Jupiter-mass planet. On top of the gaseous disk, we set a distribution of μm–cm dust particles interacting with the gas. This allows us to follow dust dynamics as solids get trapped around the Lagrangian points of the planet. We show that large vortices generated at the Lagrangian points are responsible for dust accumulation, where the leading Lagrangian point L_4 traps a larger amount of submillimeter (submm) particles than the trailing L_5, which traps mostly mm–cm particles. However, the total bulk mass, with typical values of $\sim M_{\rm moon}$, is more significant in L_5 than in L_4, in contrast to what is observed in the current Solar System a few gigayears later. Furthermore, the migration of the planet does not seem to affect the reported asymmetry between L_4 and L_5. The main initial mass reservoir for Trojan dust lies in the same co-orbital path of the planet, while dust migrating from the outer region (due to drag) contributes very little to its final mass, imposing strong mass constraints for the in situ formation scenario of Trojan planets.

Download/Website: `https://arxiv.org/abs/2009.10768`

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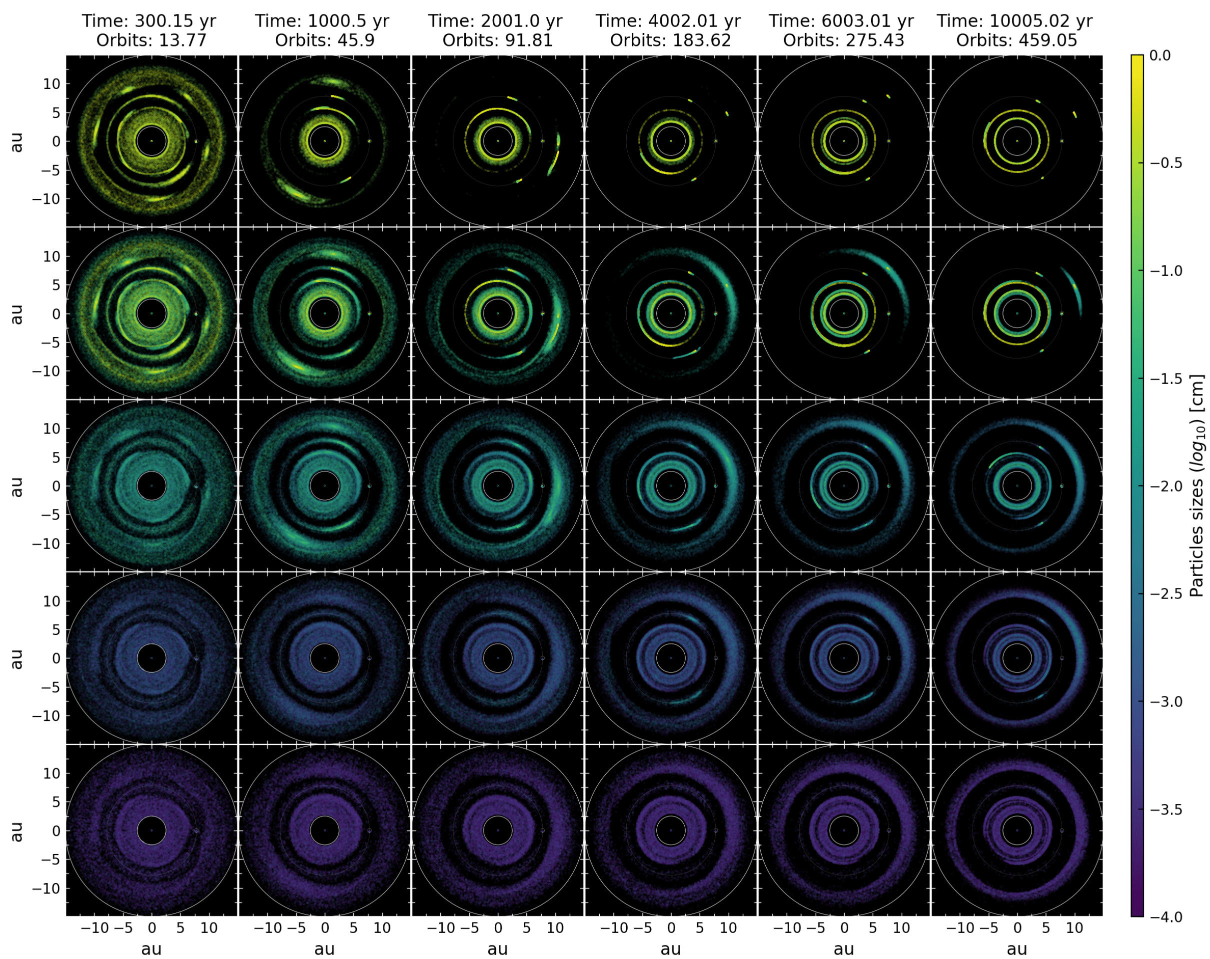

Figure 2: Evolution in time of the dust as a function of particle sizes, ranging from μm to cm. The panels have been rotated to always keep the planet at the same location x = 7.8 au, y = 0.

The *EXPRES* Stellar Signals Project I. Description of Data

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Research Notes of the AAS, published (2020RNAAS.4.156Z)

The *EXPRES* Stellar Signals Project is providing sets of high-fidelity, spectroscopic and photometric observations to enable direct comparisons of various approaches for disentangling stellar signals and true radial velocities (RV). We will provide all *EXPRES* RVs, meta data, and activity indicators as well as high-precision photometric data from the Fairborn Automatic Photoelectric Telescopes (*APTs*) for HD 101501, HD 34411, HD 217014, and HD 10700. Intrinsic stellar variability and the resulting apparent RVs are widely believed to dominate the error budget for extremely-precise radial-velocity (EPRV) measurements. Several new methods to disentangle photospheric velocities from Keplerian velocities are being developed throughout the EPRV community. In addition to releasing data sets for testing these methods, the *EXPRES* Stellar Signals Project will publish a summary of the current state of the field circa 2020 to guide next steps towards mitigating photospheric velocities in EPRV data. More information can be found on http://exoplanets.astro.yale.edu/science/activity.php.

Download/Website: `http://exoplanets.astro.yale.edu/science/activity.php`

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Excalibur: A Non-Parametric, Hierarchical Wavelength-Calibration Method for a Precision Spectrograph

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In Review AAS, published (arXiv:2010.13786)

Excalibur is a non-parametric, hierarchical framework for precision wavelength-calibration of spectrographs. It is designed with the needs of extreme-precision radial velocity (EPRV) in mind, which require that instruments be calibrated or stabilized to better than 10^{-4} pixels. Instruments vary along only a few dominant degrees of freedom, especially EPRV instruments, which feature highly stabilized optical systems and detectors. *Excalibur* takes advantage of this property by using all calibration data to construct a low-dimensional representation of all accessible calibration states for an instrument. *Excalibur* also takes advantage of laser-frequency combs or etalons, which generate a dense set of stable calibration points. This density permits the use of a non-parametric wavelength solution that can adapt to any instrument or detector oddities better than any parametric model, such as a polynomial. We demonstrate the success of this method with data from the *EXtreme PREcision Spectrograph* (*EXPRES*), which includes a laser frequency comb. When wavelengths are assigned to laser comb lines using *excalibur*, the RMS of the residuals is about five times lower than wavelengths assigned using polynomial fits to individual exposures. In a typical test case, radial-velocity measurements of HD 34411 showed a reduction in RMS scatter over a 10-month time baseline from 1.22 to $1.05\,m\,s^{-1}$.

Download/Website: `https://arxiv.org/abs/2010.13786`

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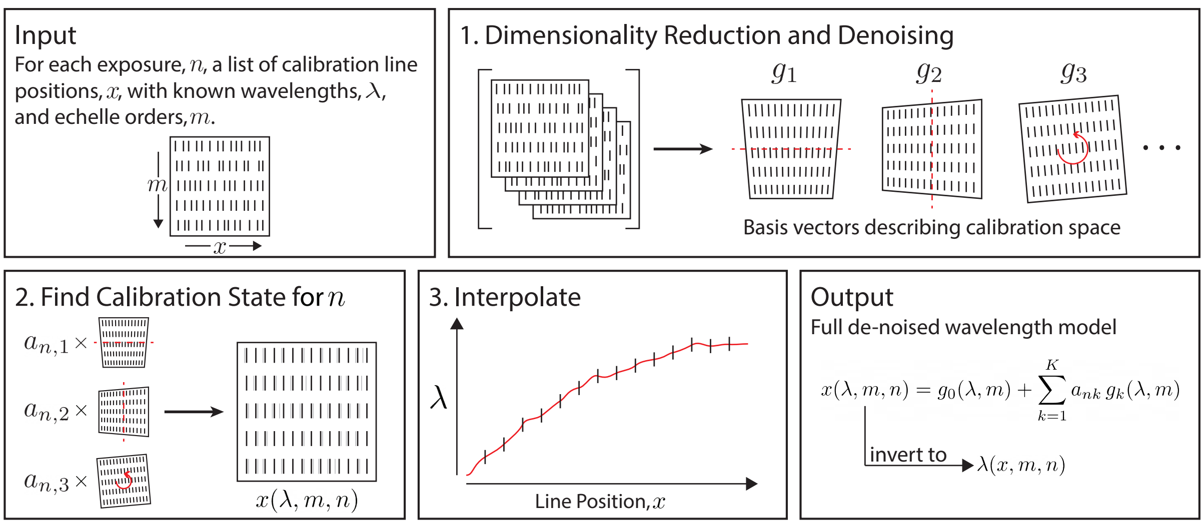

Figure 3: A cartoon representation of the *excalibur* method. We exaggerate variations in measured line position, changes in calibration space, and interpolation deviations for clarity. In step one, dimensionality reduction and denoising, the complete set of line positions for all exposures is analyzed to return a set of K basis vectors, g_n, which represent different ways the spectrograph calibration changes. These basis vectors span the K-dimensional calibration space of the spectrograph, which includes all possible wavelength solutions. In step two, the amplitude of each basis vector, $a_{n,k}$, is interpolated to return the calibration state for a specific science exposure, returned as a set of de-noised calibration lines. The assigned wavelengths of these de-noised line positions are then interpolated onto other pixels in step three to construct a full wavelength model that returns wavelength as a function of detector position x and echelle order m.

HADES RV programme with HARPS-N at TNG XII. The abundance signature of M dwarf stars with planets

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Astronomy & Astrophysics, in press/arXiv:2010.14867

Most of our current knowledge on planet formation is still based on the analysis of main-sequence, solar-type stars. Con- versely, detailed chemical studies of large samples of M-dwarf planet hosts are still missing. We aim to test whether the correlations between the metallicity, individual chemical abundances, and mass of the star and the presence of different type of planets found for FGK stars still holds for the less massive M dwarf stars. Methods to determine in a consistent way stellar abundances of M dwarfs from high-resolution optical spectra are still missing. The present work is a first attempt to fill this gap.

We analyse in a coherent and homogeneous way a large sample of M dwarfs with and without known planetary companions. We develop for the first time a methodology to determine stellar abundances of elements others than iron for M dwarf stars from high- resolution, optical spectra. Our methodology is based on the use of principal component analysis and sparse Bayesian's methods. We made use of a set of M dwarfs orbiting around an FGK primary with known abundances to train our methods. We applied our methods to derive stellar metalliticies and abundances of a large sample of M dwarfs observed within the framework of current radial velocity surveys. We then used a sample of nearby FGK stars to cross-validate our technique by comparing the derived abundance trends in the M dwarf sample with those found on the FGK stars.

The metallicity distribution of the different subsamples shows that M dwarfs hosting giant planets show a planet-metallicity correlation as well as a correlation with the stellar mass. M dwarfs hosting low-mass planets do not seem to follow the planet- metallicity correlation. We also found that the frequency of low-mass planets does not depend on the mass of the stellar host. These results seem in agreement with previous works. However, we note that for giant planet hosts our metallicities predict a weaker planet metallicity correlation but a stronger mass-dependency than photometric values. We show, for the first time, that there seems to be no differences in the abundance distribution of elements different from iron between M dwarfs with and without known planets.

Our data shows that low-mass stars with planets follow the same metallicity, mass, and abundance trends than their FGK counterparts, which are usually explained within the framework of core-accretion models.

Download/Website: `https://arxiv.org/abs/2010.14867`

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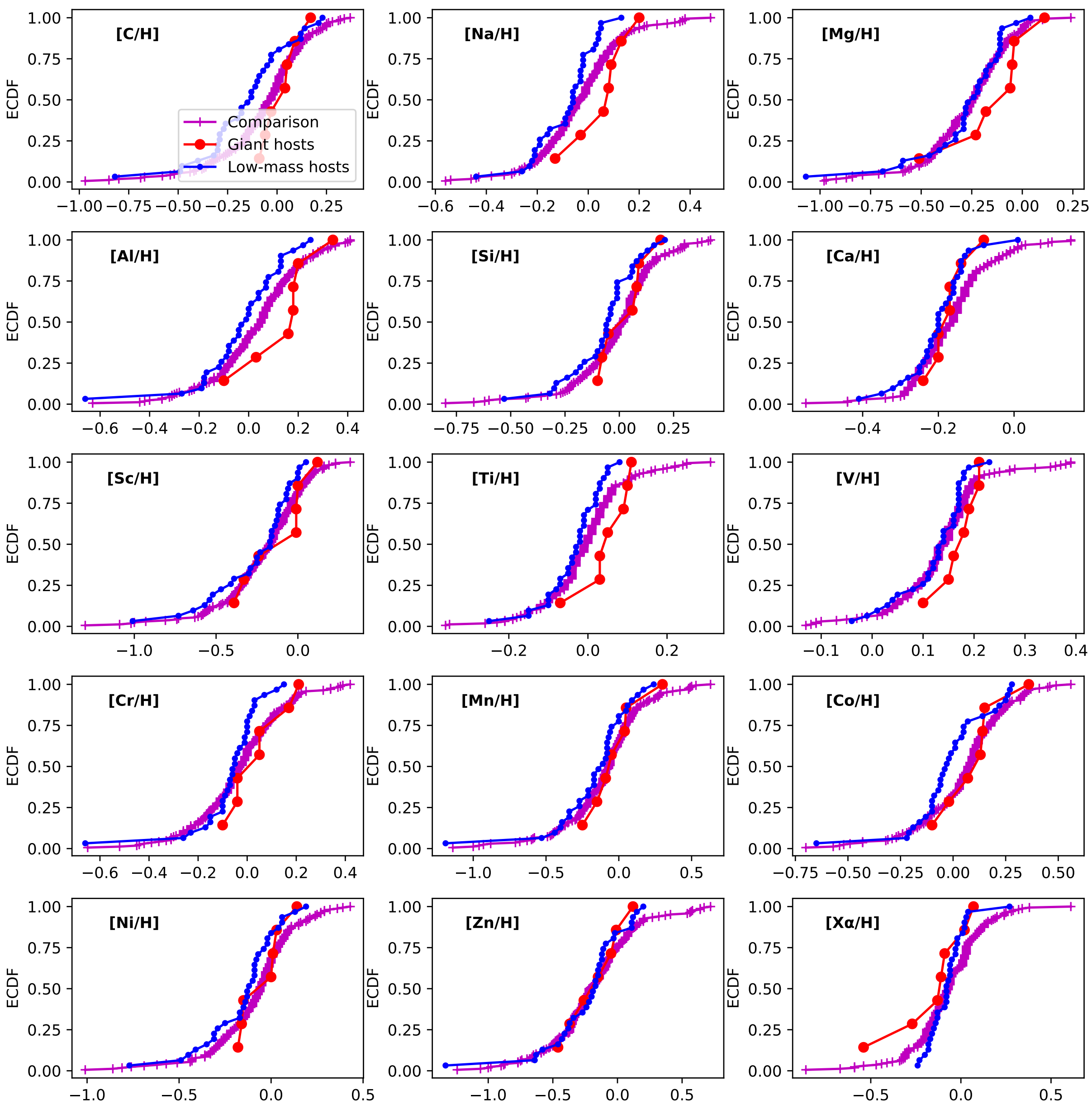

Figure 4: [X/H] cumulative fraction of low-mass hosts (blue), gas-giant hosts (red), and comparison M dwarfs (purple).

Search for giant planets around seven white dwarfs in the Hyades cluster with the Hubble Space Telescope

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:2011.03562)

Only a small number of exoplanets has been identified in stellar cluster environments. We initiated a high angular resolution direct imaging search using the Hubble Space Telescope (HST) and its NICMOS instrument for self-luminous giant planets in orbit around seven white dwarfs in the 625 Myr old nearby (45 pc) Hyades cluster. The observations were obtained with NIC1 in the F110W and F160W filters, and encompass two HST roll angles to facilitate angular differential imaging. The difference images were searched for companion candidates, and radially averaged contrast curves were computed. Though we achieve the lowest mass detection limits yet for angular separations $>$0.5 arcsec, no planetary mass companion to any of the seven white dwarfs, whose initial main sequence masses were $>$2.8 Msun, was found. Comparison with evolutionary models yields detection limits of 5 to 7 Jupiter masses according to one model, and between 9 and 12 Mjup according to another model, at physical separations corresponding to initial semimajor axis of $>$5 to 8 A.U. (i.e., before the mass loss events associated with the red and asymptotic giant branch phase of the host star). The study provides further evidence that initially dense cluster environments, which included O- and B-type stars, might not be highly conducive to the formation of massive circumstellar disks, and their transformation into giant planets (with m$>$6 Mjup and a$>$6 A.U.). This is in agreement with radial velocity surveys for exoplanets around G- and K-type giants, which did not find any planets around stars more massive than about 3 Msun.

Download/Website: `https://doi.org/10.1093/mnras/staa3422`

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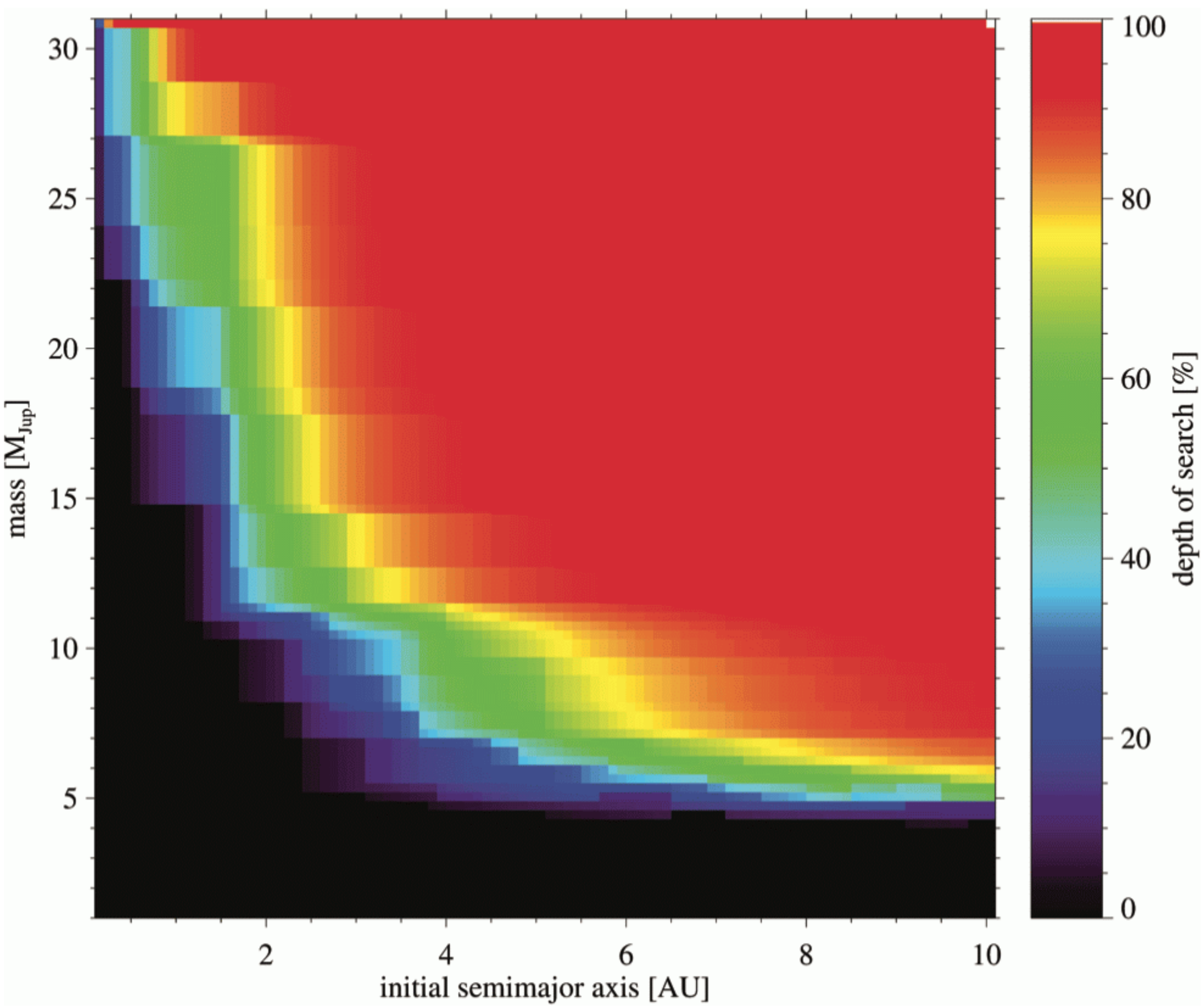

Figure 5: Depth of search, indicating the completeness of the survey of the seven white dwarfs with respect to companion mass and semimajor axis for an assumed typical orbital eccentricity of 0.35. The green colour marks a detection probability of ≈50%, while the red colour corresponds to ≥90%.

Search for planets in hot Jupiter systems with multi-sector TESS photometry. I. No companions in planetary systems KELT-18, KELT-23, KELT-24, Qatar-8, WASP-62, WASP-100, WASP-119, and WASP-126

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Acta Astronomica, in press (arXiv:2010.11977)

Origins of giant planets on tight orbits, so called hot Jupiters, are a long-lasting question in the planetary formation and evolution theory. The answer seems to be hidden in architectures of those systems that remain only partially understood. Using multi-sector time-series photometry from the Transiting Exoplanet Survey Satellite, we searched for additional planets in the KELT-18, KELT-23, KELT-24, Qatar-8, WASP-62, WASP-100, WASP-119, and WASP-126 planetary systems using both the transit technique and transit timing method. Our homogenous analysis has eliminated the presence of transiting companions down to the terrestrial-size regime in the KELT-23 and WASP-62 systems, and down to mini-Neptunes or Neptunes in the remaining ones. Transit timing analysis has revealed no sign of either long-term trends or periodic perturbations for all the studied hot Jupiters, including the WASP-126 b for which deviations from a Keplerian model were claimed in the literature. The loneliness of the planets of the sample speaks in favour of the high-eccentricity migration mechanism that probably brought them to their tight orbits observed nowadays. As a byproduct of our study, the transit light curve parameters were redetermined with a substantial improvement of the precision for 6 systems. For KELT-24 b, a joint analysis allowed us to place a tighter constraint on its orbital eccentricity.

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Effects of the stellar wind on the Ly-α transit

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Monthly Notices of the Royal Astronomical Society, in press (2020MNRAS.tmp.3245C)

We use 3D hydrodynamics simulations followed by synthetic line profile calculations to examine the effect increasing the strength of the stellar wind has on observed Ly-α transits of a Hot Jupiter (HJ) and a Warm Neptune (WN). We find that increasing the stellar wind mass-loss rate from 0 (no wind) to 100 times the solar mass-loss rate value causes reduced atmospheric escape in both planets (a reduction of 65% and 40% for the HJ and WN, respectively, compared to the 'no wind' case). For weaker stellar winds (lower ram pressure), the reduction in planetary escape rate is very small. However, as the stellar wind becomes stronger, the interaction happens deeper in the planetary atmosphere and, once this interaction occurs below the sonic surface of the planetary outflow, further reduction in evaporation rates is seen. We classify these regimes in terms of the geometry of the planetary sonic surface."Closed" refers to scenarios where the sonic surface is undisturbed, while "open" refers to those where the surface is disrupted. We find that the change in stellar wind strength affects the Ly-α transit in a non-linear way (note that here we do not include charge-exchange processes). Although little change is seen in planetary escape rates ($\simeq 5.5 \times 10^{11}$g/s) in the closed to partially open regimes, the Ly-α absorption (sum of the blue [-300, -40 km/s] & red [40, 300 km/s] wings) changes from 21% to 6% as the stellar wind mass-loss rate is increased in the HJ set of simulations. For the WN simulations, escape rates of $\simeq 6.5 \times 10^{10}$g/s can cause transit absorptions that vary from 8.8% to 3.7%, depending on the stellar wind strength. We conclude that the same atmospheric escape rate can produce a range of absorptions depending on the stellar wind and that neglecting this in the interpretation of Ly-α transits can lead to underestimation of planetary escape rates.

Download/Website: `https://arxiv.org/pdf/2010.15094.pdf`

Contact: `carolast@tcd.ie`

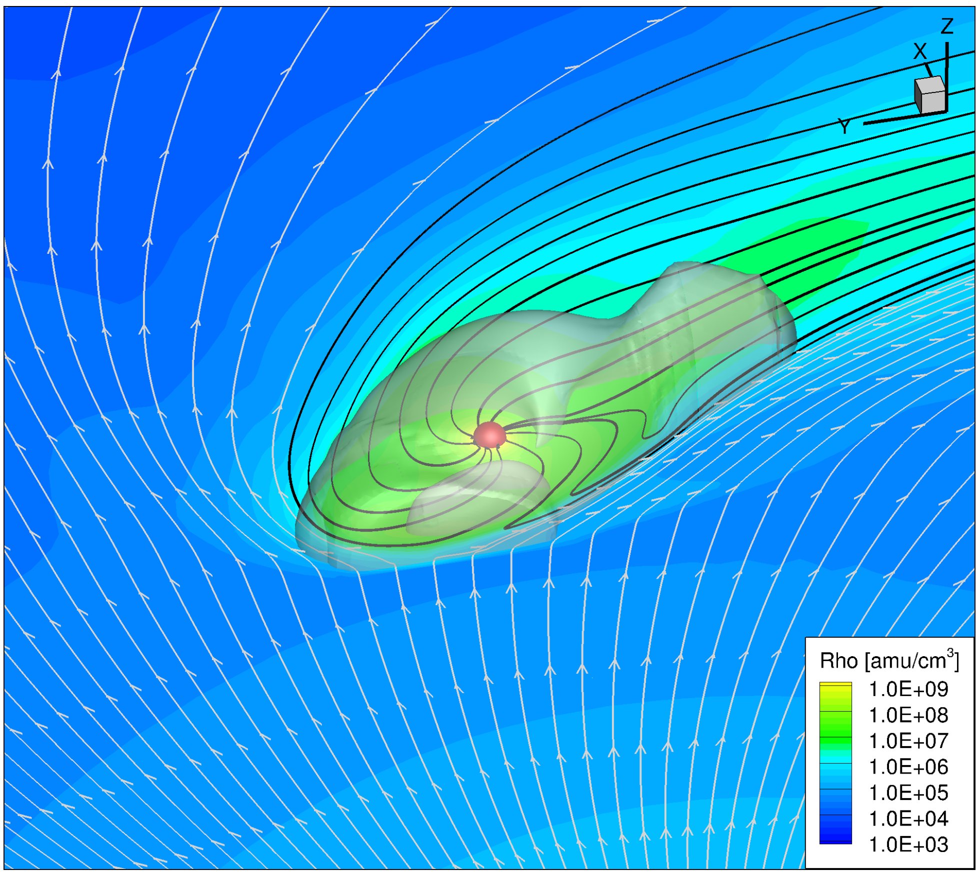

Figure 6: A 3D view of one of our Hot Jupiter models for a stellar mass-loss rate of 10 $\dot{M}_{\odot}$. The colour shows the density in the orbital plane. The gray surface marks the sonic surface around the planet. The grey streamlines show the flow of the stellar wind in the grid, while the black lines trace the escaping atmosphere of the planet.

Refining the transit timing and photometric analysis of TRAPPIST-1: Masses, radii, densities, dynamics, and ephemerides

E. Agol[1], C. Dorn[2], S.L. Grimm[3], M. Turbet[4], E. Ducrot[5], L. Delrez[4,5,6], M. Gillon[5], B.-O. Demory[3], A. Burdanov[7], K. Barkaoui[5,8], Z. Benkhaldoun[8], E. Bolmont[4], A. Burgasser[9], S. Carey [10], J. de Wit[7], D. Fabrycky[11], D. Foreman-Mackey[12], J. Haldemann[13], D.M. Hernandez[14], J. Ingalls[10], E. Jehin[6], Z. Langford[1], J. Leconte[15], S.M. Lederer[16], R. Luger[12], R. Malhotra[17], V.S. Meadows[1], B.M. Morris[3], F.J. Pozuelos[6,5] , Didier Queloz[18], S.N. Raymond[15], F. Selsis[15], M. Sestovic[3], A.H.M.J. Triaud[19], Valerie Van Grootel[6]

[1] Astronomy Department and Virtual Planetary Laboratory, University of Washington, Seattle, WA 98195 USA
[2] University of Zurich, Institute of Computational Sciences, Winterthurerstrasse 190, CH-8057, Zurich, Switzerland
[3] Center for Space and Habitability, University of Bern, Gesellschaftsstrasse 6, CH-3012, Bern, Switzerland
[4] Observatoire de Genève, Université de Genève, 51 Chemin des Maillettes, CH-1290 Sauverny, Switzerland
[5] Astrobiology Research Unit, Université de Liège, Allée du 6 Août 19C, B-4000 Liège, Belgium
[6] Space Sciences, Technologies and Astrophysics Research (STAR) Institute, Université de Liège, Alleé du 6 Août 19C, B-4000 Liège, Belgium
[7] Department of Earth, Atmospheric and Planetary Science, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA
[8] Oukaimeden Observatory, High Energy Physics and Astrophysics Laboratory, Cadi Ayyad University, Marrakech, Morocco
[9] Center for Astrophysics and Space Science, University of California San Diego, La Jolla, CA, 92093, USA
[10] IPAC, California Institute of Technology, 1200 E California Boulevard, Mail Code 314-6, Pasadena, California 91125, USA
[11] Department of Astronomy & Astrophysics, University of Chicago, 5640 S. Ellis Ave., Chicago, IL 60637 USA
[12] Center for Computational Astrophysics, Flatiron Institute, Simons Foundation, 162 5th Ave., New York, NY 10010, USA
[13] University of Bern, Gesellschaftsstrasse 6, CH-3012, Bern, Switzerland
[14] Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS 51, Cambridge, MA 02138, USA
[15] Laboratoire d'astrophysique de Bordeaux, Univ. Bordeaux, CNRS, B18N, Allée Geoffroy Saint-Hilaire, F-33615 Pessac, France
[16] NASA Johnson Space Center, 2101 NASA Pkwy., Houston TX, 77058, USA
[17] Lunar and Planetary Laboratory, The University of Arizona, Tucson, AZ 85721 USA
[18] Cavendish Laboratory, JJ Thomson Avenue, Cambridge, CB3 0H3, UK
[19] School of Physics & Astronomy, University of Birmingham, Edgbaston, Birmimgham B15 2TT, UK

Planetary Science Journal, in press (arXiv:2010.01074)

We have collected transit times for the TRAPPIST-1 system with the Spitzer Space Telescope over four years. We add to these ground-based, HST and K2 transit time measurements, and revisit an N-body dynamical analysis of the seven-planet system using our complete set of times from which we refine the mass ratios of the planets to the star. We next carry out a photodynamical analysis of the Spitzer light curves to derive the density of the host star and the planet densities. We find that all seven planets' densities may be described with a single rocky mass-radius relation which is depleted in iron relative to Earth, with Fe 21 wt% versus 32 wt% for Earth, and otherwise Earth-like in composition. Alternatively, the planets may have an Earth-like composition, but enhanced in light elements, such as a surface water layer or a core-free structure with oxidized iron in the mantle. We measure planet masses to a precision of 3-5%, equivalent to a radial-velocity (RV) precision of 2.5 cm/sec, or two orders of magnitude more precise than current RV capabilities. We find the eccentricities of the planets are very small; the orbits are extremely coplanar; and the system is stable on 10 Myr timescales. We find evidence of infrequent timing outliers which we cannot explain with an eighth planet; we instead account for the outliers using a robust likelihood function. We forecast JWST timing observations, and speculate on possible implications of the planet densities for the formation, migration and evolution of the planet system.

Download/Website: https://github.com/ericagol/TRAPPIST1_Spitzer/

Contact: agol@uw.edu

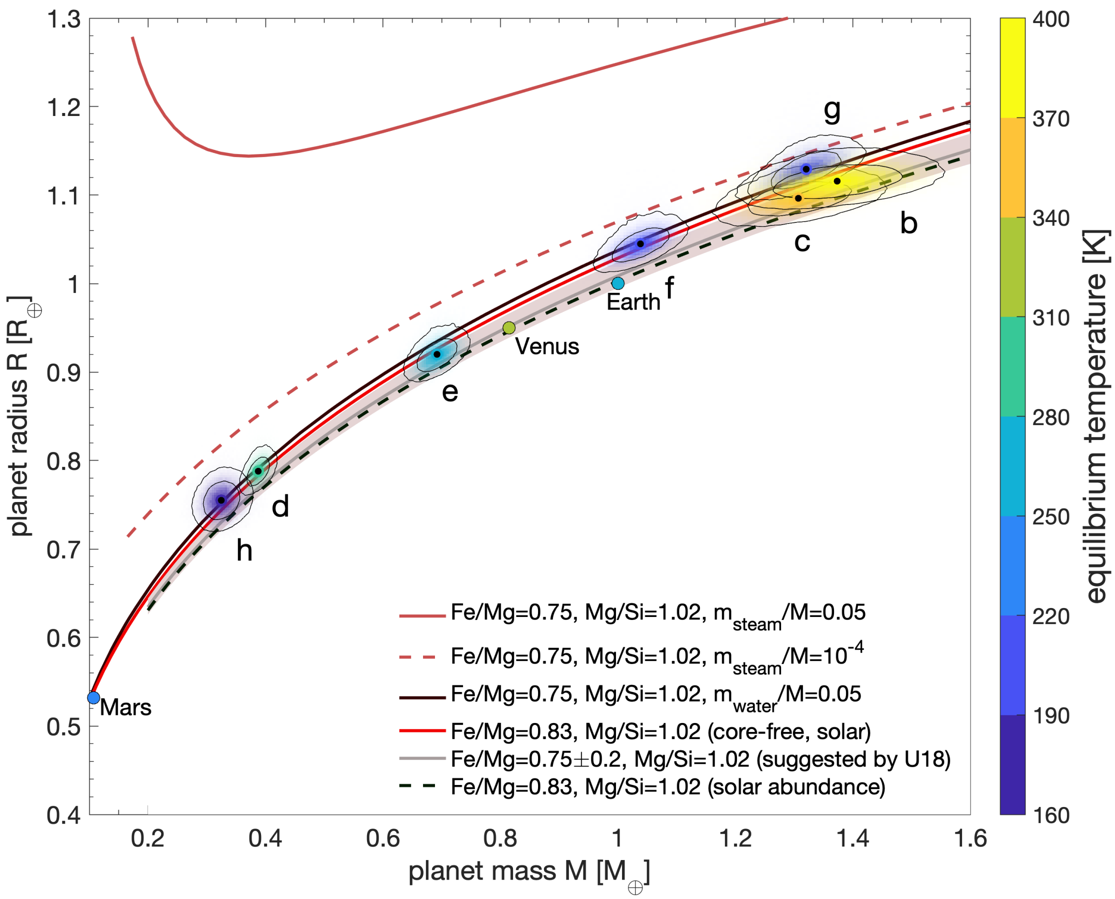

Figure 7: Mass-radius relation for the seven TRAPPIST-1 planets based on our transit-timing and photodynamic analysis. Each planet's posterior probability is colored by the equilibrium temperature (see colorbar), with the intensity proportional to probability, while the 1 and 2σ confidence levels from the Markov chain posterior are plotted with solid lines. Theoretical mass-radius relations are overplotted using the model in Dorn+2016 for an Earth-like molar Fe/Mg=0.83 ratio with a core (black dashed) and core-free (red), and a range of cored models with molar Fe/Mg = 0.75 ± 0.2 (grey). *U18* refers to Unterborn+2018a (see text). The solid black line was calculated for a 5% water composition, for irradiation low enough (i.e. for planets e, f, g and h) that water is condensed on the surface (assuming a surface pressure of 1 bar and a surface temperature of 300 K). The umber dashed and solid lines were calculated for a 0.01% and a 5% water composition, respectively, for irradiation high enough (i.e. for planets b, c and d) that water has fully evaporated in the atmosphere, with the U18 interior model with CMF = 32.5% Turbet+2020. The Earth, Venus and Mars are plotted as single points, also colored by their equilibrium temperatures.

Resolving the outer ring of HD 38206 using ALMA and constraining limits on planets in the system

M. Booth[1], *M. Schulz*[1], *A. V. Krivov*[1], *S. Marino*[2,3], *T. D. Pearce*[1], *R. Launhardt*[2]

[1] Astrophysikalisches Institut und Universitätssternwarte, Friedrich-Schiller-Universität Jena, Schillergäßchen 2-3, 07745 Jena, Germany
[2] Max Planck Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany
[3] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK

MNRAS, in press (2020MNRAS.tmp.3165B)

HD 38206 is an A0V star in the Columba association, hosting a debris disc first discovered by *IRAS*. Further observations by *Spitzer* and *Herschel* showed that the disc has two components, likely analogous to the asteroid and Kuiper belts of the Solar System. The young age of this star makes it a prime target for direct imaging planet searches. Possible planets in the system can be constrained using the debris disc. Here we present the first ALMA observations of the system's Kuiper belt and fit them using a forward modelling MCMC approach. We detect an extended disc of dust peaking at around 180 au with a width of 140 au. The disc is close to edge on and shows tentative signs of an asymmetry best fit by an eccentricity of $0.25^{+0.10}_{-0.09}$. We use the fitted parameters to determine limits on the masses of planets interior to the cold belt. We determine that a minimum of four planets are required, each with a minimum mass of 0.64 M_J, in order to clear the gap between the asteroid and Kuiper belts of the system. If we make the assumption that the outermost planet is responsible for the stirring of the disc, the location of its inner edge and the eccentricity of the disc, then we can more tightly predict its eccentricity, mass and semimajor axis to be $e_\mathrm{p} = 0.34^{+0.20}_{-0.13}$, $m_\mathrm{p} = 0.7^{+0.5}_{-0.3}\,\mathrm{M_J}$ and $a_\mathrm{p} = 76^{+12}_{-13}$ au.

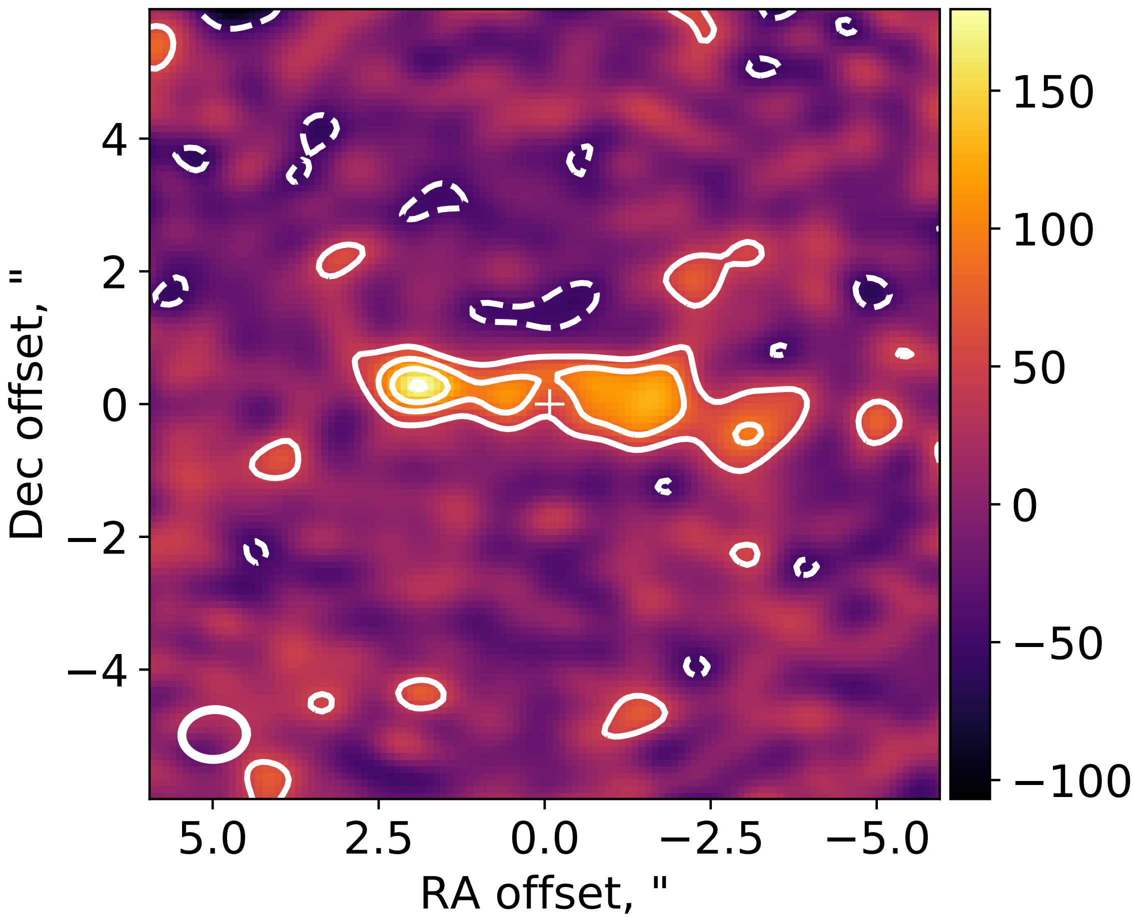

Figure 8: Image of HD 38206 at 1.35 mm after processing with the CLEAN algorithm. The contours show the $\pm 2, 4,$ 6 and 8σ levels. The white cross marks the position on the star based on the *Gaia* DR2 position and accounting for proper motion.

AQUA: a collection of H_2O equations of state for planetary models

J. Haldemann, Y. Alibert, C. Mordasini, W. Benz
Department of Space Research & Planetary Sciences, University of Bern, Gesellschaftsstrasse 6, 3012 Bern, Switzerland

Astronomy & Astrophysics, published (2020A&A...643A.105H)

Context. Water is one of the key chemical elements in planetary structure modelling. Due to its complex phase diagram, equations of state often only cover parts of the pressure-temperature space needed in planetary modelling.
Aims. We aim to construct an equation of state of H_2O spanning a very wide range, from 0.1 Pa to 400 TPa and 150 K to 10^5 K, which can be used to model the interior of planets.
Methods. We combined equations of state valid in localised regions to form a continuous equation of state spanning over the above-mentioned pressure and temperature range.
Results. We provide tabulated values (see link below) for the most important thermodynamic quantities: the density, adiabatic temperature gradient, entropy, internal energy, and bulk speed of sound of water over this pressure and temperature range. For better usability we also calculated density-temperature and density-internal energy grids. We discuss further the impact of this equation of state on the mass radius relation of planets compared to other popular equations of state like ANEOS and QEOS.
Conclusions. AQUA is a combination of existing equations of state useful for planetary models. We show that, in most regions, AQUA is a thermodynamic consistent description of water. At pressures above 10 GPa, AQUA predicts systematic larger densities than ANEOS or QEOS. This is a feature that was already present in a previously proposed equation of state, which is the main underlying equation of this work. We show that the choice of the equation of state can have a large impact on the mass-radius relation, which highlights the importance of future developments in the field of equations of state and regarding experimental data of water at high pressures.

Download/Website: `https://github.com/mnijh/aqua`

Contact: `jonas.haldemann@space.unibe.ch`

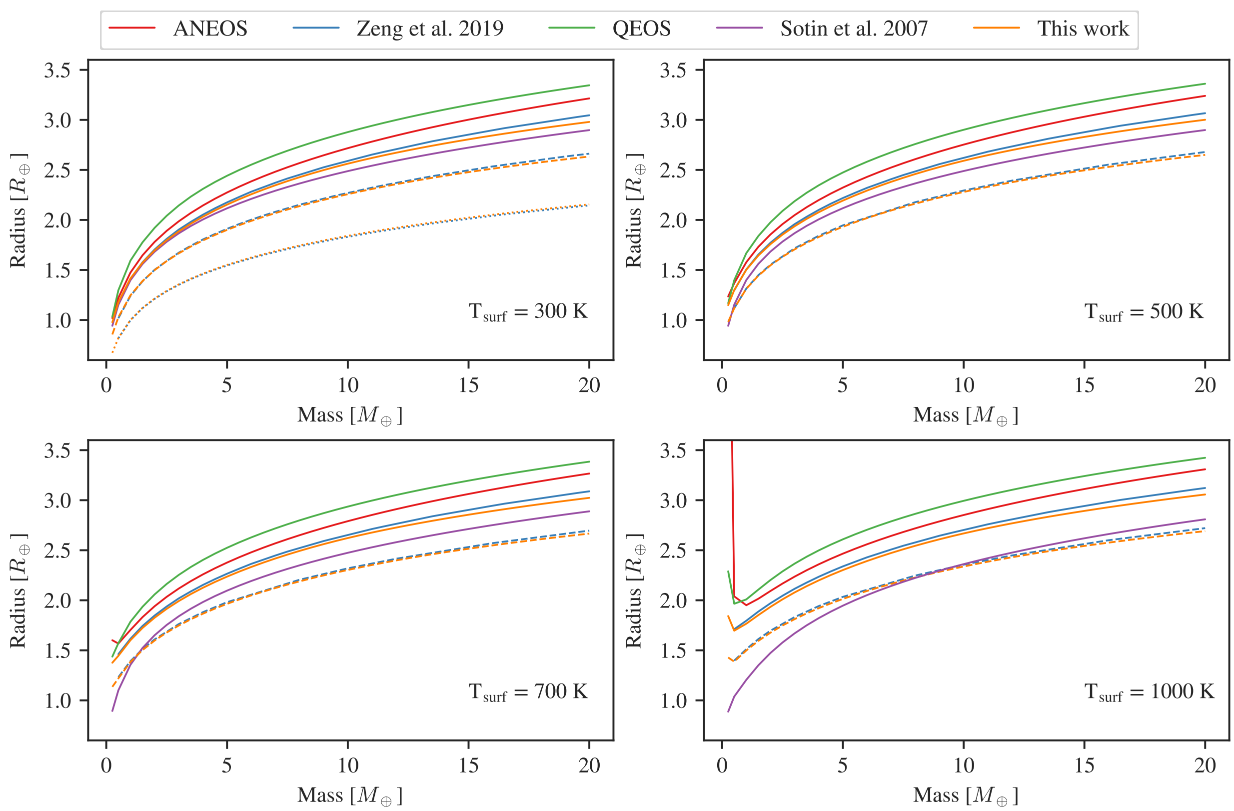

Figure 9: Mass radius relations of isothermal spheres in hydrostatic equilibrium made of 100 wt.% H_2O (solid lines) or 50 wt.% H_2O and 50 wt.% Earth-like composition as in Zeng et al. (2019) (dashed lines), for different EoS and different surface temperatures T_{surf} . The surface pressure was chosen to be 1 mbar as in Zeng et al. (2019). For the cases with Earth-like composition, we used Hakim et al. (2018) as EoS for the Fe and Sotin et al. (2007) to calculate the density in the $MgSiO_3$ layer. Top left panel: Earth-like composition case is also plotted (dotted lines) in order to quantify the contribution from the underlying rocky part to the cases of mixed composition.

3 Jobs and Positions

Postdoctoral Position in Local ISM and/or Exoplanets

Prof. Seth Redfield
Astronomy Department, Van Vleck Observatory, Wesleyan University

Middletown, CT, Fall 2021/flexible

Applications are invited for a Postdoctoral Research Associate to work in collaboration with Seth Redfield primarily on UV/optical/IR spectra of the interstellar medium and/or transiting exoplanets. Projects may include measuring and modeling the fundamental properties of the interstellar medium amongst the nearest stars and/or characterizing the atmospheres and circumplanetary environments of exoplanets. The data sources are high-resolution spectra from a variety of ground-based and space-based facilities, spanning the UV, optical, and IR. Experience with data reduction and analysis, high resolution spectroscopy, and observational studies of the ISM and/or exoplanets will be helpful. The precise research direction will be determined in collaboration with the Postdoctoral Research Associate. The Postdoctoral Research Associate will be encouraged to interact with other faculty and to carry out independent research with full access to observational facilities available. Applicants must have a Ph.D. in astronomy or astrophysics at the start of the appointment.

Wesleyan University, located between New York City and Boston, has a small and active astronomy program which emphasizes involvement of undergraduate and M.A. students in research. The Postdoctoral Research Associate would also have the opportunity, if desired, to develop educational skills through mentoring students in research and possibly teaching. This is a grant-funded position and funding has been approved for 2 years with the possibility of 1 additional year contingent upon mutual agreement and continued funding. Anticipated start date is in the Fall of 2021.

The following documents are required (submitted electronically): (1) Cover letter, (2) Current curriculum vitae with publication list, and (3) Statement of research experience and interests. Applicants should arrange for three letters of reference to be sent to sredfield@wesleyan.edu by the due date. Applications will be considered on a rolling basis. Applications received by 15 December 2020 will be given full consideration.

Salary is competitive and includes health and retirement benefits as well as a travel allowance. Please see the Wesleyan Benefits website for more information: https://www.wesleyan.edu/hr.

Apply through the Wesleyan Online Career Opportunities site listed below.

Download/Website: `https://careers.wesleyan.edu/postings/7487`

Contact: `sredfield@wesleyan.edu`

PhD Position

John Lee Grenfell (lee.grenfell@dlr.de) and Heike Rauer

Technische Universität Berlin offers an open position:
Research Assistant - 0.75 working time - salary grade E13 TV-L Berliner Hochschulen
Faculty II - Center for Astronomy and Astrophysics
Reference number: II-516/20 (starting at 01/01/21 / until 31/12/23 / closing date for applications 13/11/20)
Working field: Implement redox-dependent outgassing and impact dependent escape into a coupled climate-chemistry model of the atmosphere during the early Hadean period. In particular: Validate and analyse model output in terms of atmospheric climate and composition Interpret results in the broad context of the emergence of habitable conditions on Earth and Earth-like planets Publish results in international peer-reviewed scientific journals and and present at international conference.

Requirements: successfully completed university degree (Master, Diplom or equivalent) in physics, meteorology, geophysics, applied mathematics or related disciplines solid programming experience in a high-level language (FORTRAN, C, Python, or similar) basic knowledge of astrophysics, atmospheric climate and chemistry experience in numerical modeling, especially of (exo)planetary atmospheres is desirable good command of German and/or English required; willingness to learn either English or German is expected.
Please send your application with the reference number and the appropriate documents (letter of motivation including a description of your research interests, CV, copies of university degrees and contact details for at least two letters of reference, combined in a single pdf file, max 5 MB) by email to kieschke@astro.physik.tu-berlin.de and lee.grenfell@dlr.de.

By submitting your application via email you consent to having your data electronically processed and saved. Please note that we do not provide a guaranty for the protection of your personal data when submitted as unprotected file. Please find our data protection notice acc. DSGVO (General Data Protection Regulation) at the TU staff department homepage (link below).

To ensure equal opportunities between women and men, applications by women with the required qualifications are explicitly desired. Qualified individuals with disabilities will be favored. The TU Berlin values the diversity of its members and is committed to the goals of equal opportunities. Technische Universität Berlin - Der Präsident - Fakultät II, Zentrum für Astronomie und Astrophysik, Frau Prof. Dr. Rauer, Sekr. EW 8-1, Hardenbergstraße 36, 10623 Berlin

Download/Website: https://www.abt2-t.tu-berlin.de/menue/themen$_{az}$/datenschutzerklaerung/ or quick access 214041.

Contact: lee.grenfell@dlr.de

Postdoctoral Position in Exoplanet Research

Prof. Ray Jayawardhana
Department of Astronomy, Cornell University, Itaca, NY, U.S.A.

Ithaca, NY, Start date: flexible

Applications are invited for a postdoctoral position at Cornell University. The successful candidate will work with Professor Ray Jayawardhana and his collaborators on observational and analytical studies of extra-solar planets and related topics such as sub-stellar objects and planet formation. Spectroscopic and photometric characterization of exoplanets is of particular interest. Prof. Jayawardhana's research group currently includes two postdocs and two graduate students.
Group members lead a recently accepted Large Program at the Gemini Observatory focused on high-resolution spectroscopy of exoplanet atmospheres. The program plans to observe 50+ targets, spanning a range of properties, over the next three years. Prof. Jayawardhana is also on the JWST/NIRISS science team, with $\sim$200 hours of GTO dedicated to exoplanet characterization. In addition, team members use data from TESS, Kepler, CHEOPS, Subaru, Keck, VLT, CFHT, and other major observatories.
The position is for two years, with extension to a third year possible, and comes with a competitive salary and funds for research expenses. Start date is flexible, ideally between January-September 2021.
Applicants should send their curriculum vitae, a description of research interests and plans and a list of publications, and should arrange for three letters of recommendation to be sent directly to Lynda Sovocool (lmk3@cornell.edu). All materials should be submitted electronically to her e-mail address. Applications are accepted until the position is filled, and those received before December 1, 2020 will receive full consideration. Early expressions of interest and inquiries are encouraged, and should be made to rayjay@cornell.edu Candidates interested in applying for a Klarman Fellowship (https://as.cornell.edu/klarman-postdoctoral-fellowships) at Cornell, or bringing other independent fellowships to Cornell, are also encouraged to contact Prof. Jayawardhana.

Download/Website: `https://astro.cornell.edu/ray-jayawardhana`

Contact: `lmk3@cornell.edu`

Post-doctoral Research Positions in Exoplanet Science

Michael R. Meyer

Ann Arbor, Michigan, USA, Summer, 2021 (flexible)

The Department of Astronomy at the University of Michigan welcomes applications for one (or more) post-doctoral positions to join the Formation and Evolution of Planetary Systems research group ($https://sites.lsa.umich.edu/feps/$). Applications are especially welcome in the areas of high contrast imaging, exoplanet detection and spectral characterization, infrared instrumentation (especially detector expertise), as well as exoplanet population statistics, and planet formation. Our lab is involved in a funded effort to develop new mid-infrared detectors for use with adaptive optics on large ground-based telescopes. Successful applicants will have access to departmental facilities such as the Magellan telescopes, the MDM Observatories, NOEMA, SWIFT, high performance computing clusters, and other facilities (please see $http://www.lsa.umich.edu/astro/$). Members of the research team have a chance to collaborate on on-going projects (such as planned observations with the James Webb Space Telescope), and work with students (if appropriate). Interdisciplinary collaborations with the Departments of Astronomy, Physics, Earth Sciences, as well as Climate and Space Sciences, are supported through the Michigan Institute for Research in Astrophysics. The University of Michigan is recognized as a top academic employer and Ann Arbor, Michigan is routinely recognized for its high quality of life. Please send a cover letter, CV, description of research accomplishments and plans (suggested length 8 pages total), list of publications, and arrange for three letters of recommendation to be sent directly to Professor Michael R. Meyer at mrmeyer@umich.edu by 4 January 2020 for full consideration. We expect offers to be made by January 30, with a deadline to accept of February 15. We encourage applications from people holding any identity(ies) that have been traditionally underrepresented in the field of astronomy. The Department of Astronomy has a specific commitment to enhance diversity, equity, and inclusion within our department, and the field ($https://sites.google.com/umich.edu/astro-dei$).

Download/Website:

Contact: `mrmeyer@umich.edu`

University of Michigan Department of Astronomy McLaughlin Postdoctoral Fellowship

Michael R. Meyer (on behalf of the Selection Committee)

Ann Arbor, Michigan, USA, September, 2021

The University of Michigan Department of Astronomy invites applications for its McLaughlin Postdoctoral Fellowship. Fellows are afforded the opportunity to construct and pursue an independent research program in an energetic and diverse research environment. The Department has guaranteed access to the 6.5 Magellan telescopes in Chile, the 1.2m and 2.4m MDM telescopes in Arizona, the NOEMA sub-mm interferometer in France, and the Swift UV/X-ray/Gamma-ray telescope. Observational and theoretical efforts within the department span span a range of topics including exoplanets, star and planet formation, as well as related instrumentation efforts. The salary for the fellowship will start at 69,000 USD, with an annual research stipend of 6,000 USD. A full benefits package is included. Fellowships will commence in September 2021, the expected term is three years, dependent on performance and funding. Applicants need to have completed a Ph. D. in astronomy, physics, or a closely related field prior to the start of the fellowship. Applicants should send a cover letter, statement of past research, statement of proposed research, CV, and publications list (with three "key" papers specifically highlighted) to mclfellows@umich.edu. Letters from three references are also required and should be sent to the same address. Applications that are complete by December 1, 2020, will receive full attention. We encourage applications from people holding any identity(ies) that have been traditionally underrepresented in the field of astronomy.

Download/Website:

Contact: `mclfellows@umich.edu`

4 Conferences

2021 Sagan Summer Virtual Workshop: Circumstellar Disks and Young Planets

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

Online Workshop, July 19-23, 2021

The 2021 Sagan Summer Workshop will take place July 19-23, 2021. As with last year, we expect that the 2021 workshop will be fully virtual.

The 2021 Sagan Summer Workshop will focus on young planets and the circumstellar disks from which they form during the first few million years of a star's lifetime. The workshop will address how transformational new datasets are allowing us to address key questions about the formation and evolution of planets and their potential habitability; topics will include:

- Properties of transiting young planets detected by the Kepler/K2 and TESS missions
- Gaia identification of groups of young stars and determination of their ages
- Properties of planets and disks imaged directly with ground-based faculties (e.g., Gemini/GPI, SPHERE/VLTI, Keck and ALMA) and space-based telescopes (Spitzer, HST and, soon, JWST)
- Environment influence of an active young star on the evolution of the primordial atmosphere of a young planet
- Theoretical bases for the formation and evolution of a planetary systems, including both the disk and planets
- Attendees will have the chance to submit posters, participate in hands-on tutorials, and meet in small groups with our speakers.

There is no registration fee for this workshop and registration will open in February 2021.

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

Download/Website: `http://nexsci.caltech.edu/workshop/2021`
Contact: `sagan_workshop@ipac.caltech.edu`

Call for Abstract Submissions: EGU2021 PS1.1: "Earths around other stars – bulk, interiors and atmospheres"

H.S. Wang, D.J. Bower, C. Dorn, A. Hunt

vEGU21: Gather Online, 19–30 April 2021 (Submission deadline: 13 Jan 2021, 13:00 CET)

Interactions between the interior and atmosphere of terrestrial planets are modulated by the planets' bulk composition, which in turn is linked to the chemical properties of their host stars. As stellar photosphere and planetary atmosphere can be directly probed, compositional properties of the rocky interior can only be inferred from other data. What constraints can be placed on the range of possible compositions of terrestrial exoplanets? How do surface-interior interactions shape atmospheric properties of rocky worlds around other stars? How diverse is the physical and chemical parameter space of these exo-worlds? We invite contributions - from geodynamics, geochemistry, cosmochemistry as well as astrophysics - that explore physical and chemical links between stars and planets and between rocky interior and atmosphere, and their implications for planet long-term evolution.

Download/Website: `https://meetingorganizer.copernicus.org/EGU21/session/40033`

Contact: `egu21@copernicus.org`

5 Exoplanet Archive Updates

October 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, November 15, 2020

Note: Unless otherwise noted, all planetary and stellar data mentioned in the news are in the Planetary Systems Table (beta) (`http://bit.ly/2Pt0tM1`), which provides a single location for all self-consistent planetary solutions, and its companion table the Planetary Systems Composite Parameters (alpha) (`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 Data Table (`http://bit.ly/2JQr180`) or Direct Imaging Table (`http://bit.ly/3ayD185`).

October 22, 2020

Four New Planets, 14 Multiplicity Parameter Sets Added

There are four new planets this week, including gas giant NGTS-12 b, discovered by the Next Generation Transit Survey (NGTS). The other three planets are GJ 3473 b & c and TOI-837 b.

We've also added 14 solution sets for companion stars—data for additional stars in planet-hosting systems.

October 8, 2020

The Archive Adds Its 100th Microlensing Planet

This week marks another archive milestone: we've surpassed 100 microlensing exoplanets!

Three of the eight planets added this week were discovered and confirmed using gravitational microlensing. Though the bulk of the archive's 4,292 exoplanets were detected by other methods such as radial velocity motions and transits with Kepler and TESS, microlensing is the technique most sensitive to finding planets near the snow line (where water exists as a solid) of their host stars. The NASA Roman Space Telescope will use the microlensing technique to determine the frequency of planets in the outer reaches of planetary systems, complementing the statistical census begun by Kepler.

Learn more about microlensing—and other detection techniques—at the NASA Exoplanet Exploration website (`https://exoplanets.nasa.gov/alien-worlds/ways-to-find-a-planet/#/4`). Also, these animations from NASA's Goddard Space Flight Center Conceptual Image Lab illustrate how the Roman Space Telescope will make microlensing observations: `https://svs.gsfc.nasa.gov/20315`. You can also learn more about Microlensing Resources in the Exoplanet Archive (`https://bit.ly/32vX5q0`).

The new microlensing planets are OGLE-2018-BLG-1269L b, KMT-2018-BLG-0748L b, and KMT-2019-BLG-0842L b. The other new planets this week are TOI-540 b, TOI-1266 b & c, and TOI-421 b & c.

Data for the new microlensing planets are available in our interactive Microlensing Table (`http://bit.ly/2JQr180`), as well as the Planetary Systems Table (beta) and its companion table, Planetary

Systems Composite Parameters (alpha), which offers a more complete table of planet parameters combined from multiple references and calculations. The Confirmed Planets, Composite Planet Data, and Extended Planet Data interactive tables are also updated with new planetary and stellar data. Please note that these three tables are being retired in late 2020/early 2021, as described in this transition document: `https://bit.ly/3jLgrhl`.

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

6 Announcements

CHEOPS AO-2

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

,

Dear Colleagues,

I would like to draw your attention to the second Announcement of Opportunity (AO-2) for participation in the ESA CHEOPS Guest Observers Programme.

AO-2 solicits proposals for observations to be carried out in the period 26 March 2021 to 25 March 2022, and is open to the community worldwide.

Full details, including all tools/manuals/information needed to prepare and submit observing proposals, can be found at the link below.

The deadline for submission of proposals is **12:00 hrs GMT/13:00 hrs CET on 1 Dec 2020**

Please send any questions to either myself or to cheops-support@cosmos.esa.int

Best wishes,

Kate Isaak

Download/Website:
`https://www.cosmos.esa.int/web/cheops-guest-observers-programme/ao-2`
Contact: `kate.isaak@esa.int`

7 As seen on astro-ph

List of exoplanet related entries seen on astro-ph during October 2020.

astro-ph/2010.00146: **Beyond Equilibrium Temperature: How the Atmosphere/Interior Connection Affects the Onset of Methane, Ammonia, and Clouds in Warm Transiting Giant Planets** by *Jonathan J. Fortney et al.*

astro-ph/2010.00474: **The CARMENES search for exoplanets around M dwarfs. Three temperate to warm super-Earths** by *S. Stock et al.*

astro-ph/2010.00485: **How planetary gas accretion changes the shape and depth of gaps in protoplanetary discs** by *C. Bergez-Casalou et al.*

astro-ph/2010.00559: **An In-Plane J2-Invariance Condition and Control Algorithm for Highly Elliptical Satellite Formations** by *Jackson Kulik*

astro-ph/2010.00687: **A Comprehensive Reanalysis of Spitzer's 4.5 m Phase Curves, and the Phase Variations of the Ultra-hot Jupiters MASCARA-1b and KELT-16b** by *Taylor J. Bell et al.*

astro-ph/2010.00862: **Parametric instability in a free evolving warped protoplanetary disc** by *Hongping Deng, Gordon I. Ogilvie, Lucio Mayer*

astro-ph/2010.00870: **Multiple subglacial water bodies below the south pole of Mars unveiled by new MARSIS data** by *Sebastian Emanuel Lauro et al.*

astro-ph/2010.00997: **A data-driven approach to constraining the atmospheric temperature structure of KELT-9b** by *L. Fossati et al.*

astro-ph/2010.01074: **Refining the transit timing and photometric analysis of TRAPPIST-1: Masses, radii, densities, dynamics, and ephemerides** by *Eric Agol et al.*

astro-ph/2010.01095: **Effect of the surface shape of a large space body on its fragmentation in a planetary atmosphere** by *Daniil E. Khrennikov et al.*

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