ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Dear readers,

Welcome to the May edition of the ExoPlanet News!

In this issue you will find abstracts of scientific papers, job advertisements, announcements (conferences, book), the latest exoplanet talks, updates from the Exoplanet archive, 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 June 14, 2022.

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

2 Abstracts of refereed papers

Detailed chemical compositions of planet-hosting stars: II. Exploration of the interiors of terrestrial-type exoplanets

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:2204.09558)

A major goal in the discovery and characterisation of exoplanets is to identify terrestrial-type worlds that are similar to (or otherwise distinct from) our Earth. Recent results have highlighted the importance of applying devolatilisation – i.e. depletion of volatiles – to the chemical composition of planet-hosting stars to constrain bulk composition and interiors of terrestrial-type exoplanets. In this work, we apply such an approach to a selected sample of 13 planet-hosting Sun-like stars, for which high-precision photospheric abundances have been determined in the first paper of the series. With the resultant devolatilised stellar composition (i.e. the model planetary bulk composition) as well as other constraints including mass and radius, we model the detailed mineralogy and interior structure of hypothetical, habitable-zone terrestrial planets (”exo-Earths”) around these stars. Model output shows that most of these exo-Earths are expected to have broadly Earth-like composition and interior structure, consistent with conclusions derived independently from analysis of polluted white dwarfs. The exceptions are the Kepler-10 and Kepler-37 exo-Earths, which we predict are strongly oxidised and thus would develop metallic cores much smaller than Earth. Investigating our devolatilisation model at its extremes as well as varying planetary mass and radius (within the terrestrial regime) reveals potential diversities in the interiors of terrestrial planets. By considering (i) high-precision stellar abundances, (ii) devolatilisation, and (iii) planetary mass and radius holistically, this work represents essential steps to explore the detailed mineralogy and interior structure of terrestrial-type exoplanets, which in turn are fundamental for our understanding of planetary dynamics and long-term evolution.

Download/Website: `https://arxiv.org/abs/2204.09558`

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A target list for searching for habitable exomoons

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MNRAS, in press (arXiv:2204.11614)

We investigate the habitability of hypothethical moons orbiting known exoplanets. This study focuses on big, rocky exomoons that are capable of maintaining a significant atmosphere. To determine their habitability, we calculate the incident stellar radiation and the tidal heating flux arising in the moons as the two main contributors to the energy budget. We use the runaway greenhouse and the maximum greenhouse flux limits as a definition of habitability. For each exoplanet we run our calculations for plausible ranges of physical and orbital parameters for the moons and the planet using a Monte Carlo approach. We calculate the moon habitability probability for each planet which is the fraction of the investigated cases that lead to habitable conditions. Based on our results, we provide a target list for observations of known exoplanets of which the top 10 planets have more than 50% chance for hosting habitable moons on stable orbits. Two especially promising candidates are Kepler-62 f and Kepler-16 b, both of them with known masses and radii. Our target list can help to detect the first habitable exomoon.

Download/Website: `https://doi.org/10.1093/mnras/stac1180`

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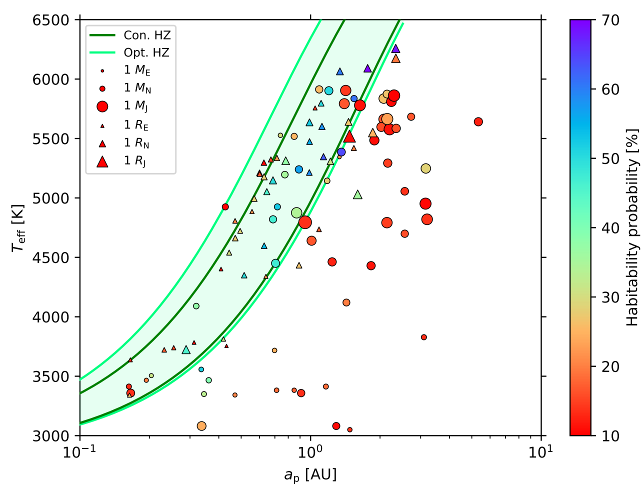

Figure 1: Habitability probability for exomoons around known exoplanets on the semi-major axis – stellar effective temperature plane. Planets with known masses (with or without radius data) are marked with circles, planets with known radii only are marked with triangles. Colours of the markers correspond to the fraction of habitable moons and the sizes of the markers represent the sizes of the planets as shown in the legend. Note that the legend only shows three representative sizes (Earth, Neptune and Jupiter), while the size of the markers in the plot is scaled to the real size of the planets. Green curves represent the borders of the circumstellar habitable zone for a 1 Earth-mass planet: dark green for the consevative HZ (*Con. HZ*) and light green for the optimistic HZ (*Opt. HZ*).

A SuperWASP light curve displaying a single long-duration transit: a Jupiter size exoplanet in a very distant orbit?

Andrew J. Norton[1], *Hugh J. Dickinson*[1], *Adam McMaster*[1,2], *Matthew Middleton*[3], *Richard G. West*[4,5]

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Research Notes of the American Astronomical Society, 6(4), 84

We present the SuperWASP light curve of a 10th magnitude A7V star containing a single, well-defined U-shaped transit-like event lasting around 11 days with a depth of 1.1%. The star is otherwise non-variable throughout the 8-year duration of the observations. If the event is modeled as an exoplanet transit, it is compatible with a 1.8 R_J exoplanet in a $\sim$ 205 AU orbit with a period of $\sim$ 2200 years.

Download/Website: `https://iopscience.iop.org/article/10.3847/2515-5172/ac6811`

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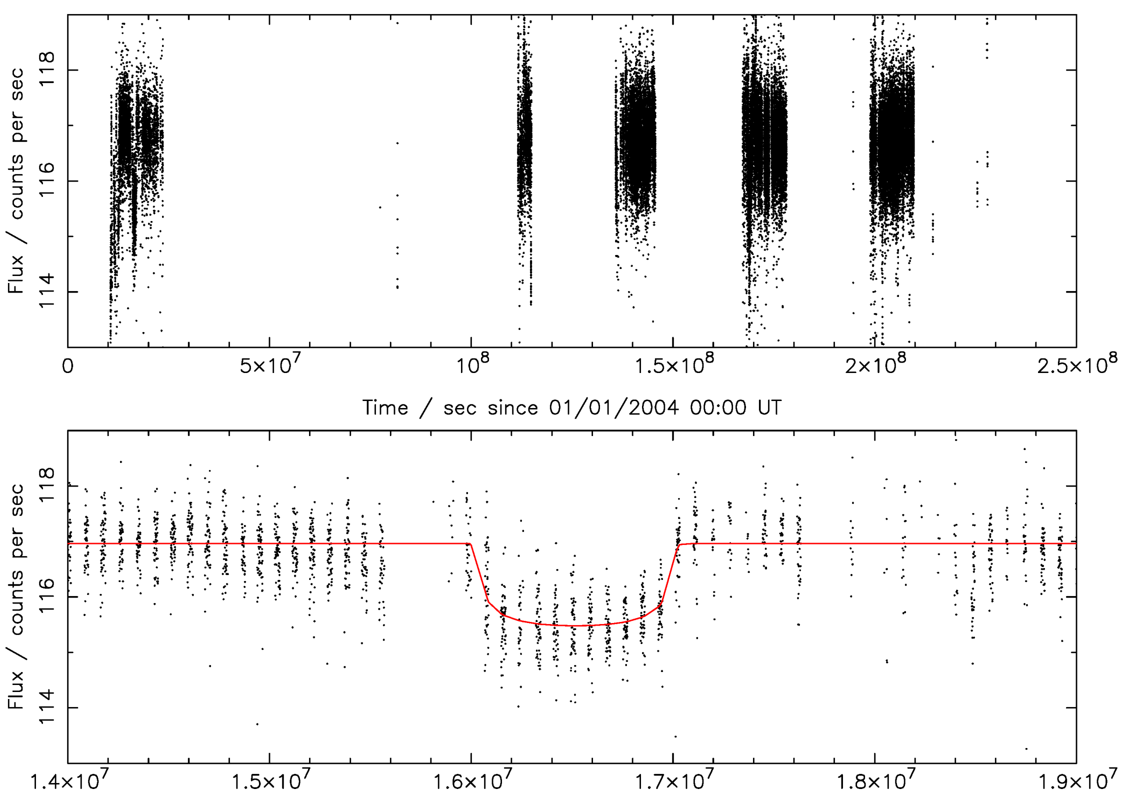

Figure 2: *upper panel*) The SuperWASP light curve of 1SWASP J182438.34+302546.0 spanning 8 years. (*lower panel*) A zoom-in to $\sim$ 60-days of the light curve during 2004 showing the transit-like event, over-layed with a best-fit transit model.

Multi-Mask Least-Squares Deconvolution: Extracting RVs using tailored masks

F. Lienhard[1], *A. Mortier*[1,2], *L. Buchhave*[3], *A. Collier Cameron*[4], *M. López-Morales*[5], *A. Sozzetti*[6], *C. A. Watson*[7], *R. Cosentino*[8]

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:2204.13556)

To push the radial velocity (RV) exoplanet detection threshold, it is crucial to find more reliable radial velocity extraction methods. The Least-Squares Deconvolution (LSD) technique has been used to infer the stellar magnetic flux from spectropolarimetric data for the past two decades. It relies on the assumption that stellar absorption lines are similar in shape. Although this assumption is simplistic, LSD provides a good model for intensity spectra and likewise an estimate for their Doppler shift. We present the Multi-Mask Least-Squares Deconvolution (MM-LSD) RV extraction pipeline which extracts the radial velocity from two-dimensional echelle-order spectra using LSD with multiple tailored masks after continuum normalisation and telluric absorption line correction. The flexibility of LSD allows to exclude spectral lines or pixels at will, providing a means to exclude variable lines or pixels affected by instrumental problems. The MM-LSD pipeline was tested on HARPS-N data for the Sun and selected well-observed stars with $5.7 < \mathrm{Vmag} < 12.6$. For FGK-type stars with median signal-to-noise above 100, the pipeline delivered RV time series with on average 12 per cent lower scatter as compared to the HARPS-N RV extraction pipeline based on the Cross-Correlation Function technique. The MM-LSD pipeline may be used as a standalone RV code, or modified and extended to extract a proxy for the magnetic field strength.

Download/Website: `https://github.com/florian-lienhard/MM-LSD`

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Dayside Fe I Emission, Day–Night Brightness Contrast and Phase Offset of the Exoplanet WASP-33b

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The Astronomical Journal, published (2022AJ....163...248H)

We report on Fe I in the day-side atmosphere of the ultra-hot Jupiter WASP-33b, providing evidence for a thermal inversion in the presence of an atomic species. We also introduce a new way to constrain the planet's brightness variation throughout its orbit, including its day-night contrast and peak phase offset, using high-resolution Doppler spectroscopy alone. We do so by analyzing high-resolution optical spectra of six arcs of the planet's phase curve, using ESPaDOnS on the Canada-France-Hawaii telescope and HDS on the Subaru telescope. By employing a likelihood mapping technique, we explore the marginalized distributions of parameterized atmospheric models, and detect Fe I emission at high significance ($> 10.4\sigma$) in our combined data sets, located at $K_{\mathrm{p}} = 222.1 \pm 0.4$ km/s and $v_{\mathrm{sys}} = -6.5 \pm 0.3$ km/s. Our values agree with previous reports. By accounting for WASP-33b's brightness variation, we find evidence that its night-side flux is $< 10\%$ of the day-side flux and the emission peak is shifted westward of the substellar point, assuming the spectrum is dominated by Fe I. Our ESPaDOnS data, which cover phases before and after the secondary eclipse more evenly, weakly constrain the phase offset to $+22 \pm 12$ degrees. We caution that the derived volume-mixing-ratio depends on our choice of temperature-pressure profile, but note it does not significantly influence our constraints on day-night contrast or phase offset. Finally, we use simulations to illustrate how observations with increased phase coverage and higher signal-to-noise ratios can improve these constraints, showcasing the expanding capabilities of high-resolution Doppler spectroscopy.

Download/Website: `https://iopscience.iop.org/article/10.3847/1538-3881/ac5f4d`

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Unveiling the outer dust disc of TW Hya with deep ALMA observations

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Monthly Notices of the Royal Astronomical SocietyLetters, in press (arXiv:2205.01396)

The radial extent of millimetre dust in protoplanetary discs is often far smaller than that of their gas, mostly due to processes such as dust growth and radial drift. However, it has been suggested that current millimetre continuum observations of discs do not trace their full extent due to limited sensitivity. In this Letter, we present deep ($19\,\mu$Jy beam^{-1}) moderate resolution (0.37) ALMA observations at 1 mm of the nearest protoplanetary disc, TW Hya. Using the visibility analysis tool `frank`, we reveal a structured millimetre intensity distribution out to 100 au, well beyond previous estimates of 60–70 au. Our analysis suggests the presence of a new millimetre continuum gap at 82 au, coincident with similar features seen in optical/near-infrared scattered light and millimetre molecular line observations. Examination of the fit residuals confirms the presence of the previously reported au-scale continuum excess at 52 au ($\mathrm{P.A.} = 242.5$). Our results demonstrate the utility of combining deep, moderate resolution observations with super-resolution analysis techniques to probe the faintest regions of protoplanetary discs.

Download/Website: `https://arxiv.org/pdf/2205.01396.pdf`

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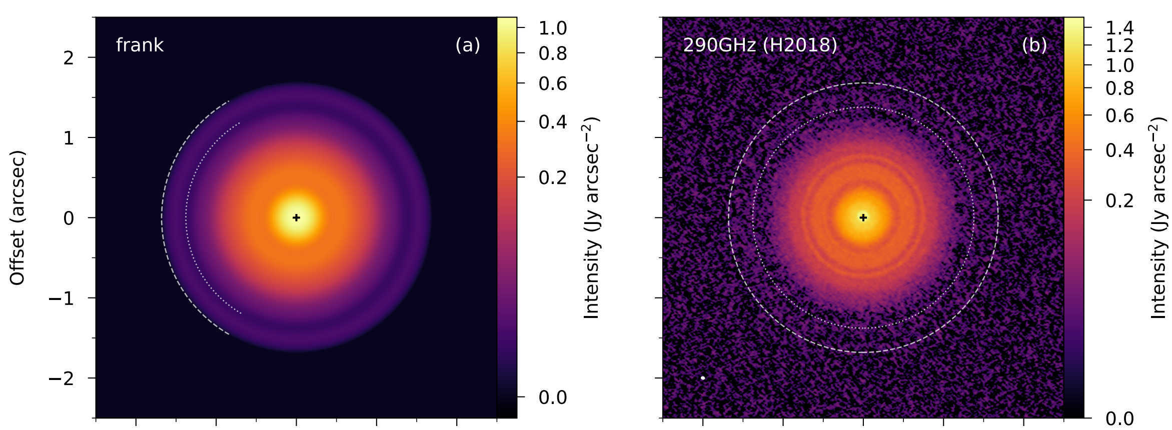

Figure 3: Left: Our reconstructed `frank` radial intensity profile of TW Hya as it would appear 'on-sky' out to a radius of approximately 100 au. Right: Previous, high resolution observations of TW Hya at a similar frequency.

Nucleation and growth of iron pebbles explains the formation of iron-rich planets akin to Mercury

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Astronomy & Astrophysics, in press (arXiv:2204.04241)

The pathway to forming the iron-rich planet Mercury remains mysterious. Mercury's core makes up 70% of the planetary mass, which implies a significant enrichment of iron relative to silicates, while its mantle is strongly depleted in oxidized iron. The high core mass fraction is traditionally ascribed to evaporative loss of silicates, e.g. following a giant impact, but the high abundance of moderately volatile elements in the mantle of Mercury is inconsistent with reaching temperatures much above 1,000 K during its formation. Here we explore the nucleation of solid particles from a gas of solar composition that cools down in the hot inner regions of the protoplanetary disc. The high surface tension of iron causes iron particles to nucleate homogeneously (i.e., not on a more refractory substrate) under very high supersaturation. The low nucleation rates lead to depositional growth of large iron pebbles on a sparse population of nucleated iron nano-particles. Silicates in the form of iron-free $MgSiO_3$ nucleate at similar temperatures but obtain smaller sizes due to the much higher number of nucleated particles. This results in a chemical separation of large iron particles from silicate particles with ten times lower Stokes numbers. We propose that such conditions lead to the formation of iron-rich planetesimals by the streaming instability. In this view, Mercury formed by accretion of iron-rich planetesimals with a sub-solar abundance of highly reduced silicate material. Our results imply that the iron-rich planets known to orbit the Sun and other stars are not required to have experienced mantle-stripping impacts. Instead their formation could be a direct consequence of temperature fluctuations in protoplanetary discs and chemical separation of distinct crystal species through the ensuing nucleation process.

Download/Website: `https://arxiv.org/abs/2204.04241`

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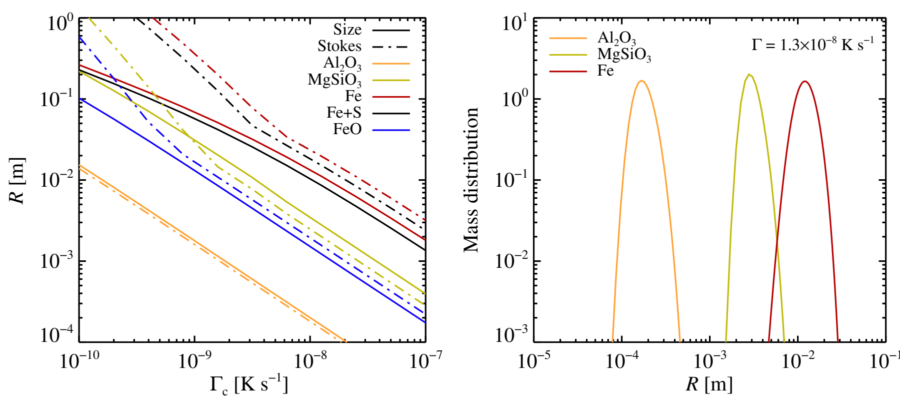

Figure 4: Particle sizes and Stokes numbers as a function of the cooling rate of our protoplanetary disc model at r = 0.4 AU (left panel) and size distribution of corundum, enstatite and iron at a specific cooling rate (right panel). All the species increase in size for decreasing cooling rates. The Stokes number increases quadratically with the particle size above the size transition from Epstein to Stokes regime. Pure iron (Fe) and iron with sulfur (Fe+S) obtain the largest sizes and, by far, the highest Stokes numbers.

Transit Timing Variations for AU Microscopii b & c

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The Astronomical Journal, published (arXiv:2202.05813)

We explore the transit timing variations (TTVs) of the young (22 Myr) nearby AU Mic planetary system. For AU Mic b, we introduce three *Spitzer* (4.5 μm) transits, five *TESS* transits, 11 *LCOGT* transits, one *PEST* transit, one *Brierfield* transit, and two transit timing measurements from Rossiter-McLaughlin observations; for AU Mic c, we introduce three *TESS* transits. We present two independent TTV analyses. First, we use `EXOFASTv2` to jointly model the *Spitzer* and ground-based transits and to obtain the midpoint transit times. We then construct an O–C diagram and model the TTVs with `Exo-Striker`. Second, we reproduce our results with an independent photodynamical analysis. We recover a TTV mass for AU Mic c of $10.8^{+2.3}_{-2.2}$ $\mathrm{M_E}$. We compare the TTV-derived constraints to a recent radial-velocity (RV) mass determination. We also observe excess TTVs that do not appear to be consistent with the dynamical interactions of b and c alone, and do not appear to be due to spots or flares. Thus, we present a hypothetical non-transiting "middle-d" candidate exoplanet that is consistent with the observed TTVs, the candidate RV signal, and would establish the AU Mic system as a compact resonant multi-planet chain in a 4:6:9 period commensurability. These results demonstrate that the AU Mic planetary system is dynamically interacting producing detectable TTVs, and the implied orbital dynamics may inform the formation mechanisms for this young system. We recommend future RV and TTV observations of AU Mic b and c to further constrain the masses and to confirm the existence of possible additional planet(s).

Download/Website: `https://arxiv.org/abs/2202.05813`

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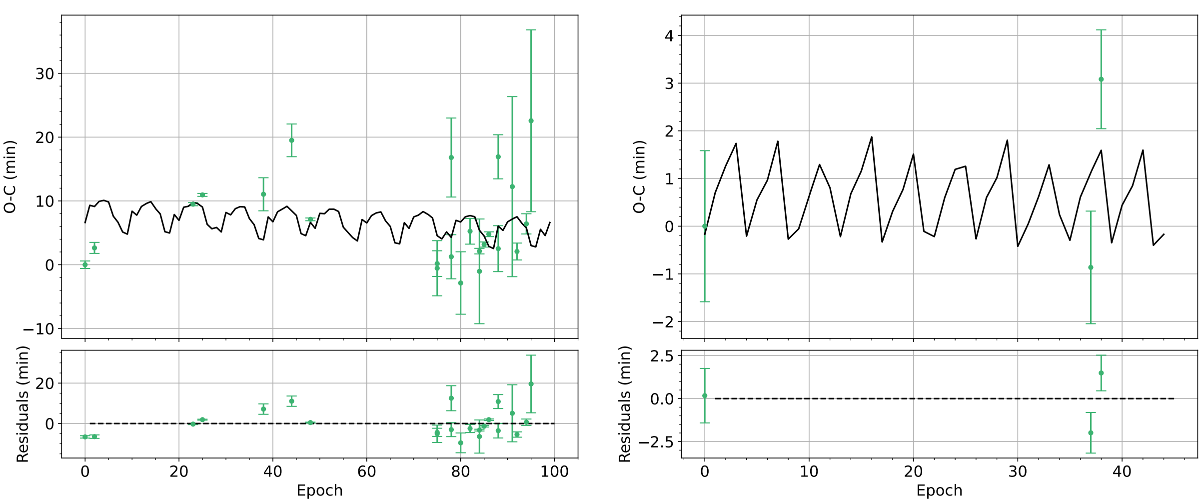

Figure 5: 2-planet O–C diagram of AU Mic b (left) and AU Mic c (right), with comparison between TTVs (green) and Exo-Striker-generated best-fit models (black)

A close-in puffy Neptune with hidden friends: The enigma of TOI 620

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The Astronomical Journal, in press (arXiv:2204.03108)

We present the validation of a transiting low-density exoplanet orbiting the M2.5 dwarf TOI 620 discovered by the NASA TESS mission. We utilize photometric data from both TESS and ground-based follow-up observations to validate the ephemerides of the 5.09-day transiting signal and vet false positive scenarios. High-contrast imaging data are used to resolve the stellar host and exclude stellar companions at separations $> 0.2''$. We obtain follow-up spectroscopy and corresponding precise radial velocities (RVs) with multiple PRV spectrographs to confirm the planetary nature of the transiting exoplanet. We calculate a 5σ upper limit of $M_P < 7.1\,\mathrm{M}_\oplus$ and $\rho_P < 0.74\,\mathrm{g\,cm}^{-3}$, and we identify a non-transiting 17.7-day candidate. We also find evidence for a substellar (1–20 M_J) companion with a projected separation < 20 au from a combined analysis of Gaia, AO imaging, and RVs. With the discovery of this outer companion, we carry out a detailed exploration of the possibilities that TOI 620 b might instead be a circum-secondary planet or a pair of eclipsing binary stars orbiting the host in a hierarchical triple system. We find, under scrutiny, that we can exclude both of these scenarios from the multi-wavelength transit photometry, thus validating TOI 620 b as a low-density exoplanet transiting the central star in this system. The low density of TOI 620 b makes it one of the most amenable exoplanets for atmospheric characterization, such as with JWST and Ariel, validated or confirmed by the TESS mission to date.

Download/Website: `https://arxiv.org/abs/2204.03108`

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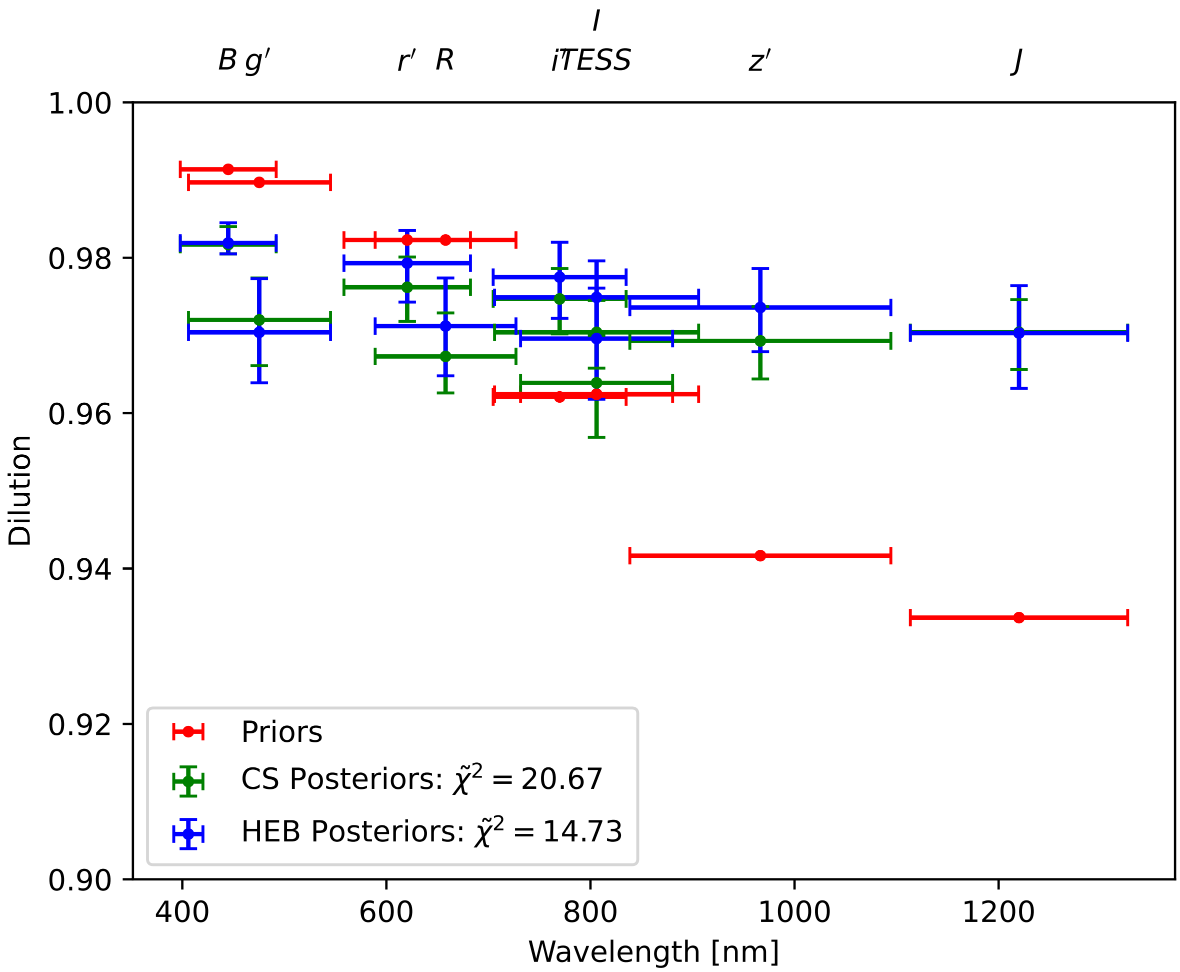

Figure 6: Dilution of the secondary star as a function of wavelength. We ran MCMC simulations of the transiting system under three assumptions: 1) a single, circum-primary planet, 2) a circum-secondary planet, 3) a hierarchical eclipsing binary system. Our MCMC dilution priors (red) are shown in contrast to the posteriors of the secondary for the circum-secondary model (green) and the HEB model (blue). We see a prior distribution that decreases with wavelength as expected for flux contamination from a hotter primary star, whereas the posteriors are mostly flat and become inconsistent at short and long wavelengths. Thus, we exclude the circum-secondary and HEB models.

Radio masers on WX UMa: hints of a Neptune-sized planet, or magnetospheric reconnection?

R. D. Kavanagh[1,2], *A. A. Vidotto*[1,2], *H. K. Vedantham*[3,4], *M. M. Jardine*[5], *J. R. Callingham*[1,3], *J. Morin*[6]

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[3] ASTRON, The Netherlands Institute for Radio Astronomy, Oude Hogeveensedijk 4, 7991PD, Dwingeloo, The Netherlands
[4] Kapteyn Astronomical Institute, University of Groningen, Landleven 12, 9747 AD Groningen, The Netherlands
[5] SUPA, School of Physics and Astronomy, University of St Andrews, St Andrews KY16 9SS, UK
[6] Laboratoire Univers et Particules de Montpellier (LUPM), Université de Montpellier, CNRS, 34095 Montpellier, France

Monthly Notices of the Royal Astronomical Society, in press (arXiv:2205.01661)

The nearby M dwarf WX UMa has recently been detected at radio wavelengths with LOFAR. The combination of its observed brightness temperature and circular polarisation fraction suggests that the emission is generated via the electron-cyclotron maser instability. Two distinct mechanisms have been proposed to power such emission from low-mass stars: either a sub-Alfvénic interaction between the stellar magnetic field and an orbiting planet, or reconnection at the edge of the stellar magnetosphere. In this paper, we investigate the feasibility of both mechanisms, utilising the information about the star's surrounding plasma environment obtained from modelling its stellar wind. Using this information, we show that a Neptune-sized exoplanet with a magnetic field strength of 10 – 100 G orbiting at ~ 0.034 au can accurately reproduce the observed radio emission from the star, with a corresponding orbital period of 7.4 days. Due to the stellar inclination, a planet in an equatorial orbit is unlikely to transit the star. While such a planet could induce radial velocity semi-amplitudes from 7 to 396 m s^{-1}, it is unlikely that this signal could be detected with current techniques due to the activity of the host star. The application of our planet-induced radio emission model here illustrates its exciting potential as a new tool for identifying planet-hosting candidates from long-term radio monitoring. We also develop a model to investigate the reconnection-powered emission scenario. While this approach produces less favourable results than the planet-induced scenario, it nevertheless serves as a potential alternative emission mechanism which is worth exploring further.

Download/Website: `https://arxiv.org/abs/2205.01661`

Contact: `kavanagh@strw.leidenuniv.nl`

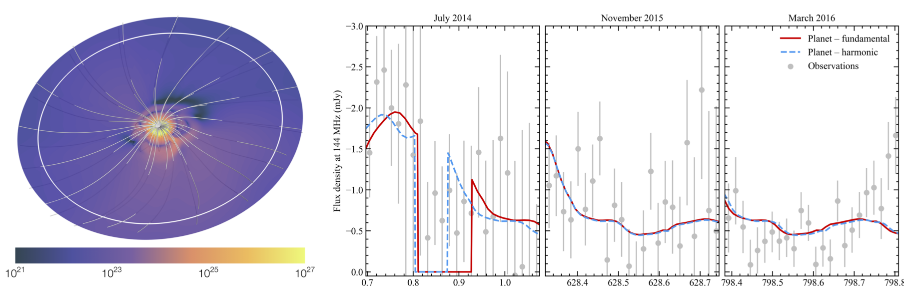

Figure 7: *Left*: Stellar wind environment of WX UMa. The white circle shows the orbital distance of 0.034 au that we identify where a Neptune-sized planet could orbit and reproduce the recently-detected radio emission from the star via magnetic star-planet interactions. Each point in the equatorial plane is coloured with the radio power that such a planet could induce from the star. The grey lines show the large-scale stellar magnetic field that connects to the orbit of the potential planet. *Right*: Comparison of the 144 MHz radio emission that was recently detected from the star with LOFAR (grey dots) to that which a Neptune-sized planet can induce from the star at an orbital distance of 0.034 au. Emission generated at the fundamental (red) or second harmonic (blue) of the local cyclotron frequency can reproduce the observations.

Jupiter's Temperature Structure: A Reassessment of the Voyager Radio Occultation Measurements

Pranika Gupta[1], *Sushil K. Atreya*[1], *Paul G. Steffes*[2], *Leigh N. Fletcher*[3], *Tristan Guillot*[4], *Michael D. Allison*[5], *Scott J. Bolton*[6], *Ravit Helled*[7], *Steven Levin*[8], *Cheng Li*[1], *Jonathan I. Lunine*[9], *Yamila Miguel*[10], *Glenn S. Orton*[8], *J. Hunter Waite*[6], *and Paul Withers*[11]

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[10] Leiden Observatory, University of Leiden, Niels Bohrweg 2, Leiden 2333CA, The Netherlands and SRON Netherlands Institute for Space Research, Niels Bohrweg 4, Leiden 2333CA, The Netherlands
[11] Astronomy Department, Boston University, Boston, MA 02215, USA

Planetary Science Journal, Submitted 19 March 2022. Revised 19 April 2022. Accepted 20 April 2022.

The thermal structure of planetary atmospheres is an essential input for predicting and retrieving the distribution of gases and aerosols, as well as the bulk chemical abundances. In the case of Jupiter, the temperature at a reference level – generally taken at 1 bar – serves as the anchor in models used to derive the planet's interior structure and composition. Most models assume the temperature measured by the Galileo probe (Seiff et al. 1998). However, those data correspond to a single location, an unusually clear, dry region, affected by local atmospheric dynamics. On the other hand, the Voyager radio occultation observations cover a wider range of latitudes, longitudes, and times (Lindal et al. 1981). The Voyager retrievals were based on atmospheric composition and radio refractivity data that require updating and were never properly tabulated: the few existing tabulations are incomplete and ambiguous. Here, we present a systematic electronic digitization of all available temperature profiles from Voyager, followed by their reanalysis, employing currently accepted values of the abundances and radio refractivities of atmospheric species. We find the corrected temperature at the 1 bar level to be up to 4 K greater than previously published values, i.e., 170.33.8 K at 12S (Voyager 1 ingress) and 167.33.8 K at 0N (Voyager 1 egress). This is to be compared with the Galileo probe value of 166.10.8 K at the edge of an unusual feature at 6.57N. Altogether, this suggests that Jupiter's tropospheric temperatures may vary spatially by up to 7 K between 7N and 12S.

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A scaled-up planetary system around a supernova progenitor

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[9] Departamento de Física Teórica, Universidad Autónoma de Madrid; S-28049 Madrid, Spain
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[11] Landessternwarte, Zentrum für Astronomie der Universität Heidelberg; Königstuhl 12, D-69117 Heidelberg, Germany
[12] Leiden Observatory, Leiden University; Postbus 9513, NL-2300 RA Leiden, The Netherlands
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Astronomy & Astrophysics, accepted (arXiv:2205.02279)

Virtually all known exoplanets reside around stars with $M < 2.3\ M_\odot$ either due to the rapid evaporation of the protostellar disks or to selection effects impeding detections around more massive stellar hosts. To clarify if this dearth of planets is real or a selection effect, we launched the planet-hunting B-star Exoplanet Abundance STudy (BEAST) survey targeting B stars ($M > 2.4\ M_\odot$) in the young (5-20 Myr) Scorpius-Centaurus association by means of the high-contrast spectro-imager SPHERE at the Very Large Telescope. In this paper we present the analysis of high-contrast images of the massive ($M \sim 9\ M_\odot$) star μ^2 Sco obtained within BEAST. We carefully examined the properties of this star, combining data from Gaia and from the literature, and used state-of-the-art algorithms for the reduction and analysis of our observations. Based on kinematic information, we found that μ^2 Sco is a member of a small group which we label Eastern Lower Scorpius within the Scorpius-Centaurus association. We were thus able to constrain its distance, refining in turn the precision on stellar parameters. Around this star we identify a robustly detected substellar companion ($14.4 \pm 0.8\ M_\mathrm{J}$) at a projected separation of 290 ± 10 au, and a probable second similar object ($18.5 \pm 1.5\ M_\mathrm{J}$) at 21 ± 1 au. The planet-to-star mass ratios of these objects are similar to that of Jupiter to the Sun, and the flux they receive from the star is similar to those of Jupiter and Mercury, respectively. The robust and the probable companions of μ^2 Sco are naturally added to the giant $10.9\ M_\mathrm{J}$ planet recently discovered by BEAST around the binary b Cen system. While these objects are slightly more massive than the deuterium burning limit, their properties are similar to those of giant planets around less massive stars and they are better reproduced by assuming that they formed under a planet-like, rather than a star-like scenario. Irrespective of the (needed) confirmation of the inner companion, μ^2 Sco is the first star that would end its life as a supernova that hosts such a system. The tentative high frequency of BEAST discoveries is unexpected, and it shows that systems with giant planets or small-mass brown dwarfs can form around B stars. When putting this finding in the context of core accretion and gravitational instability formation scenarios, we conclude that the current modeling of both mechanisms is not able to produce this kind of companion. The completion of BEAST will pave the way for the first time to an extension of these models to intermediate and massive stars.

Download/Website: `https://arxiv.org/pdf/2205.02279.pdf`

Contact: `vito.squicciarini@inaf.it`

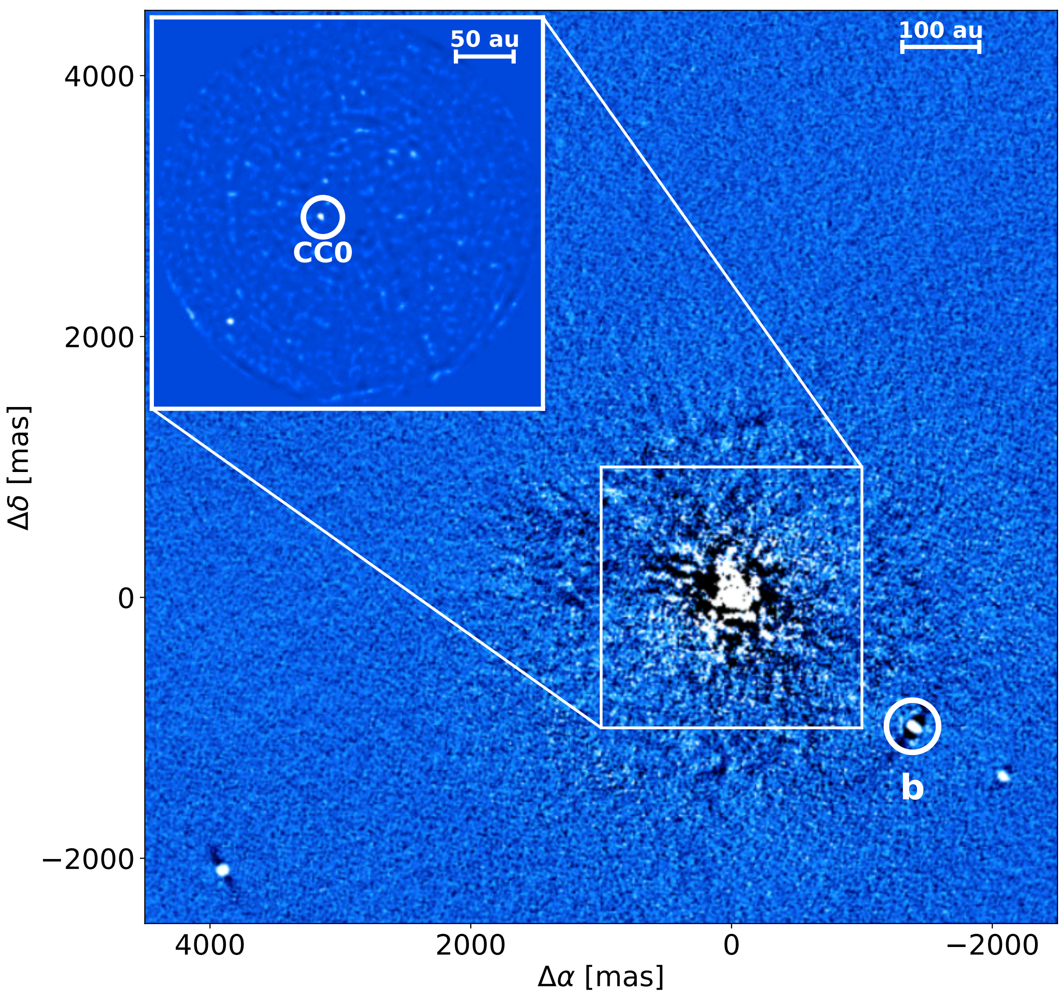

Figure 8: *Main plot*: final reduced high-contrast image of μ^2 Sco obtained by the Infra-Red Dual-beam Imaging and Spectroscopy (IRDIS) at the Very Large Telescope (VLT) in 2018. The star, artificially obscured by a coronagraphic mask, is at the center of the image. Several background sources can be seen as bright point sources. μ^2 Sco b is the source labeled as "b" inside the white circle. *Inset*: image obtained at the same epoch by the Integral Field Spectrograph (IFS) @ VLT. The probable companion CC0 is the source inside the white circle. A background source is visible on the lower left.

3 Exoplanet Archive Updates

April 2022 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, May 10, 2022

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

April 21, 2022

Three New Planets and 10 New K2 Candidates

We've added two more circumbinary planets found in the Kepler-451 system, and GJ 514 b, a super-Earth that moves in and out of the habitable zone in an eccentric orbit. Find their data in the Planetary Systems Table and its companion table, Planetary Systems Composite Parameters.

There are also 10 new K2 candidates in the K2 Planets and Candidates Table. **Pro Tip:** To display only this week's new candidates and parameter sets in the table, scroll horizontally to the Release Date column (the last one) and enter 2022-04-21 to filter the results.

April 14, 2022

Two New Planets, Including AB Aur b

The AB Aur system is the second protoplanetary disk where an embedded exoplanet has been found, which supports the "disk instability" theory of planet formation. Read NASA's media release (`https://go.nasa.gov/3N05UgG`) and the discovery paper (`https://www.nature.com/articles/s41550-022-01634-x`).

The other new planet is TOI-620 b. There are also new parameters for TOI-2076 b, c, & d, TOI-216 b & c, KELT-24 b (MASCARA-3 b), and WD 0806-661 (GJ 3483 b).

Access all of these new data from the Planetary Systems Table and its companion table, Planetary Systems Composite Parameters, which offers a more complete table of planet parameters combined from multiple references and calculations.

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

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

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

Hybrid Workshop, July 25-29, 2022

The 2022 Sagan Summer Workshop will be a hybrid workshop with both in-person and on-line attendance. As of late March, our in-person capacity limit has been reached and we have started a waitlist for in-person attendance. We are optimistic that the in-person limit will be increased before the workshop. Note that in-person attendees are required to verify their COVID vaccination and booster status before their registration is confirmed. Additionally, in person attendees must comply with any mask mandates and public health guidelines from L. A. County, City of Pasadena, and California Institute of Technology that are in place at the time of the workshop. The workshop website will be updated with this information going forward.

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

The workshop will cover the topics listed below. Please visit the workshop website for the agenda and list of confirmed speakers.

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

There is no registration fee for this workshop and registration is available on the workshop website.

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

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

4 Jobs and Positions

JUNIOR GROUP LEADER (F*M) in Space Instrumentation

at the Space Research Institute, Graz, Austria, 30 June 2022 (or until the post has been filled)

The Space Research Institute (IWF) of the Austrian Academy of Sciences (OeAW), Austria's leading non-university research and science institution, is offering a position as (Junior) Group leader in Space Instrumentation (Job-ID: IWF184JGL121). We invite ambitious candidates who are interested in technology development for new and existing fields of scientific instruments. We strive for a tight collaboration between instrumentation and space science as we understand instrumentation as science enabler.

Your profile:

- PhD in engineering or physics/astrophysics
- Experiences in development of space-qualified instrumentation and related engineering disciplines: electrical, electronics, mechanical, software, quality assurance as well as other engineering fields which fit to the scientific activities of the institute
- Proven track record in development of at least one space-borne instrument or in leading subunit development or in being responsible for one of the mentioned engineering fields
- Proven track-record in project and in people management

Your tasks:

- Leading an existing research group with focus on instrument development and development support in direct link with the IWF's research activities
- Management (jointly with senior engineers of the research group) of already existing projects (Router and Data Compression Unit for PLATO and IWF's contribution for SXI aboard SMILE to be finalised; Digital Processing Unit for MANiaC aboard Comet Interceptor and IWF's contribution for the Wide Field Imager aboard ATHENA under preparation)
- Initiation of new developments in accordance with the scientific core activities of IWF
- Technical and financial proposal writing and reporting
- Coordination of all activities to fulfil technical and schedule requirements
- Supervision of group members, incl. PhD students and PostDocs
- Publication activities

The appointment begins as early as September 01, 2022 for initially 4 years with the option for tenure track. More senior applicants can be offered the position of a group leader for an initial duration of 6 years with a tenure-track option. We offer an annual gross salary of 54.661,32 for a junior group leader. Applications must include a cover letter, their curriculum vitae, list of publications, a statement of the applicant's research experience (2 pages) and a research plan (1 page), certificates for full academic record, and the full contact information for two references letters. Please send the application as one PDF file, to cosima.muck@oeaw.ac.at, mentioning Job ID: IWF184JGL121, no later than 30 June 2022 (or until the post has been filled).

The Austrian Academy of Sciences pursues a non-discriminatory employment policy and values equal opportunities, and diversity. Individuals from underrepresented groups are particularly encouraged to apply.

Download/Website: `https://www.oeaw.ac.at/en/iwf/home`

Contact: `cosima.muck@oeaw.ac.at`

5 Conferences and Workshops

Exoplanet Imaging Data Challenge - Phase 2 launch: characterization

F. Cantalloube, on behalf of the Exoplanet Imaging Data Challenge Team

Submissions are open on the EvalAI platform, 25/04/2022 - 25/06/2022

The second phase of the *Exoplanet Imaging Data Challenge* is now open for submissions, until end of June. This second phase is focused on the characterisation of exoplanets signals from low spectral resolving power high-contrast instruments (namely VLT/SPHERE-IFS [1] and Gemini-S/GPI [2]). The data challenge is hosted on the EvalAI platform [3] and the data are permanently available on a Zenodo repository [4]. The results will be announced during the Spirit of Lyot conference [5] during a plenery session, and a prize will be offered to the winner of the contest based on the leaderboard results. A deeper analysis of all the received entries will be published in an SPIE Astronomical Telescopes + Instrumentation proceeding [6]. As for the 1st phase, participants are invited to co-author this publication.

Main information:
Opening date: 25/04/2022
Closing date: 25/06/2022
Number of image datacubes: 4 from SPHERE-IFS, 4 from GPI
Number of injections per cube: 2 to 3 per dataset (total 21)

Tasks for participants
Task 1: **Astrometry** (position of the signal with respect to the star, in pixels);
Task 2: **Spectrophotometry** (contrast of the signal with respect to the host star at each wavelength).
On top of the estimated values, optional outputs from participants are the uncertainties on the estimated value and/or posterior distribution.

Metric used for the leaderboard
Distance, in absolute value (L1-norm), between the ground-truth and the estimated value for each exoplanet signal. The final result displayed is the average of the distances computed for the 21 injected signals.

Useful links:
[1] https://sphere.osug.fr/
[2] http://planetimager.org/
[3] https://eval.ai/web/challenges/challenge-page/1717/
[4] https://zenodo.org/record/6477664
[5] https://lyot2022.strw.leidenuniv.nl/
[6] https://spie.org/conferences-and-exhibitions/astronomical-telescopes-and-instrumentation

Feel free to advertise this initiative to whoever would be interested, and enjoy the contest !

Faustine Cantalloube for the Exoplanet Imaging Data Challenge Working Group:
Olivier Absil, Markus Bonse, Carles Cantero, Valentin Christiaens, Anthony Cioppa, Sandrine Juillard, Johan Mazoyer, Evert Nasedkin, Rakesh Nath, J.-B. Ruffio, Matthias Samland, Marc Van Droogenbroeck

Download/Website: `https://exoplanet-imaging-challenge.github.io/`

Contact: `exoimg.datachallenge@gmail.com`

EPSC 2022, EXOA7: Future instruments to detect and characterise extrasolar planets and their environment

Camilla Danielski[1], Elodie Choquet[2], Lorenzo V. Mugnai[3], Enzo Pascale[3]

[1] Instituto de Astrofísica de Andalucía, CSIC, Glorieta de la Astronomía, 18008, Granada, Spain
[2] Aix Marseille Univ, CNRS, CNES, LAM, Marseille, France
[3] Dipartimento di Fisica, La Sapienza Università di Roma, Piazzale Aldo Moro 2, 00185 Roma, Italy

Palacio de Congresos, Granada, Spain, 18 - 23 September 2022

Dear colleagues,

we would like to bring to your attention the following session that will take place during the Europlanet Science Congress 2022 (EPSC2022), as part of the "Exoplanets, Origins of Planetary Systems and Astrobiology" and "Missions, Instrumentation, Techniques, Modelling (MITM)" programmes:

EXOA7: Future instruments to detect and characterise extrasolar planets and their environment

Exoplanets are being discovered in large numbers thanks to recent and ongoing surveys using state-of-the-art instrumentation from the ground and from space. In the next years, new astronomical instruments will further scout our Galaxy to overcome the current observational biases in the search of alien worlds, to gain a deeper understanding of the chemical and physical properties of both exoplanets and their environments, and to unveil the processes of formation and evolution of planets and their atmospheres.

The goal of this session is to bring together the instrumentation and observational communities that are underpinning the future of this field. Contributions are invited to review ongoing programmes of exoplanet and circumstellar discs discovery and characterisation, to update on the progress of planned instrumentation programmes, and to present innovative ideas for future instrumentation.

The **non-extendable** abstract submission deadline is **18 May 2022, 13:00 CEST**.

Download/Website: `https://meetingorganizer.copernicus.org/EPSC2022/session/44585/`

Contact: `cdanielski@iaa.es`

EPSC 2022 - EXOA1 Formation, evolution, and stability of extrasolar systems

A.-S. Libert[1], *A. C. Petit*[2]
[1] Namur Institute for Complex Systems naXys, University of Namur, Belgium
[2] Centre for Star and Planet Formation, GLOBE Institute, University of Copenhagen, Denmark

Palacio de Congresos de Granada, Spain, 18 - 23 September 2022

Hundreds of planetary systems are currently known. A deep understanding of the architecture of both RV-detected systems and transit-detected systems is essential to probe planetary system formation.

In this session we address the question of the formation, dynamical evolution and stability of planetary systems in a broad sense, including (but not restricted to) the effects of planet-disc interactions, resonances, high eccentricity migration, binary stars, chaotic dynamics,...

The non-extendable abstract submission deadline is 18 May 2022, 13:00 CEST. Early career scientists are encouraged to submit an abstract.

Download/Website: `https://meetingorganizer.copernicus.org/EPSC2022/session/44587`
Contact: `anne-sophie.libert@unamur.be`

PFE-SPP 1992 joint meeting "(Exo)Planet Diversity, Formation, and Evolution"

Heike Rauer on behalf of the PFE-SPP1992 SOC

Freie Universität Berlin, Germany, September 12-14, 2022

Dear colleagues,

As announced earlier this year, we would like to draw your attention to the PFE-SPP 1992 joint meeting, for which the biennial workshop series "Planet formation and evolution" (PFE) and the DFG funded priority program "Exploring the diversity of extrasolar planets" (SPP 1992) join forces. The 2.5 day meeting is scheduled for September 12-14, 2022 as a hybrid meeting. The venue will be the Freie Universität (FU) Berlin.

Registration and abstract submission are now open. The meeting website with all relevant information can be found here: https://pfe-spp1992-joint-meeting.spp1992-exoplanetdiversity.de/.

The aim of the workshop is to bring together the solar system and exoplanetary communities to improve our insights on the formation, evolution and diversity of planets.

Looking forward to meeting you in Berlin!

Heike Rauer
(on behalf of the PFE-SPP1992 SOC)

About the PFE-SPP 1992 joint meeting: In order to foster collaborations across fields, this PFE-SPP1992 joint meeting aims at being a platform for researchers from the scientific fields of exoplanets, planet formation, protoplanetary and debris disks, astrobiology, cosmochemistry, and planetary research in general. The organizers want to encourage contributions from all disciplines, i.e. theory, observations as well as numerical and laboratory studies. The overarching goal of this meeting is to stimulate and intensify the dialogue between researchers from these different fields.

Download/Website: `https://pfe-spp1992-joint-meeting.spp1992-exoplanetdiversity.de/`

Contact: `spp1992@astro.physik.tu-berlin.de`

6 As seen on Exoplanet-talks.org

Download/Website: `http://exoplanet-talks.org`
Contact: `info@exoplanet-talks.org`

Instruction video: http://exoplanet-talks.org/talk/164

Geophysical Evolution During Rocky Planet Formation by *Tim Lichtenberg* - talk/403
Isotopes in exoplanet atmosphere by *Ignas Snellen* - talk/404

7 As seen on astro-ph

The following list contains exoplanet related entries appearing on astro-ph in April 2022.

April 2022

astro-ph/2204.00019: **Kepler-1656b's Extreme Eccentricity: Signature of a Gentle Giant** by *Isabel Angelo et al.*

astro-ph/2204.00124: **Co-accretion + giant impact origin of the Uranus system: Tilting Impact** by *Raluca Rufu, Robin M. Canup*

astro-ph/2204.00395: **Near-Linear Orbit Uncertainty Propagation in the Perturbed Two-Body Problem** by *Javier Hernando-Ayuso et al.*

astro-ph/2204.00633: **Images of Embedded Jovian Planet Formation At A Wide Separation Around AB Aurigae** by *Thayne Currie et al.*

astro-ph/2204.00709: **Estimating the Heights of Martian Vortices from Mars 2020 MEDA Data** by *Brian Jackson*

astro-ph/2204.00721: **Identifying Exoplanets with Machine Learning Methods: A Preliminary Study** by *Yucheng Jin, Lanyi Yang, Chia-En Chiang*

astro-ph/2204.01040: **Distribution of dust ejected from the lunar surface into the Earth-Moon system** by *Kun Yang et al.*

astro-ph/2204.01063: **Numerical analysis of processes for the formation of moonlets confining the arcs of Neptune** by *Gustavo Madeira, Silvia Maria Giuliatti Winter*

astro-ph/2204.01104: **Near-Infrared Spectroscopy Of The Nucleus Of Low-Activity Comet P/2016 BA14 During Its 2016 Close Approach** by *Theodore Kareta et al.*

astro-ph/2204.01135: **Annular structures in perturbed low mass disc-shaped gaseous nebulae I : general and standard models** by *Vladimir Pletser*

astro-ph/2204.01137: **Near infrared and optical emission of WASP-5 b** by *G. Kovacs et al.*

astro-ph/2204.01330: **Retrieval Study of Brown Dwarfs Across the L-T Sequence** by *Anna Lueber et al.*

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