ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Dear readers,

Welcome to Edition 140 of the ExoPlanet News!

In this February issue you will find abstracts of scientific papers, announcement of workshops, Exoplanet Archive updates, job postings, proposal call, and an overview of exoplanet-related articles on astro-ph.

In addition, we delightfully inform you about a new section in this newsletter: **As seen on Exoplanet-talks.org**. You will find, in this section, a list of all the talks which were uploaded to this platform in the previous month.

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 16 March 2021.
Thanks again for your support.

Best wishes from the editorial team,

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

2 Abstracts of refereed papers

A Theoretical Framework for the Mass Distribution of Gas Giant Planets forming through the Core Accretion Paradigm

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The Astrophysical Journal, in press, arXiv:2101.06714

This paper constructs a theoretical framework for calculating the distribution of masses for gas giant planets forming via the core accretion paradigm. Starting with known properties of circumstellar disks, we present models for the planetary mass distribution over the range $0.1M_J \leq M_{\rm p} < 10M_J$. If the circumstellar disk lifetime is solely responsible for the end of planetary mass accretion, the observed (nearly) exponential distribution of disk lifetime would imprint an exponential fall-off in the planetary mass function. This result is in apparent conflict with observations, which suggest that the mass distribution has a (nearly) power-law form $dF/dM_{\rm p} \sim M_{\rm p}^{-p}$, with index $p \approx 1.3$, over the relevant planetary mass range (and for stellar masses $\sim 0.5 - 2M_\odot$). The mass accretion rate onto the planet depends on the fraction of the (circumstellar) disk accretion flow that enters the Hill sphere, and on the efficiency with which the planet captures the incoming material. Models for the planetary mass function that include distributions for these efficiencies, with uninformed priors, can produce nearly power-law behavior, consistent with current observations. The disk lifetimes, accretion rates, and other input parameters depend on the mass of the host star. We show how these variations lead to different forms for the planetary mass function for different stellar masses. Compared to stars with masses M_* = $0.5 - 2M_\odot$, stars with smaller masses are predicted to have a steeper planetary mass function (fewer large planets).

Download/Website: `arXiv:2101.06714`

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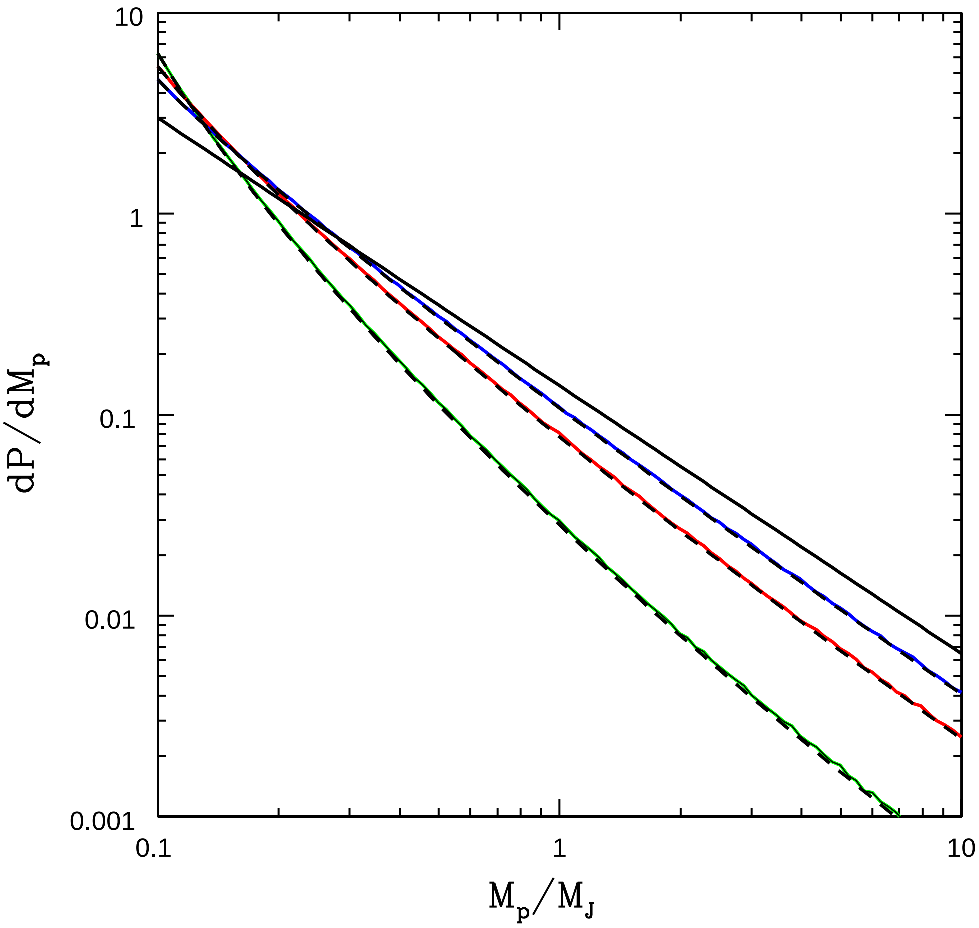

Figure 1: Planetary Mass Function. The curves show the theoretical planetary mass function predicted from an exponential distribution of disk lifetimes, uniform-random distribution of mass accretion rates, and accretion rate that increases with planet mass. The distributions are characterized by the mass scale $M_0 = \dot{M}_0 \tau$, which is determined by the the overall mass accretion rate $\dot{M}_0$ and the time scale τ of the disk lifetime distribution. Results are shown for $M_0 = 1 M_J$ (green) $\sqrt{10} M_J$ (red), and $10 M_J$ (blue). For each case, the colored curves are determined by sampling from the distributions, whereas the underlying dashed black curves show the analytic result derived in the paper. For comparison, the solid black curve shows a power-law mass distribution ($dP/dM \sim M^{-1.3}$), as indicated by observations.

Spectral appearance of the planetary surface accretion shock: Global spectra and hydrogen-line profiles and luminosities

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The Astrophysical Journal, arXiv:2011.06608

Hydrogen-line emission from an accretion shock has recently been observed at planetary-mass objects. Our previous work predicted the shock spectrum and luminosity for a shock on the circumplanetary disc. We extend this to the planet-surface shock. We calculate the global spectral energy distribution (SED) of accreting planets by combining our model emission spectra with photospheric SEDs, and predict the line-integrated flux for several hydrogen lines, especially Hα, but also Hβ, Paα, Paβ, Paγ, Brα, and Brγ. We apply our non-equilibrium emission model to the surface accretion shock for a wide range of accretion rates $\dot{M}$ and masses $M_{\rm p}$. Fits to formation calculations provide radii and effective temperatures. Extinction by the surrounding material is neglected, which is arguably often appropriate. We find that the line luminosity increases monotonically with $\dot{M}$ and $M_{\rm p}$, depending mostly on $\dot{M}$ and weakly on $M_{\rm p}$ for the relevant range of parameters. The Lyman, Balmer, and Paschen continua can exceed the photosphere. The Hβ line is fainter by 0–1 dex than Hα, whereas other lines are weaker (by $\sim$ 1–3 dex). Shocks on the planet or the CPD surface are distinguishable at very high spectral resolution, but the planet surface shock likely dominates if both are present. Applied to recent non-detections of Hα, our models imply looser constraints on the $\dot{M}$ of putative large-separation planets than from stellar extrapolations. These hydrogen-line luminosity predictions are useful for interpreting (non-)detections of accreting planets.

Download/Website: `http://adsabs.harvard.edu/abs/2020arXiv201106608A`

Download/Website: Fits to the radii and effective temperatures of forming planets: `https://github.com/gabrielastro/St-Moritz`

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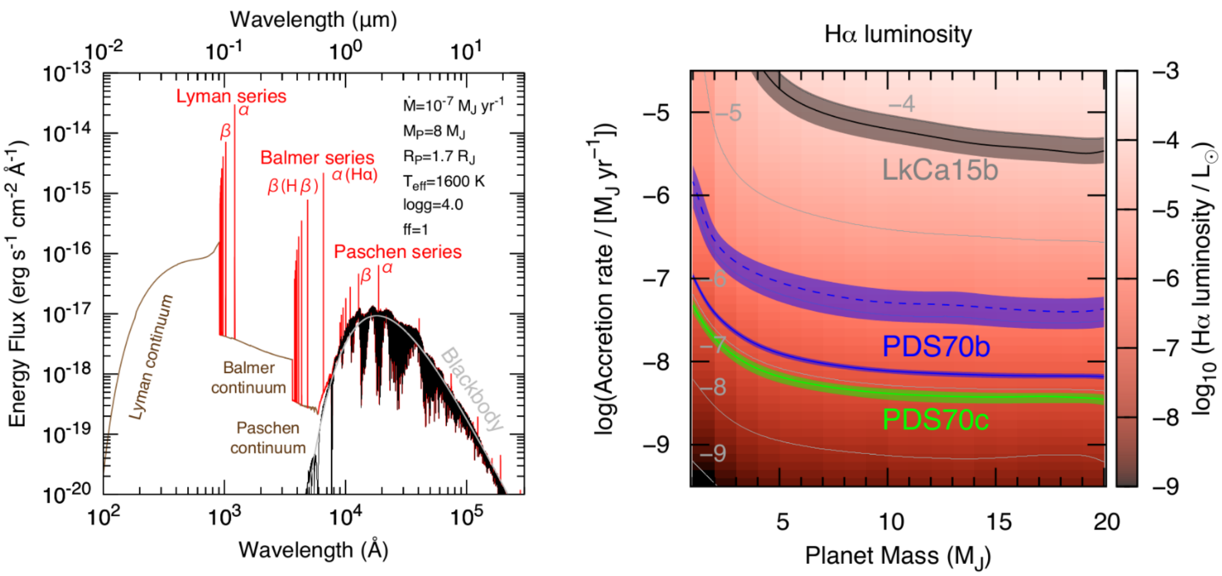

Figure 2: *Left panel:* SED of an accreting gas giant, e.g., for a $M_\mathrm{p} = 8\ M_\mathrm{J}$ planet accreting at $\dot{M} = 10^{-7}\ M_\mathrm{J}\,\mathrm{yr}^{-1}$, 150 pc away. The black line shows the pure photospheric radiation (BT-Settl; Allard et al. 2012) and the red shows the photospheric radiation with the shock excess. The Lyman, Balmer, and Paschen continua are approximate but are brighter than the photosphere.

Right panel: Line-integrated non-extincted Hα luminosity from the planet-surface shock as a function of accretion rate and planet mass. Thin gray lines highlight $\log(L_{\mathrm{H}\,\alpha}/L_\odot) = -9$ to -4 in steps of 1 dex. Shaded bands show non-dereddened 1-σ contour regions for PDS 70 b (dashed blue line: $10^{-5.9}\ L_\odot$, Wagner et al. 2018; solid: $10^{-6.8}\ L_\odot$, Haffert et al. 2019) and PDS 70 c (green: $10^{-7.1}\ L_\odot$, Haffert et al. 2019). Contours for the Hashimoto et al. (2020) value of $L_{\mathrm{H}\,\alpha} = 10^{-6.5}\ L_\odot$ (not shown) would lie between the two blue bands. The gray region is for the less secure protoplanet candidate LkCa 15 b (black: $10^{-4.1}\ L_\odot$; Sallum et al. 2015, but see discussion

Tracking Advanced Planetary Systems (TAPAS) with HARPS-N. TAPAS VII. Elder suns with low-mass companions.

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Astronomy and Astrophysics, accepted (arXiv:2101.10410)

We present the current status of and new results from our search for exoplanets in a sample of solar-mass, evolved stars observed with the HARPS-N and the 3.6-m Telescopio Nazionale Galileo (TNG), and the High Resolution Spectrograph (HRS) and the 9.2-m Hobby Eberly Telescope (HET). The aim of this project is to detect and characterise planetary-mass companions to solar-mass stars in a sample of 122 targets at various stages of evolution from the main sequence (MS) to the red giant branch (RGB), mostly sub-gaints and giants, selected from the Pennsylvania-Toruń Planet Search (PTPS) sample, and use this sample to study relations between stellar properties, such as metallicity, luminosity, and the planet occurrence rate.
This work is based on precise radial velocity (RV) measurements. We have observed the program stars for up to 14 years with the HET/HRS and the TNG/HARPS-N. We present the analysis of RV measurements with the HET/HRS and the TNG/HARPS-N of four solar-mass stars, HD 4760, HD 96992 , BD+02 3313, and TYC 0434-04538-1. We found that: HD 4760 hosts a companion with a minimum mass of 13.9 M_J (a=1.14 au, e=0.23); HD 96992 is a host to a $m\sin i$=1.14 M_J companion on a a=1.24 au and e=0.41 orbit, and TYC 0434-04538-1 hosts an $m\sin i$=6.1M_J companion on a a=0.66 au and e=0.08 orbit. In the case of BD+02 3313 we found a correlation between the measured RVs and one of the stellar activity indicators, suggesting that the observed RV variations may originate in either stellar activity or be caused by the presence of an unresolved companion. We also discuss the current status of the project and a statistical analysis of the RV variations in our sample of target stars.

Download/Website: `https://arxiv.org/abs/2101.10410`

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The HARPS search for southern extra-solar planets XLV. Two Neptune mass planets orbiting HD 13808: a study of stellar activity modelling's impact on planet detection

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:2102.03387)

We present a comprehensive analysis of 10 years of HARPS radial velocities of the K2V dwarf star HD 13808, which has previously been reported to host two unconfirmed planet candidates. We use the state-of-the-art nested sampling algorithm PolyChord to compare a wide variety of stellar activity models, including simple models exploiting linear correlations between RVs and stellar activity indicators, harmonic models for the activity signals, and a more sophisticated Gaussian process regression model. We show that the use of overly-simplistic stellar activity models that are not well-motivated physically can lead to spurious 'detections' of planetary signals that are almost certainly not real. We also reveal some difficulties inherent in parameter and model inference in cases where multiple planetary signals may be present. Our study thus underlines the importance both of exploring a variety of competing models and of understanding the limitations and precision settings of one's sampling algorithm. We also show that at least in the case of HD 13808, we always arrive at consistent conclusions about two particular signals present in the RV, regardless of the stellar activity model we adopt; these two signals correspond to the previously-reported though unconfirmed planet candidate signals. Given the robustness and precision with which we can characterize these two signals, we deem them secure planet detections. In particular, we find two planets orbiting HD 13808 at distances of $0.11, 0.26$ AU with periods of $14.2, 53.8$ d, and minimum masses of $11, 10$ Earth masses.

Download/Website: `https://arxiv.org/abs/2102.03387`

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Bifurcation of planetary building blocks during Solar System formation

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Science 371, 365–370 (2021), doi:10.1126/science.abb3091

Geochemical and astronomical evidence demonstrate that planet formation occurred in two spatially and temporally separated reservoirs. The origin of this dichotomy is unknown. We use numerical models to investigate how the evolution of the solar protoplanetary disk influenced the timing of protoplanet formation and their internal evolution. Migration of the water snow line can generate two distinct bursts of planetesimal formation that sample different source regions. These reservoirs evolve in divergent geophysical modes and develop distinct volatile contents, consistent with constraints from accretion chronology, thermo-chemistry, and the mass divergence of inner and outer Solar System. Our simulations suggest that the compositional fractionation and isotopic dichotomy of the Solar System was initiated by the interplay between disk dynamics, heterogeneous accretion, and internal evolution of forming protoplanets.

Download/Website: `https://arxiv.org/abs/2101.08571`
`https://exoplanet-talks.org/talk/211`

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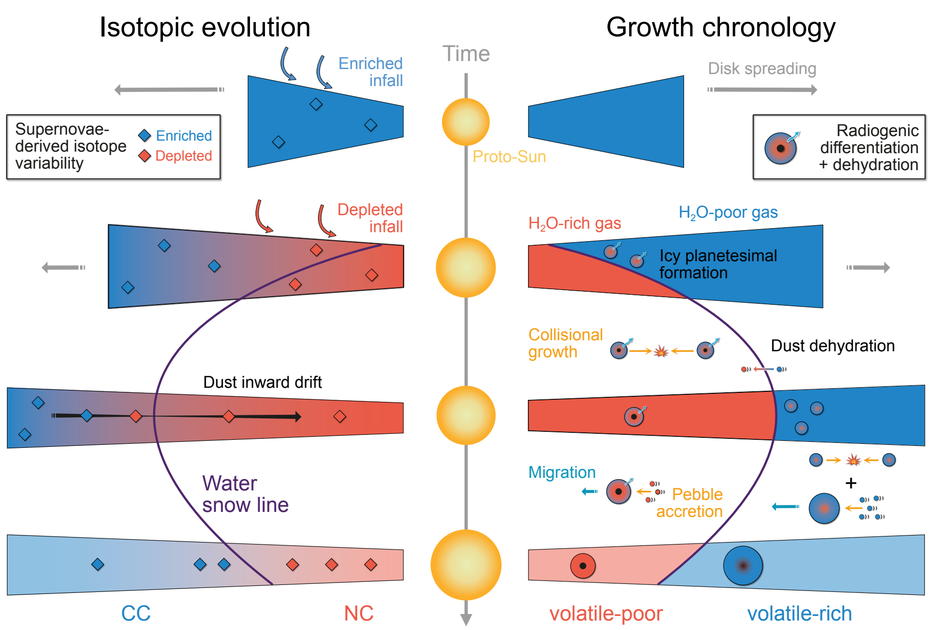

Figure 3: Schematic illustration of our proposed chronology of early Solar System accretion. Nucleosynthetic isotope variability (left) across the disk due to varying composition of infall material is retained by the pile-up of inward-drifting dust grains at the snow line. The formation of two distinct planetesimal populations initiates divergent evolutionary pathways of inner and outer Solar System (right) due to the secular variation of local material composition, internal radiogenic heating, and dominant mode of planetary growth.

Vertically resolved magma ocean–protoatmosphere evolution: H_2, H_2O, CO_2, CH_4, CO, O_2, and N_2 as primary absorbers

Tim Lichtenberg[1], *Dan J. Bower*[2], *Mark Hammond*[3], *Ryan Boukrouche*[1], *Patrick Sanan*[4], *Shang-Min Tsai*[1], *Raymond T. Pierrehumbert*[1]

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Journal of Geophysical Research: Planets (2021), doi:10.1029/2020JE006711

The earliest atmospheres of rocky planets originate from extensive volatile release during magma ocean epochs that occur during assembly of the planet. These establish the initial distribution of the major volatile elements between different chemical reservoirs that subsequently evolve via geological cycles. Current theoretical techniques are limited in exploring the anticipated range of compositional and thermal scenarios of early planetary evolution, even though these are of prime importance to aid astronomical inferences on the environmental context and geological history of extrasolar planets. Here, we present a coupled numerical framework that links an evolutionary, vertically-resolved model of the planetary silicate mantle with a radiative-convective model of the atmosphere. Using this method we investigate the early evolution of idealized Earth-sized rocky planets with end-member, clear-sky atmospheres dominated by either H_2, H_2O, CO_2, CH_4, CO, O_2, or N_2. We find central metrics of early planetary evolution, such as energy gradient, sequence of mantle solidification, surface pressure, or vertical stratification of the atmosphere, to be intimately controlled by the dominant volatile and outgassing history of the planet. Thermal sequences fall into three general classes with increasing cooling timescale: CO, N_2, and O_2 with minimal effect, H_2O, CO_2, and CH_4 with intermediate influence, and H_2 with several orders of magnitude increase in solidification time and atmosphere vertical stratification. Our numerical experiments exemplify the capabilities of the presented modeling framework and link the interior and atmospheric evolution of rocky exoplanets with multi-wavelength astronomical observations.

Download/Website: `https://arxiv.org/abs/2101.10991`
`https://exoplanet-talks.org/talk/251`

Contact: `tim.lichtenberg@physics.ox.ac.uk`

Exoplanet Imaging Data Challenge: benchmarking the various image processing methods for exoplanet detection

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SPIE conference proceeding, published (arXiv:2101.05080v1)

The *Exoplanet Imaging Data Challenge* is a community-wide effort meant to offer a platform for a fair and common comparison of image processing methods designed for exoplanet direct detection. For this purpose, it gathers on a dedicated repository (Zenodo), data from several high-contrast ground-based instruments worldwide in which we injected synthetic planetary signals. The data challenge is hosted on the CodaLab competition platform, where participants can upload their results. The specifications of the data challenge are published on our website (https://exoplanet-imaging-challenge.github.io/). The first phase, launched on the 1st of September 2019 and closed on the 1st of October 2020, consisted in detecting point sources in two types of common data-set in the field of high-contrast imaging: data taken in pupil-tracking mode at one wavelength (subchallenge 1, also referred to as ADI) and multispectral data taken in pupil-tracking mode (subchallenge 2, also referred to as ADI+mSDI). In this paper, we describe the approach, organisational lessons-learnt and current limitations of the data challenge, as well as preliminary results of the participants' submissions for this first phase. In the future, we plan to provide permanent access to the standard library of data sets and metrics, in order to guide the validation and support the publications of innovative image processing algorithms dedicated to high-contrast imaging of planetary systems.

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

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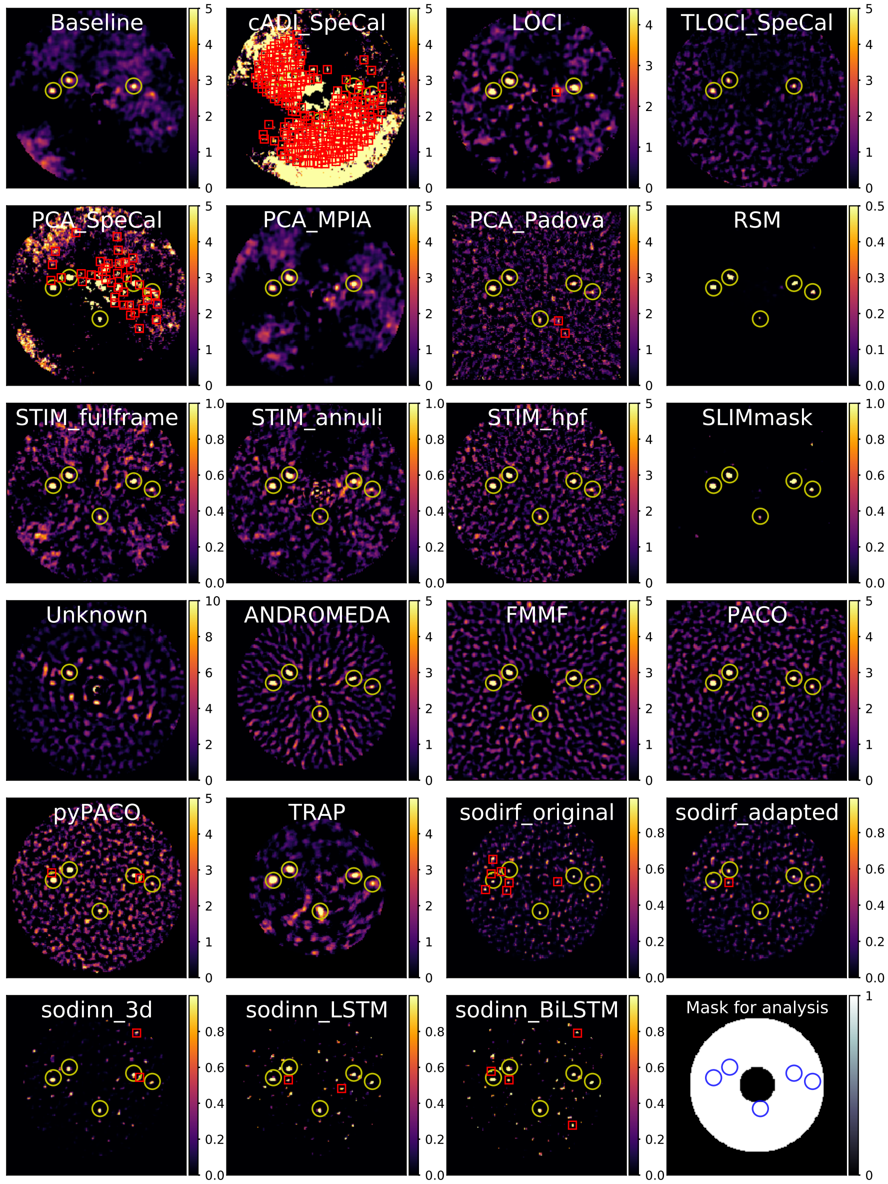

Figure 4: Example of the detection maps received on one of the VLT/SPHERE data set taken in pupil tracking mode. In this data set, we injected 5 planetary signals (blue circles in the bottom right insert). The synthetic planetary signals are injected close to the detection limit obtained from an annular Principal Component Analysis (baseline, top left). We received 22 submissions using various algorithms. For each detection map, the color scales from 0 to the chosen threshold (submitted by each participant). The yellow circles indicate true detections while the red squares indicate false detections. For more information about the various algorithms used, please refer to the publication.

A backward-spinning star with two coplanar planets

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PNAS, to be published Feb. 15 (https://doi.org/10.1073/pnas.2017418118)

It is widely assumed that a star and its protoplanetary disk are initially aligned, with the stellar equator parallel to the disk plane. When observations reveal a misalignment between stellar rotation and the orbital motion of a planet, the usual interpretation is that the initial alignment was upset by gravitational perturbations that took place after planet formation. Most of the previously known misalignments involve isolated hot Jupiters, for which planet-planet scattering or secular effects from a wider-orbiting planet are the leading explanations. In theory, star/disk misalignments can result from turbulence during star formation or the gravitational torque of a wide-orbiting companion star, but no definite examples of this scenario are known. An ideal example would combine a coplanar system of multiple planets — ruling out planet-planet scattering or other disruptive post-formation events — with a backward-rotating star, a condition that is easier to obtain from a primordial misalignment than from post-formation perturbations. There are two previously known examples of a misaligned star in a coplanar multi-planet system, but in neither case has a suitable companion star been identified, nor is the stellar rotation known to be retrograde. Here, we show that the star K2-290 A is tilted by 124 ± 6 degrees compared to the orbits of both of its known planets, and has a wide-orbiting stellar companion that is capable of having tilted the protoplanetary disk. The system provides the clearest demonstration that stars and protoplanetary disks can become grossly misaligned due to the gravitational torque from a neighbouring star.

Download/Website: `https://ui.adsabs.harvard.edu/abs/2021arXiv210207677H/abstract`

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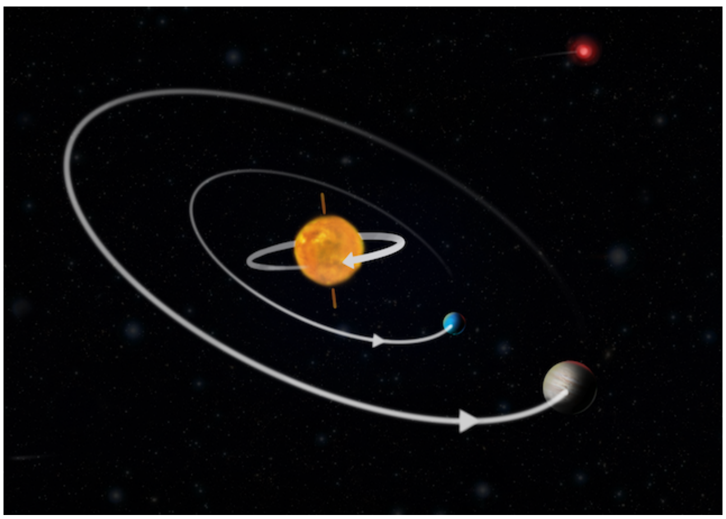

Figure 5: This artist illustration depicts the exoplanetary system in K2-290. It shows the main star K2-290 A, its two planets, and in the background the smaller companion star K2-290 B. The arrows indicate the sense of the stellar rotation and orbital motion.

A survey of the linear polarization of directly imaged exoplanets and brown dwarf companions with SPHERE-IRDIS. First polarimetric detections revealing disks around DH Tau B and GSC 6214-210 B

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Astronomy & Astrophysics, in press (arXiv:2101.04033)

Context. Young giant planets and brown dwarf companions emit near-infrared radiation that can be linearly polarized up to several percent. This polarization can reveal the presence of an (unresolved) circumsubstellar accretion disk, rotation-induced oblateness of the atmosphere, or an inhomogeneous distribution of atmospheric dust clouds.
Aims. We aim to measure the near-infrared linear polarization of 20 known directly imaged exoplanets and brown dwarf companions.
Methods. We observed the companions with the high-contrast imaging polarimeter SPHERE-IRDIS at the Very Large Telescope. We reduced the data using the IRDAP pipeline to correct for the instrumental polarization and crosstalk of the optical system with an absolute polarimetric accuracy $<0.1\%$ in the degree of polarization. We employed aperture photometry, angular differential imaging, and point-spread-function fitting to retrieve the polarization of the companions.
Results. We report the first detection of polarization originating from substellar companions, with a polarization of several tenths of a percent for DH Tau B and GSC 6214-210 B in H-band. By comparing the measured polarization with that of nearby stars, we find that the polarization is unlikely to be caused by interstellar dust. Because the companions have previously measured hydrogen emission lines and red colors, the polarization most likely originates from circumsubstellar disks. Through radiative transfer modeling, we constrain the position angles of the disks and find that the disks must have high inclinations. For the 18 other companions, we do not detect significant polarization and place subpercent upper limits on their degree of polarization. We also present images of the circumstellar disks of DH Tau, GQ Lup, PDS 70, β Pic, and HD 106906. We detect a highly asymmetric disk around GQ Lup and find evidence for multiple scattering in the disk of PDS 70. Both disks show spiral-like features that are potentially induced by GQ Lup B and PDS 70 b, respectively.
Conclusions. The presence of the disks around DH Tau B and GSC 6214-210 B as well as the misalignment of the disk of DH Tau B with the disk around its primary star suggest in situ formation of the companions. The non-detections of polarization for the other companions may indicate the absence of circumsubstellar disks, a slow rotation rate of young companions, the upper atmospheres containing primarily submicron-sized dust grains, and/or limited cloud inhomogeneity.

Download/Website: `https://arxiv.org/abs/2101.04033`

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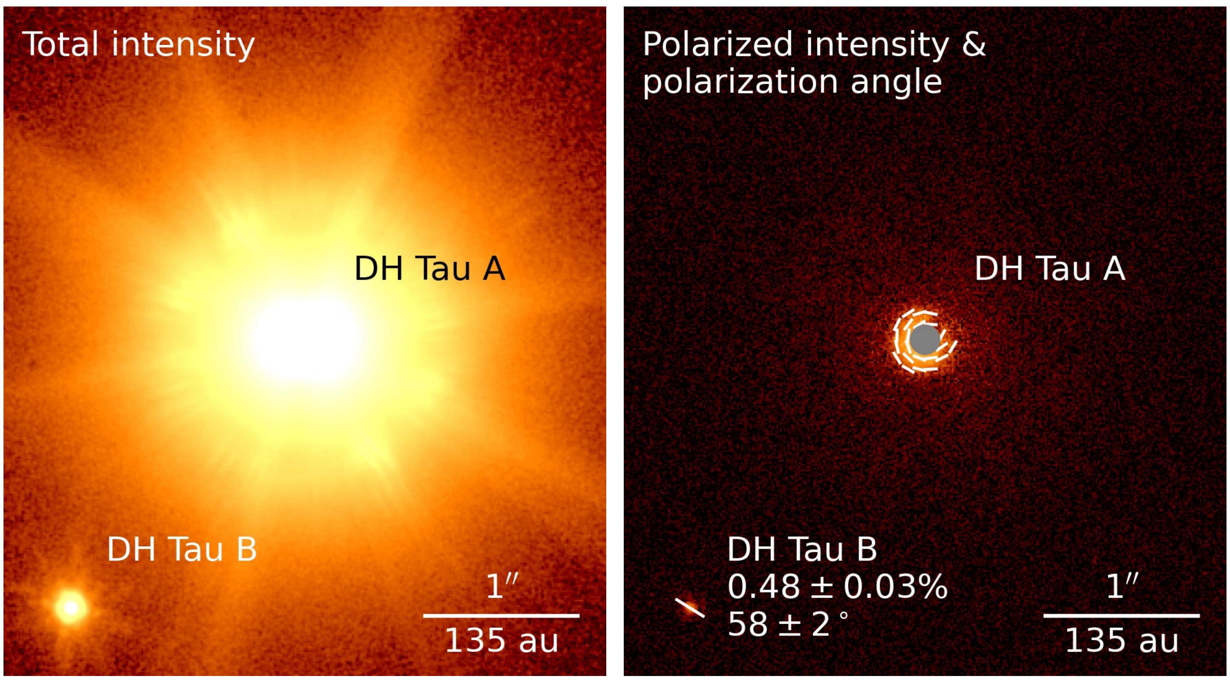

Figure 6: Images of the total intensity (left) and the linearly polarized intensity (right) of the DH Tau system. In polarized light the companion DH Tau B is visible, which is most likely due to its spatially unresolved circumsubstellar disk. The disk around the parent star is also visible.

The β Pictoris b Hill Sphere Transit Campaign. Paper I: Photometric limits to dust and rings

M. A. Kenworthy[1], S. N. Mellon[2], J. I. Bailey, III[3], R. Stuik[1,4], P. Dorval[1,4], G. J. J. Talens[5], S. R. Crawford[6,7], E.E. Mamajek[2,8], I. Laginja[9,10], M. Ireland[11], B. Lomberg[6,12,13], R. B. Kuhn[6,14], I. Snellen[1], K. Zwintz[15], R. Kuschnig[16], G. M. Kennedy[17,18], L. Abe[19], A. Agabi[19], D. Mekarnia[19], T. Guillot[19], F. Schmider[19], P. Stee[19], Y. de Pra[20,21], M. Buttu[20], N. Crouzet[22], P. Kalas[23,24,25], J. J. Wang[26], K. Stevenson[27,28], E. de Mooij[29,30], A.-M. Lagrange[31,32,33], S. Lacour[32], A. Lecavelier des Etangs[34], M. Nowak[32,35], P. A. Strøm[17], Z. Hui[36], L. Wang[37]
(a complete list of author affiliations can be found on the publication)

Astronomy & Astrophysics, accepted/2102.05672

Photometric monitoring of Beta Pictoris in 1981 showed anomalous fluctuations of up to 4% over several days, consistent with foreground material transiting the stellar disk. The subsequent discovery of the gas giant planet Beta Pictoris b and the predicted transit of its Hill sphere to within 0.1 au projected separation of the planet provided an opportunity to search for the transit of a circumplanetary disk in this 21 ± 4 Myr-old planetary system. We aim to detect or put an upper limit of the density and nature of the material in the circumplanetary environment of the planet through continuous photometric monitoring of the Hill sphere transit in 2017 and 2018.
Continuous broadband photometric monitoring of Beta Pictoris requires ground-based observatories at multiple longitudes to provide redundancy and to provide triggers for rapid spectroscopic followup. These observatories include the dedicated Beta Pictoris monitoring observatory bRing at Sutherland and Siding Springs, the ASTEP400 telescope at Concordia, and observations from the space observatories BRITE and Hubble Space Telescope. We search the combined light curves for evidence of short period transient events caused by rings and for longer term photometric variability due to diffuse circumplanetary material. We find no photometric event that matches with the event seen in November 1981, and there is no systematic photometric dimming of the star as a function of the Hill sphere radius. We conclude that the 1981 event was not caused by the transit of a circumplanetary disk around Beta Pictoris b. The upper limit on the long term variability of Beta Pictoris places an upper limit of 1.8×10^{22} g of dust within the Hill sphere (comparable to the $\sim$100 km-radius asteroid 16 Psyche). Circumplanetary material is either condensed into a disk that does not transit Beta Pictoris, is condensed into a disk with moons that has an obliquity that does not intersect with the path of Beta Pictoris behind the Hill sphere, or is below our detection threshold. This is the first time that a dedicated international campaign has mapped the Hill sphere transit of a gas giant extrasolar planet at 10 au.

Download/Website: `https://arxiv.org/abs/2102.05672`

Contact: `kenworthy@strw.leidenuniv.nl`

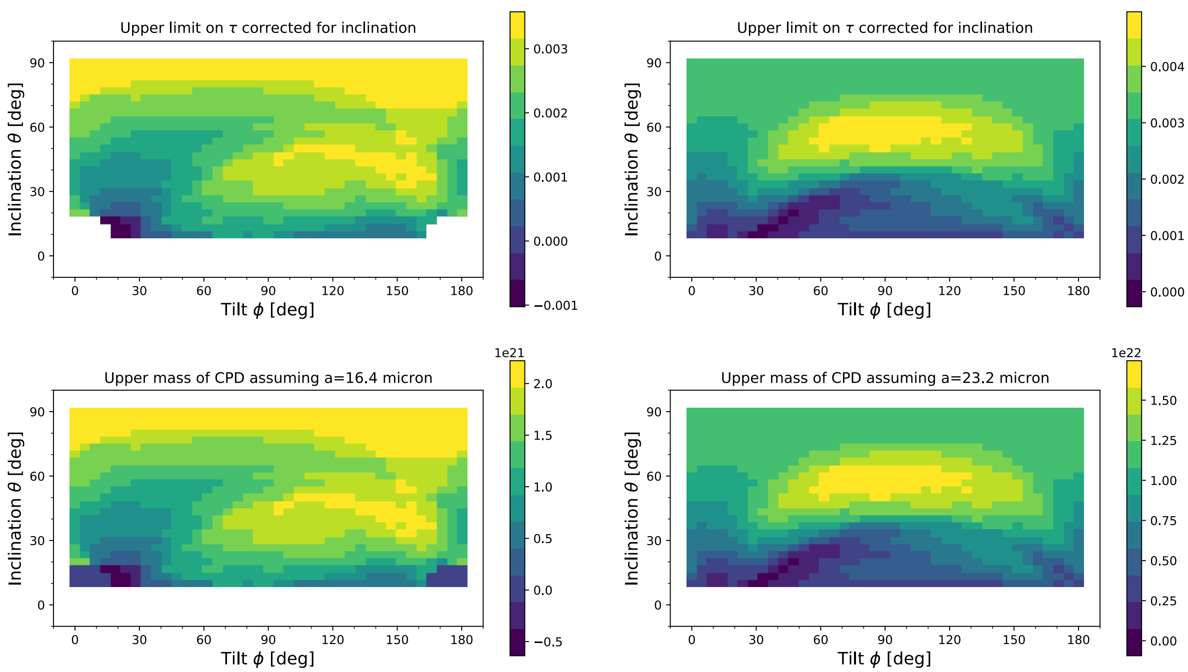

Figure 7: Beta Pictoris b circumplanetary disk models for $r = 0.30r_{Hill}$ and $r = 0.60r_{Hill}$ radii. The upper row shows the measured optical depth corrected for disk inclination, and the lower panel shows the upper limit on the total mass of the disk assuming mean particle sizes of 16.4 microns and 23.2 microns.

The radial structure of planetary bodies formed by the streaming instability

R.G. Visser[1], *J. Drążkowska*[2], *C. Dominik*[1]

[1] Anton Pannekoek Institute for Astronomy (API), University of Amsterdam, Science Park 904, 1098XH, Amsterdam
[2] University Observatory, Faculty of Physics, Ludwig-Maximilians-Universität München, Scheinerstr. 1, 81679 Munich, Germany

Astronomy & Astrophysics, in press, arXiv:2101.09209

Comets and small planetesimals are believed to contain primordial building blocks in the form of millimeter to centimeter sized pebbles. One of the viable growing mechanisms to form these small bodies is through the streaming instability (SI) in which pebbles cluster and gravitationally collapse toward a planetesimal or comet in the presence of gas drag. However, most SI simulations are global and lack the resolution to follow the final collapse stage of a pebble cloud within its Hill radius. We aim to track the collapse of a gravitationally bound pebble cloud subject to mutual collisions and gas drag with the representative particle approach. We determine the radial pebble size distribution of the collapsed core and the impact of mutual pebble collisions on the pebble size distribution. We find that virial equilibrium is never reached during the cloud evolution and that, in general, pebbles with a given Stokes number (St) collapse toward an optically thick core in a sequence from aerodynamically largest (St ~ 0.1) to aerodynamically smallest (St $\sim 2 \times 10^{-3}$). We show that at the location where the core becomes optically thick, the terminal velocity $v_{t,*} \sim 60 \ \mathrm{m\,s^{-1}St^2}$ is well below the fragmentation threshold velocity. While collisional processing is negligible during cloud evolution, the collisions that do occur are sticking. These results support the observations that comets and small planetary bodies are composed of primordial pebbles in the millimeter to centimeter size range.

Download/Website: `https://arxiv.org/abs/2101.09209`

Contact: `r.g.visser@uva.nl`

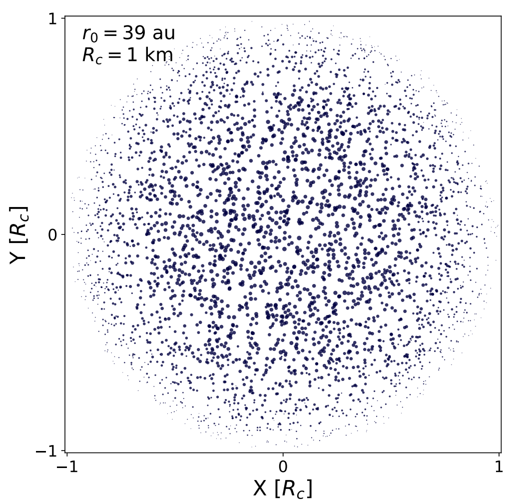

Figure 8: 2D slices in the XY plane of the final core formed from the collapse on 39 au normalized in units of core radius. Pebbles are indicated with the circles and scale from smallest circle (minimum Stokes number) to largest circle (maximum Stokes number). The inner core is composed of primarily large pebbles decreasing in size toward the core surface.

3 Jobs and Positions

University Professor - Planetary Physics with focus on extrasolar planets

TU Berlin - DLR

Berlin, Deadline 18.03.2021

The **Technische Universität Berlin**, Faculty II – Mathematics and Natural Sciences, Centre for Astronomy and Astrophysics, and the **German Aerospace Center (DLR)** jointly call for applications for a position of a University Professor for the field of *Planetary Physics with focus on extrasolar planets* as a joint position (Berliner Modell).
The position includes the role of **head of the department** ***Extrasolar Planets and Atmospheres*** at the DLR Institute for Planetary Research, Berlin-Adlershof. The holder of the position represents the area of *Planetary Physics with focus on extrasolar planets* in teaching at the Centre for Astronomy and Astrophysics at TU Berlin. The regular teaching obligation is 2 course hours per week. Working at the DLR fulfils the obligation for research at TU Berlin.
The Institute for Planetary Research engages in the exploration of planets, moons and small bodies in our solar system. Main focus are scientific questions about the formation and development as well as the habitability of planets and moons. The Institute participates in international scientific satellite missions of ESA, NASA and JAXA (amongst others the missions BepiColombo, CHEOPS, Comet Interceptor, ExoMars, JUICE, MMX, PLATO).
In the future this position shall strengthen in particular the connection between the characterization of extrasolar planets and planet populations with the knowledge about planetary evolution processes and small bodies in the solar system.
The application deadline is March 18th, 2021.
The job advertisement, the requirements, and details on how to apply can be found in
https://tub.stellenticket.de/de/offers/88675.

Download/Website: `https://tub.stellenticket.de/de/offers/88675`

Two Postdoctoral Associate positions on exoplanet atmosphere modelling

Vincent Bourrier
Observatoire Astronomique de l'Université de Genève, Chemin Pegasi 51b, 1290 Versoix, Switzerland

University of Geneva, September 2021

Applications are invited for two Postdoctoral Associate positions at the Department of Astronomy of the University of Geneva, working on exoplanet atmospheres in the research group led by Dr. Vincent Bourrier. The two positions are fully funded on the ERC project SPICE DUNE (SpectroPhotometric Inquiry of Close-in Exoplanets around the Desert to Understand their Nature and Evolution), with an initial duration of two years and a possible extension for a third year, depending on performance.

Position 1 is focused on developing models of upper atmospheres for hot gas-dominated planets. The main goal is the interpretation and prediction of atmospheric escape signatures in high-resolution spectroscopic data. The successful applicant will work with available HST ultraviolet data, ground-based visible and near-infrared data, and will have access to Guaranteed Time Observations of the NIRPS spectrograph (ESO/VLT), in which the Department of Astronomy is deeply involved.

Position 2 is focused on the study of ultra-short period (USP) small rocky planets. The successful applicant will mainly work on the development of models describing the envelope structure and escape from these objects. They will further collaborate with local experts to improve internal structure models for USP rocky planets, and to develop dedicated tools to search for and analyze their signatures in space-based photometry. The University of Geneva hosts the CHEOPS Science Operations Centre and the mission Project Science Office, and the successful applicant will contribute to the interpretation of CHEOPS data.

Setting: The Geneva Observatory offers one of the most vibrant environments worldwide for exoplanet research. The exoplanet team (www.exoplanets.ch) counts over 50 members, currently including 10 faculty members, 12 postdoctoral researchers, 15 PhD students, and 14 project staff members. Research topics include exoplanet detection and characterisation (atmospheres, interiors), planetary system dynamics, and instrumentation. Team members are directly involved in a large number of projects, including photometric instruments (CHEOPS, NGTS, TESS, PLATO), high-resolution spectrographs (ESPRESSO, NIRPS, HARPS, and others), direct imaging (SPHERE@VLT) and astrometry (GAIA). The exoplanet team is also part of PlanetS (www.nccr-planets.ch), a Swiss research network focused on exoplanetary science, which includes 130 scientists from the Universities of Geneva, Bern, Zurich and the Swiss Federal Institute of Technology in Zurich (ETHZ). The successful applicants will be able to take advantage of this unique collaborative framework. The University of Geneva is an equal opportunity employer committed to diversity.

Start date: is flexible, with a targeted start in September 2021 but no later than December 2021.
Salary: 81,000 CHF/year gross salary, according to rules of the University and Canton of Geneva.
Deadline: Applications received until 14 March 2021 will receive full consideration. Later applications will be reviewed until the positions are filled.
Requirements: A PhD degree in astrophysics or in any of the fields related to the proposed topics, completed by the start of the position. For both positions, expertise in exoplanets, atmospheric modeling, and radiative transfer codes is desired. Experience in particle and/or hydrodynamical codes, as well as photochemistry, would be a plus. Additional knowledge in high-resolution transmission spectroscopy (for position 1), and in dust physics/opacity, time-series photometry, interior models (for position 2) would also be valued. The successful applicants will become part of an active team with a wide range of expertises. We especially look for team players with a high level of autonomy and scientific creativity.

Any inquiries can be emailed to vincent.bourrier@unige.ch. The following application materials should be sent to this address in a single PDF:

- A curriculum vitae (2 pages).
- A cover letter (1 page), indicating which position the application refers to.
- A short research statement describing past achievements and future projects (max. 2 pages)
- A list of publications

Two letters of recommendation should be sent directly to Dr. Vincent Bourrier by the referees themselves.

Download/Website: `https://jobregister.aas.org/ad/82589e1a`

Contact: `vincent.bourrier@unige.ch`

4 Conferences

CHEOPS Science Workshop IV

Y. Alibert (SOC Chair)

Bern or Online, Switzerland, July 13 - 16, 2021

The CHEOPS workshop IV will be held 13-16 July, 2021, some 15 months after the beginning of CHEOPS science operations. The workshop will be the occasion for the planetary science community at large to discuss and share the first main results of CHEOPS in different fields, from the planetary internal structure to atmospheric characterization, etc. Participants are invited to propose contributed talks and posters on all scientific aspects linked to CHEOPS, including CHEOPS based-results as well as proposals for future observations and synergies with other facilities, as for example: mission update and performances, finding transits of already known planets, mass-radius relation and planetary internal structure, TTV, tidal deformation, moons and rings, tidal decay, phase curves, planet heat redistribution, cloud properties, albedo, et cetera.

Download/Website: `https://cheops.unibe.ch/scienceworkshop2021`

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

Free registration for the 2021 Sagan Summer Workshop is now available on the workshop website.

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. The preliminary agenda is available on the workshop website.

The workshop will be held via Zoom webinar and Slack will be used to facilitate discussion before, during, and after the workshop. The workshop will consist of live and pre-recorded talks, live discussions, hands-on sessions, contributed online posters and poster sessions, and virtual 'lunches with speakers'. As in previous years, all talks will be recorded and posted on the Sagan Summer Workshop YouTube channel.

The Sagan Summer Workshops are aimed at advanced undergraduates, grad students, and postdocs, however all are welcome to attend. Please visit the workshop website to register and for more information.

Download/Website: `http://nexsci.caltech.edu/workshop/2021`

Contact: `sagan_workshop@ipac.caltech.edu`

5 Announcements

50$^{\text{th}}$ Saas-Fee Advanced Course: Astronomy in the Era of Big Data

Yann Alibert, Kevin Heng, Danuta Sosnowska, Nathan Hara, Xavier Dumusque, Lucio Mayer

Online, Switzerland, March 15 - 19, 2021

The 2020 Saas-Fee Advanced Course of the Swiss Society for Astrophysics and Astronomy (SSAA) will be held from Monday, 15 March to Friday, 19 March 2021 online. This course replaces the one that should have taken place in 2020 and is devoted to:

Astronomy in the Era of Big Data.

The three lecturers will be:
- Dr. Roberto Trotta (Imperial College London)
- Prof. Suzanne Aigrain (University of Oxford)
- Prof. Marc Huertas-Company (Paris Observatory)

Registration is now open.

Download/Website: `http://nccr-planets.ch/saasfee2020/`

2021B NASA Keck Call for General Observing Proposals

Dr. Dawn M. Gelino, NASA Exoplanet Science Institute

Proposals Due: March 18, 2021 at 4 pm Pacific,

The NASA Exoplanet Science Institute is soliciting proposals to use NASA's portion of time on the Keck Telescopes for the 2021B observing semester (August 1, 2021 - January 31, 2022). All proposals are due by **March 18, 2021 at 4 pm Pacific**. The complete Call for Proposals and electronic submission site will be available on February 18, 2021.

The opportunity to propose as a Principal Investigator for NASA time on the Keck Telescopes is open to all U.S.-based astronomers (a U.S.-based astronomer has their principal affiliation at a U.S. institution). *Investigators from institutions outside of the U.S. may participate as Co-Investigators on proposals for NASA Keck time*.

NASA intends the use of the Keck telescopes to be highly strategic in support of on-going space missions and/or high priority, long-term science goals. Proposals are sought in the following discipline areas: (1) investigations in support of EXOPLANET EXPLORATION science goals and missions; (2) investigations of our own SOLAR SYSTEM; (3) investigations in support of COSMIC ORIGINS science goals and missions; and (4) investigations in support of PHYSICS OF THE COSMOS science goals and missions. Direct mission support proposals in any of these scientific areas are also encouraged. Please read the Call for Proposals for complete information and application guidelines. We also have a short video introduction titled *How to Apply for NASA Keck Time* that can be viewed here: *https://www.youtube.com/watch?v=zc5k0xHKs7s&feature=youtu.be*

Key Dates:

- March 4: deadline to request General Mission Support letter from NASA HQ
- March 18: all proposals and supporting letters due to NExScI

Download/Website: `http://nexsci.caltech.edu/missions/KeckSolicitation/index.shtml`

Contact: `KeckCFP@ipac.caltech.edu`

6 Exoplanet Archive Updates

January 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, February 16, 2021

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

The Confirmed Planets, Composite Planet Data, and Extended Planet Data interactive tables are also currently updated with new planetary and stellar data, but will be deprecated in early 2021. See this Transition document (`https://bit.ly/3jLgrhl`) and the Planetary Systems tables release notes (`https://bit.ly/3rVQPTx`) for details.

January 28, 2021

New Milestone: Over 100 TESS Planets!

This week's release consists of 10 new transiting planets, nine of which were discovered by NASA's TESS. This bumps up the total number of published, confirmed TESS planets to 107.

The new TESS planets are HD 108236 b, c, d, & e (aka TOI-1233), TOI-564 b, TOI-905 b and TOI-451 b, c, & d. The tenth planet, HD 108236 f, was discovered by ESA's CHEOPS mission. HD 108236 is also featured in this JPL Discovery Alert (`http://go.nasa.gov/3ahK0F5`); its bright, Sun-like star hosts a hot super-Earth that is evaporating under the glare of its sun—teaching us more about exoplanet atmospheres.

January 11, 2021

New Year, New Planets

For our first release of 2021, we have a new multi-planet system in the archive: TOI 561. All of the system's five planets were observed by NASA's TESS and are published in two papers, Lacedelli et al. and Weiss et al. These discoveries are also featured today in the news: A Rocky Planet Around One Of Our Galaxy's Oldest Stars (Keck Observatory) (`http://bit.ly/2Ze8lVP`).

Two additional planets have also been added to the archive, both of which were observed as transits: TOI-776 b & c.

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

7 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

Planet Detection

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Enhancing the radial-velocity technique to find Earth-like planets by *Xavier Dumusque* – talk/200
A Giant Planet Candidate Transiting a White Dwarf by *Andrew Vanderburg* – talk/204
An overview of transiting planets by *Andrew Vanderburg* – talk/206
From Pixels to Planets The Process of Validating Transiting Planets by *Andrew Vanderburg* – talk/207
The HD 217107 Planetary System: Twenty Years of Radial Velocity Measurements by *Mark Giovinazzi* – talk/208
A faint companion around CrA-9: protoplanet or obscured binary? by *Valentin Christiaens* – talk/210
Exoplanet Transits (review) by *Monika Lendl* – talk/214
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Atmospheric Characterization

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Tidal heating and the habitability of the TRAPPIST-1 planets (ExoplanetsIII conference) by *Vera Dobos* – talk/194

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Vertically resolved magma ocean?protoatmosphere evolution: H2, H2O, CO2, CH4, CO, O2, and N2 as primary absorbers by *Tim Lichtenberg* – talk/251

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The Planet as Exoplanet Analog Spectrograph (PEAS): Design and First Light by *Emily Martin* – talk/205
Combining radial velocities and astrometry to plan direct imaging exoplanet observations with the Roman Space Telescope Coronagraph by *Neil Zimmerman* – talk/233

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Precise Dynamical Masses for the Beta Pictoris System by *G. Mirek Brandt* – talk/218
Orbit fitting of Exoplanets with RV and Astrometry by *Yiting Li* – talk/219
Young planetary systems with close-in planets by *Silvano Desidera* – talk/220
orbitize! an open-source orbit-fitting toolkit for directly-imaged objects by *Sarah Blunt* – talk/221
Towards an exoplanet census in the cloud by *Nestor Espinoza* – talk/222
Transit and Radial velocity Interactive Fitting tool for Orbital analysis and N-body simulations - The Exo-Striker by *Trifon Trifonov* – talk/223
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Studying exoplanet orbits by *Maximilian Günther* – talk/226
Tidal effects in exoplanetary systems by *Emeline Bolmont* – talk/227
The Origins of Multi-Planet Systems with Misaligned, Nearby Companions by *Juliette Becker* – talk/228
Absolute Astrometry for Orbit Fitting by *Timothy Brandt* – talk/229
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Measuring mutual inclinations between giant planets and debris discs in HD 113337 by *Jerry Xuan* – talk/232
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8 As seen on astro-ph

List of exoplanet related entries seen on astro-ph during January 2021.

astro-ph/2101.00042: **Metastable Helium Absorptions with 3D Hydrodynamics and Self-Consistent Photochemistry I: WASP-69b, Dimensionality, XUV Flux Level, Spectral Types, and Flares** by *Lile Wang, Fei Dai*

astro-ph/2101.00045: **Metastable Helium Absorptions with 3D Hydrodynamics and Self-Consistent Photochemistry II: WASP-107b, Stellar Wind, Radiation Pressure, and Shear Instability** by *Lile Wang, Fei Dai*

astro-ph/2101.00469: **The Hubble WFC3 Emission Spectrum of the Extremely-Hot Jupiter, KELT-9b** by *Quentin Changeat, Billy Edwards*

astro-ph/2101.00530: **Polarized radiation and the Emergence of Biological Homochirality on Earth and Beyond** by *Noemie Globus, Anatoli Fedynitch, Roger D. Blandford*

astro-ph/2101.00663: **CHEOPS observations of the HD 108236 planetary system: A fifth planet, improved ephemerides, and planetary radii** by *A. Bonfanti et al.*

astro-ph/2101.01063: **Latitudinal variation of methane mole fraction above clouds in Neptune's atmosphere from VLT/MUSE-NFM: Limb-darkening reanalysis** by *P. G. J. Irwin et al.*

astro-ph/2101.01131: **In Situ Geochronology for the Next Decade: Mission Designs for the Moon, Mars, and Vesta** by *Barbara A. Cohen et al.*

astro-ph/2101.01179: **Giant planet migration during the disc dispersal phase** by *Kristina Monsch et al.*

astro-ph/2101.01202: **Following up the Kepler field: Masses of Targets for transit timing and atmospheric characterization** by *Daniel Jontof-Hutter et al.*

astro-ph/2101.01225: **Alkali metals in white dwarf atmospheres as tracers of ancient planetary crusts** by *Mark A. Hollands et al.*

astro-ph/2101.01277: **Possible Atmospheric Diversity of Low Mass Exoplanets, some Central Aspects** by *John Lee Grenfell et al.*

astro-ph/2101.01331: **Formation of intermediate-mass planets via magnetically-controlled disk fragmentation** by *Hongping Deng (Cambridge), Lucio Mayer (UZH), Ravit Helled (UZH)*

astro-ph/2101.01470: **NGTS-14Ab: a Neptune-sized transiting planet in the desert** by *A. M. S. Smith et al.*

astro-ph/2101.01593: **Masses and compositions of three small planets orbiting the nearby M dwarf L231-32 (TOI-270) and the M dwarf radius valley** by *Vincent Van Eylen et al.*

astro-ph/2101.01726: **TESS Delivers Five New Hot Giant Planets Orbiting Bright Stars from the Full Frame Images** by *Joseph E. Rodriguez et al.*

astro-ph/2101.01728: **How dust fragmentation may be beneficial to planetary growth by pebble accretion** by *Joanna Drazkowska, Sebastian M. Stammler, Til Birnstiel*

astro-ph/2101.01789: **High Spatial and Spectral Resolution Observations of the Forbidden 1.707 micron Rovibronic SO Emissions on Io: Evidence for Widespread Stealth Volcanism** by *Imke de Pater, Katherine de Kleer, Mate Adamkovics*

astro-ph/2101.01888: **Particle Dynamics in 3D Self-gravitating Disks I: Spirals** by *Hans Baehr, Zhaohuan Zhu*

astro-ph/2101.01891: **Particle Dynamics in 3D Self-gravitating Disks II: Strong Gas Accretion and Thin Dust Disks** by *Hans Baehr, Zhaohuan Zhu*

astro-ph/2101.01904: **Comparing Classification Models on Kepler Data** by *Rohan Saha*

astro-ph/2101.02005: **HELIOS-K 2.0 Opacity Calculator and Open-source Opacity Database for Exoplanetary Atmospheres** by *Simon L. Grimm et al.*

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