EP 10: Exoplanets and Astrobiology

Time: Friday 9:00–10:30 Location: KH 01.019

Invited Talk EP 10.1 Fri 9:00 KH 01.019

The diversity of low mass exoplanets — •Kristine Lam — Institut für Weltraumforschung, Deutsche Zentrum für Luft- und Raumfahrt (DLR)

Exoplanet discoveries and characterisation have revealed astonishing diversity. With the improved capability of observing facilities, an increasing number of low mass exoplanets are being characterised to unprecedented precision. In this talk, I will review the current exoplanet demographics with a focus on low mass exoplanets detected by transit and radial velocity surveys. We will dive into different exoplanet populations (super-Earths, sub-Neptunes, ultra-short-period planets, water worlds) and the various physical processes that could have sculpted each class of exoplanets. I will also give an overview of upcoming space- and ground-based telescopes and their expected impact on demographic studies and our understanding of exoplanetary systems and their evolution pathways.

EP 10.2 Fri 9:30 KH 01.019

Investigating the exoplanet HD88986 b by using TESS & CHEOPS space telescope data. — •Danial Almasian — Shahid Beheshti University, Tehran, Iran

The discovery of transiting planets with orbital periods exceeding 40 days has been exceptionally rare among the 5000+ planets identified to date. This dearth of findings poses a significant challenge to studying planetary demographics, formation, and evolution. In this study, we report detecting and characterizing HD88986 b, a potentially transiting sub-Neptune with the longest orbital period of any known transiting small planet. Our analysis drew on a combination of two sectors of TESS data and a 7-day observation from CHEOPS. Additionally, TLS was utilized for the analysis of HD88986 data. Our findings indicate that HD88986 b, exhibiting two likely single transits on sector 21 and sector 48, both consistent with the predicted transit time from the RV model, is a likely transit candidate. The wide orbit of HD88986 b suggests that the planet did not experience significant mass loss due to XUV radiation from its host star, likely retaining its original composition and offering insights into its formation. Furthermore, the cold nature of HD88986 b, owing to its extended orbital period, presents exciting prospects for future studies on the characterization of its cold atmosphere composition.

EP 10.3 Fri 9:45 KH 01.019

Does atmospheric composition actually trace planet formation? Results from observing aligned vs misaligned hot Jupiters as a testbed — •Eva-Maria Ahrer[1], James Kirk[2], and BOWIE-ALIGN collaboration[3] — [1]Max Planck Institute for Astronomy, Heidelberg, Germany — [2]Imperial College London, London, UK — [3]Bristol, Oxford, Warwick, Imperial, Exeter +

I will present the JWST program 'BOWIE-ALIGN', dedicated to test our understanding of planet formation with measurements of the composition of exoplanetary atmospheres, specifically hot Jupiters. It is unclear what variations in atmospheric chemistry can be attributed to different planet formation histories, made even more difficult by uncertainties in planetary evolution.

In our study, we compare the composition of a sample of seven hot Jupiters, where half their orbits are aligned and the other half misaligned relative to their host stars* spin axes. It is believed that aligned hot Jupiters around F stars are the outcome of disc migration, while misaligned ones arise from high-eccentricity migration. With this program we investigate whether these two subsets of exoplanets that are expected to have had very different formation pathways show any significant differences in their atmospheric composition.

I will summarise the observations of these seven hot Jupiters with JWST NIRSpec/G395H, and the outcome of this program. Specifically I will address if atmospheric composition using JWST can be used to make inferences about formation.

EP 10.4 Fri 10:00 KH 01.019

High-Resolution 3D Corona–Wind Models for Exoplanet Space Weather Around Solar-Type Stars — •Yuehong Chen and Julián Alvarado-Gómez — Leibniz Institute for Astrophysics Potsdam, Potsdam, Germany

Space-weather conditions experienced by exoplanets are strongly influenced by the state of the host-star corona and its magnetized wind. Existing studies typically constrain either coronal X-ray emission (spatially unresolved) or stellar winds (difficult to observe), and rarely connect both within a fully three-dimensional (3D) framework. Here we use the Space Weather Modeling Framework with the Alfvén Wave Solar Model (SWMF-AWSoM), driven by global convective dynamo-generated surface magnetic maps, to model fully 3D solar-type stellar coronae and winds spanning rotation rates 1.0–23.3 $\Omega_\odot$. Our models reproduce dense (1–2 orders of magnitude above solar) and ultra-hot ($\sim 10\,\mathrm{MK}$) coronae at high spatial resolution. We further show that enhanced coronal activity is accompanied by stronger winds, leading to elevated wind pressures that shape exoplanetary space environments. As illustrative cases, we evaluate wind pressures for super-Earth candidates Kepler-1638 b and Kepler-452 b, and find that an Earth-like dynamo can plausibly sustain magnetopauses of $r_M \simeq 5$–$10\,R_p$ under quiescent wind conditions. Overall, given the limited ability of current instrumentation to characterize exoplanet high-energy irradiation and particle environments in detail, our framework provides observation-informed inputs for exoplanet space-weather and habitability studies around solar-type stars.

EP 10.5 Fri 10:15 KH 01.019

Detectability of Atmospheric Climate and Biosignatures with the Large Interferometer for Exoplanets (LIFE) for terrestrial-type Exoplanets — •John Lee Grenfell[1,2], Benjamin Taysum[1], Iris van Zelst[1,3], Franz Schreier[1,4], Hamish Innes[1,2], Alexis Smith[1], Szilard Csizmadia[1], Nicolas Iro[1], Sarah Rugheimer[5,6], Thea Kozakis[7], Eleonora Alei[8], Lena Noack[2], Tim Lichtenberg[9], Sascha Quanz[8,10], Konstantin Herbst[1,11], Miriam Sinnhuber[12], Andreas Bartenschlager[12], Juan Cabrera[1], and Heike Rauer[2,13] — [1]Inst. Space Science, DLR, Berlin, Germany — [2]Inst. Geologische Wissenschaften, Freie Uni. Berlin, Germany — [3]Centre for Astronomy and Astrophysics, TU Berlin, Germany — [4]DLR-IMF, Oberpfaffenhofen, Germany — [5]Dept Physics and Astronomy, York Uni., Canada — [6]Inst. Astronomy, Uni. Edinburgh, Scotland, UK — [7]IAA-CSIC, Granada, Spain — [8]ETH-IPA, Zürich, Switzerland — [9]Kapteyn Astron. Inst., Uni. Groningen, The Netherlands — [10]ETH, Dept. Earth Plan. Sci., Zürich, Switzerland — [11]PHAB, Uni. Oslo, Norway — [12]KIT, Karlsruhe, Germany — [13]DLR Markgrafenstr. 37, Berlin, Germany

We investigate the detectability of atmospheric biosignatures with the LIFE mission. Starting with the modern Earth we model the climate, photochemistry and spectra of Earth-like planets over a range of insolation, gravity, humidity, albedo, atmospheric mass and carbon dioxide abundances and investigate detectability of key atmospheric species by LIFE for Earth-like planets assumed to lie at 10pc for the LIFE (20-day viewing) baseline case.