EP 2: Exoplanets and Astrobiology

Time: Monday 16:15–17:45 Location: ZEU/0160

Invited Talk EP 2.1 Mon 16:15 ZEU/0160

The exoplanet revolution: towards habitable worlds — •Alexis Smith — Institut für Planetenforschung, Deutsches Zentrum für Luft- und Raumfahrt, Berlin

In the nearly 30 years since the discovery of the first exoplanets, planet detection has continued to accelerate, driven in large part by the space-based transit missions Kepler/K2 and TESS; there are now more than 5000 confirmed exoplanets. These detections have enabled insights into the demographics of the exoplanet population, and hence into the formation and migration processes that sculpted the planetary systems that we observe today. As we begin to place our own planetary system into a Galactic context, there have been innumerable surprises such as the discovery that the most common type of planet is not represented in our Solar System. Meanwhile, bright transiting systems, such as those discovered by TESS, are increasingly amenable to atmospheric characterisation with existing ground-based facilities, as well as with JWST. In the near future, the ESA Ariel mission and the ground-based ELTs will continue to expand the available parameter for atmospheric exploration. Finally, ESA's upcoming PLATO mission will enhance our planet detection abilities, putting Earth-like planets in reach for the first time.

EP 2.2 Mon 16:45 ZEU/0160

Habitability inside astrospheres — •Klaus Scherer[1], Konstantin Herbst[2], Dominik J. Bomans[3], N. Eugene Engelbrecht[4], Stefan .E.S. Ferrerira[4], Lennart Baalmann[5], Frederiic Effenberger[1], and Jen Kleimann[1] — [1]Institut für Theoretische Physik IV, Ruhr-Universität Bochum, Germany — [2]Institut für Experimentelle and Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Germany — [3]Astronomisches Institut, Ruhr-Universität Bochum, Germany — [4]Centre for Space Research, North-West University, Potchefstroom, South Africa — [5]Institute for Particle and Astroparticle Physics, ETH Zürich, Switzerland

The habitable planets around a host star are not only influenced by the stellar wind or flare activity, but are also embedded in the interstellar environment, which can also influence these planets and their atmospheres. We will show that, for certain classes of astrospheres, the inflow of the neutrals on the top of an exoplanetary atmosphere can be large. This is done by modelling the interaction between the stellar wind and the interstellar medium using a two fluid MHD model. Moreover, such an 3D MHD simulation will also allow us to study the modulation of galactic cosmic rays in 3D, incorporating a turbulence transport model, so that the diffusion coefficients and the drift velocities can be modelled as far as possible from first principles. We will also discuss the latter point.

EP 2.3 Mon 17:00 ZEU/0160

Examining the orbital decay targets KELT-9 b, KELT-16 b, and WASP-4 b, and the transit-timing variations of HD 97658 b — •Jan-Vincent Harre — DLR - Institute of Planetary Research, Berlin, Germany

Tidal orbital decay is suspected to occur for hot Jupiters in particular, with the only observationally confirmed case of this being WASP-12 b. By examining this effect, information on the properties of the host star can be obtained using the so-called stellar modified tidal quality factor $Q_\star$', which describes the efficiency of the planetary kinetic energy dissipation within the star. In this study, we aim to improve constraints on the tidal decay of the KELT-9, KELT-16, and WASP-4 systems, making it possible to constrain the $Q_\star$' value for each star. In addition, we aim to test the existence of the TTVs in the HD 97658 system, which previously favoured a quadratic trend with increasing orbital period. Making use of newly acquired photometric observations from CHEOPS and TESS, combined with archival data, we fit three models to the data, namely a constant-period model, an orbital-decay model, and an apsidal-precession model. We find that the KELT-9 system is best described by an apsidal-precession model for now, with an orbital decay trend at over 2σ being a possibility as well. A Keplerian orbit model provides the best fit to the transit timings of KELT-16 b because of the scatter and scale of their error bars. The WASP-4 system is best represented by an orbital decay model at a 5σ significance, although apsidal precession cannot be ruled out. For HD 97658 b, we find no conclusive evidence for the suspected trend in the data.

EP 2.4 Mon 17:15 ZEU/0160

Deciphering Dayglow as Biosignature of Planet Earth — •Katharina Uhlmannsiek[1], Michael Sterzik[1], Claudia Emde[2], and Stefano Bagnulo[3] — [1]ESO, Garching, Germany — [2]Institute for Meteorology LMU, München, Germany — [3]Armagh Observatory, Belfast, UK

Biosignatures in the near-infrared spectrum of Earth's atmosphere include the simultaneous presence of H2O, O2 and CH4 molecular absorption bands, but also abundant skyline emission features caused by chemo-photolytic reaction networks of Oxygen in the upper atmosphere such as OH. New infrared spectra of Earthshine were obtained with the CRIRES+ instrument at the VLT and achieve a high spectral resolution of R > 100 000. Thus, narrowband features of day- and nightglow emission (e.g. OH, O2) can be resolved. We compare airglow lines caused by different mechanisms, and try to discern day- and nightglow from contaminating atmospheric transmission. Earthshine spectra consist of the spatially integrated light of the illuminated Earth and Earth's atmosphere and are therefore considered analogous to direct observations of exoplanets. Hence, tracing biosignatures in our high-resolution CRIRES+ observations of Earthshine opens a novel window for the detection of biosignatures of Earth-like planets.

EP 2.5 Mon 17:30 ZEU/0160

Origin of life - RNA viruses first? — •Karin Moelling — Inst Med Mikrobiol Uni Zürich Schweiz

The first biomolecules are replicating non-coding RNA enzymes, ribozymes, which can cleave and join and evolve. The ribozymes are the active component for protein synthesis, ribosomes are ribozymes. They are also designated as viroids. RNA is essential at many most prominent steps in metabolism, on planet Earth, as primers, as chief regulators (circRNA), in sperm for non-Mendelian transgenerational inheritance, for silencing, defense , evolution etc. RNA can do it all. It is unstable and sensitive and needs protection. The most versatile living entities are the archaea, which can cope with extreme environmental conditions, and were named extremophiles. They are very complicated and specialized to Earth conditions, they are innovative but evolution of metabolic pathways takes time. What are the most likely or unlikely conditions on Planet Earth, which allow to extrapolate to possible extraterrestric living conditions. The conflict is either a unique earth versus astronomical numbers of exoplanets. (Moelling K: Viren die Supermacht des Lebens (C.H. Beck Press) or "Viruses, more Friends than Foes (WSPress)).