EP 9: Exoplanets und Astrobiology with poster prize talk

Zeit: Donnerstag 11:00–12:30 Raum: BSZ - Pabel HS

Hauptvortrag EP 9.1 Do 11:00 BSZ - Pabel HS

Exoplanet observations: On the road to finding our place in the Galaxy — •Hans-Jörg Deeg — Instituto de Astrofísica de Canarias, Tenerife, Spain

An overview will be given over the development of exoplanet detection and characterization, which have shown us a large and unexpected variety of planetary systems. The radial velocity and the transit methods have been responsible for the vast majority of currently known planet systems. Furthermore, they are often used jointly on the same target, leading to the best-characterised planets and planet systems. Currently the most detailed knowledge on some planets is derived from spectroscopic observations during transits, of which some examples are being shown. These observations require large ground-based facilities and are among the principal drivers for instrument development on the next generation of very large telescopes. Lastly, on overview over upcoming exoplanet related space missions will be given, mainly the American TESS mission, currently scheduled for launch on March 20, 2018, and the European PLATO mission, set for launch in 2026. Both of these missions should provide a huge sample of planet detections on bright targets. Comparative exoplanetology based on statistical analyses of larger samples may then be expected to become a central field in the research on exoplanets. We may then also finally be able to put our solar system into context with our galactic neighbourhood.

Hauptvortrag EP 9.2 Do 11:30 BSZ - Pabel HS

New Insights into Cosmic Ray induced Biosignature Chemistry in Earth-like Atmospheres — •Markus Scheucher[1], John Lee Grenfell[2], Mareike Godolt[1], and Heike Rauer[1,2] — [1]Technische Universität Berlin, 10623 Berlin, Germany — [2]Deutsches Zentrum für Luft- und Raumfahrt, 12489 Berlin, Germany

With the recent discoveries of terrestrial planets around active M-dwarfs, better understanding of atmospheric responses to the stellar environment becomes of high importance. We investigate the habitability and potential biosignatures of planets having Earth-like (N_2-O_2 dominated) atmospheres orbiting in the habitable zone of quiet and active M-dwarf stars. Such atmospheres are strongly bombarded by high energetic particles, such as Galactic Cosmic Rays and Stellar Energetic Particles. We study the effect of stellar radiation and the incoming energetic particle fluxes upon atmospheric composition, temperature, and spectral information, by varying secondary particle production profiles and NOx(=N+NO+NO_2+NO_3) and HOx(=H+HO+HO_2) chemical production efficiency, in a cloud-free 1D climate-chemistry model. Our results show that uncertainties in flaring strength and particularly atmospheric chemical production efficiency of NOx and HOx from cosmic rays can become important for determining biosignature signals for terrestrial planets around active M-dwarfs. We further show that this is especially the case for high flaring scenarios where weakened water, methane, and ozone features followed by HNO_3 build-up may even become detectable in the future in primary transit spectra.

EP 9.3 Do 12:00 BSZ - Pabel HS

The Impact of Stellar Radiation on Bioindicators — •Vanessa Schmidt and Miriam Sinnhuber — Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen, Germany

Within the past year, several terrestrial planets have been detected in the habitable zone (HZ) of M-dwarf stars. Since these types of stars are typically significantly more active than our own sun, it is expected that the effects of their stellar activity on the chemical composition of the exoplanets' atmosphere are much more pronounced than in the case of Earth and Sun.

In our work, we study Earth-like planets in the HZ of M-dwarf stars with a particular focus on the interaction of ionizing radiation with the atmosphere of the planet. Assuming an Earth-like N2-O2 base atmosphere, we can quantify the impact of stellar radiation on molecules influenced by biogenic processes such as, e.g., ozone, nitrous oxide, and methane.

To this end, we develop and apply a 1-dimensional stacked box column model of the neutral and ionized atmosphere to obtain the production rates of several important neutral species, which allows us to determine the long time effect of stellar activity on atmospheric concentrations of bioindicators.

EP 9.4 Do 12:15 BSZ - Pabel HS

COMBUSTION-EXPLOSION IN EXOPLANETARY ATMOSPHERES — •John Lee Grenfell[1], Stefanie Gebauer[1], Mareike Godolt[2], Barbara Stracke[1], Ralph Lehmann[3], and Heike Rauer[1,2] — [1]Dept. Extrasolar Planets and Atmospheres, DLR, Berlin Adlershof — [2]Centre for Astronomy and Astrophysics, TU Berlin — [3]Alfred-Wegener-Institute, Potsdam

Super-Earths could possess a large amount of molecular hydrogen depending on disk, planetary and stellar properties. Some Super-Earths have been suggested to possess large amounts of O2(g) produced abiotically. If these two constituents were present simultaneously, such large amounts of H2(g) and O2(g) however will likely react - to form up to ~10 Earth oceans - over timescales dictated by gas-phase chemistry. This limits the abiotic build-up O2(g) on such worlds. In cases where photochemical removal is slow so that O2(g) can indeed build up abiotically, it could then reach a threshold composition termed the combustion-explosion limit. Above this limit H2(g) and O2(g) react quickly to form water and modest amounts of hydrogen peroxide. This limit sets a constraint for H2(g), O2(g) atmospheric compositions in Super-Earth atmospheres. Our initial global mean analysis suggests that photochemical oxidation of H2(g) by O2(g) likely plays an important role in limiting abiotic O2(g) build-up. An analysis of the gas-phase oxidation pathways suggests that H2(g) is oxidized by O2(g) into H2O(g) mostly via HOx and mixed HOx-NOx catalyzed cycles. We further analyze other atmospheric species-pairs including (CO-O2) and (CH4-O2) in an exoplanetary context.