EP 3: Astrobiologie

Time: Tuesday 14:00–16:00 Location: V55.02

Invited Talk EP 3.1 Tue 14:00 V55.02

Pathways to the evolution of Earth-like habitats — •Helmut Lammer — Austrian Academy of Sciences, Space Research Institute, Schmiedlstr. 6, A-8042 Graz, Austria

The atmosphere evolution of early Earth and terrestrial exoplanets which may sustain liquid water oceans and continents where life may originate is discussed. It is shown that the early atmosphere evolution of terrestrial planets depends mainly on the planet's initial volatile contents related to the formation process and is strongly related to a complex interplay of the systems impact history, the weathering time-scales of carbon dioxide into carbonates, as well as the young host star's EUV radiation and plasma outflow induced atmospheric escape processes. It will be shown that the evolutionary pathway to exo-Earth's is much more complex than previously thought. Finally, transit follow-up observations in the UV-range of terrestrial exoplanets around low mass stars with space observatories such as the World Space Observatory-UV (WSO-UV) are discussed because these observations would provide a unique opportunity to shed more light on the early evolution of Earth-like planets, including those of our own Solar System.

EP 3.2 Tue 14:30 V55.02

High-energy galactic cosmic rays in the magnetospheres of terrestrial exoplanets — •Jean-Mathias Griessmeier[1], Anja Stadelmann[2], Lee Grenfell[3], Beate Patzer[3], Philip von Paris[4,5], and Helmut Lammer[6] — [1]LPC2E/Université d'Orléans/OSUC/CNRS, Orléans, France — [2]Technische Universität Braunschweig, Germany — [3]Technische Universität Berlin, Germany — [4]Univ. Bordeaux, LAB, UMR 5804, Floirac, France — [5]CNRS, LAB, UMR 5804, Floirac, France — [6]Space Research Institute, Austrian Academy of Sciences, Graz, Austria

Theoretical arguments indicate that close-in terrestial exoplanets may have weak magnetic fields, especially in the case of planets more massive than Earth ("super-Earths"). Planetary magnetic fields, however, constitute one of the shielding layers which protect the planet against cosmic ray particles. In particular, a weak magnetic field results in a high particle flux to the top of the planetary atmosphere. For the case of cosmic ray protons, we numerically analyze the propagation of the particles through planetary magnetospheres. We evaluate the efficiency of magnetospheric shielding as a function of the particle energy (in the range 64 MeV $\leq E \leq$ 500 GeV) and of the planetary magnetic field strength (in the range $0.05\mathcal{M}_E \leq \mathcal{M} \leq 2\mathcal{M}_E$). We also show the dependence of the penetration energy on the planetary magnetic field strength. Implications of increased particle fluxes are discussed, including the modification of atmospheric chemistry, destruction of atmospheric biomarker molecules, and potential biological implications.

EP 3.3 Tue 14:45 V55.02

Photochemistry of Potential Biosignatures in Super-Earth Atmospheres — •John Lee Grenfell[1], Stefanie Gebauer[1], Karol Palczynski[1,2], Heike Rauer[1,3], Ralph Lehmann[4], Joachim Stock[3], Philip von Paris[5,6], Mareike Godolt[1], and Franck Selsis[5,6] — [1]Zentrum für Astronomie und Astrophysik, Berlin, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany — [3]Institut für Planetenforschung, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Berlin, Germany — [4]Alfred-Wegener Institut für Polar- und Meeresforschung, Potsdam, Germany — [5]Univ Bordeaux, LAB, Floirac, France — [6]CNRS, LAB, Floirac, France

The characterisation via spectra of Super-Earth atmospheres for planets orbiting in the Habitable Zone of M-stars is a central theme in exoplanet science. A challenge is to understand the expected spectral signals of atmospheric biomarkers (species associated with life). In this contribution we apply a global-mean coupled climate-photochemical column model assuming a planet with an Earth-like biomass and planetary development orbiting in the Habitable Zone. We perform runs with planetary gravity of 1g and 3g changing the spectral classes of the central star from M0 to M7. In a companion paper, Rauer et al. (2011) analysed the spectral signals of the planetary scenarios. In this work we present a deeper analysis of the chemical processes involved.

EP 3.4 Tue 15:00 V55.02

Characterization of the plasma environment around Hot Jupiters — •Kristina Kislyakova[1,6], Helmut Lammer[2], Mats Holmström[3], Maxim Khodachenko[2], Jean-Mathias Griessmeier[4], Igor Alexeev[5], Elena Belenkaya[5], Arnold Hanslmeier[6], and Erkaev Nikolai[7] — [1]N. I. Lobachevsky State University, University of Nizhnij Novgorod, Russian Federation — [2]Austrian Academy of Sciences, Space Research Institute, Graz, Austria — [3]Swedish Institute of Space Physics, Kiruna, Sweden — [4]Laboratoire de Physique et Chimie de l'Environnement et de l'Espace and Observatoire des Sciences de l'Univers en region Centre, Orleans, France — [5]Skobelitsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russian Federation — [6]Institut für Physik, IGAM, Universität Graz, Austria — [7]Institute of Computational Modeling, Russian Academy of Sciences, Krasnoyarsk, Russian Federation

Spectroscopic observations with the Hubble Space Telescope (HST) of the Jupiter-type gas giant HD 209458b have shown a broad absorption signature at the Lyman-α stellar line during transit, suggesting the presence of a thick cloud of low and high velocity H atoms around the exosolar gas giant. The production of high velocity energetic neutral atoms (ENAs) as a result between the interaction of the stellar wind and the exosphere of the exoplanet will be discussed and shown that the HST/STIS observations of fast H atoms can be explained by assuming expected values for the stellar wind plasma, exosphere, and magnetosphere parameters.

EP 3.5 Tue 15:15 V55.02

Coordinated ground- and space-based observations in planetology with focus on exoplanetary research — •Manuel Scherf[1], Florian Topf[1], Helmut O. Rucker[1], Steve Miller[2], Joanna Fabbri[2], Maxim Khodachenko[1], Helmut Lammer[1], Valentin Melnik[3], and Gerhard Dangl[4] — [1]IWF/OeAW, Graz, Austria — [2]UCL, London, United Kingdom — [3]IRA-NASU, Charkiv, Ukraine — [4]Observatory Nonndorf, Nonndorf, Austria

In the fields of planetary and space sciences a very important aspect of coordinated observations is the provision of a web-based platform for both professionals and amateurs to organize observation campaigns. The NA1 activity of the FP7 project EuroPlaNet has a dedicated part of its work to develop an interactive matrix of ground- and space-based observations (http://europlanet-na1.oeaw.ac.at). This talk presents the status quo of the interactive electronic tool, including problems in development and data integration. Furthermore, the first successful attempt to make use of the information stored in the system by integrating amateur astronomers in professional research campaigns on exoplanets and flare stars is outlined. As example radio observations of the flare star Ev Lac by UTR-2, Ukraine, together with amateur observations in the optical range are shown. Observation campaigns on exoplanets will proceed in 2012, and it is planned to make use of the interactive matrix also in other fields of planetary and space sciences.

EP 3.6 Tue 15:30 V55.02

Magnetospheres of hot giant exoplanets: structure, scaling, observations — •Maxim Khodachenko[1], Igor Alexeev[2], Elena Belenkaya[2], Helmut Lammer[1], and Helmut Rucker[1] — [1]Space Research Institute, Austrian Academy of Sciences, Graz, A-8042, Austria — [2]SINP, Moscow State University, Moscow, 119992, Russia

A more complete view of a magnetosphere of a close orbit giant exoplanet, based on the Paraboloid Magnetospheric Model (PMM), is proposed. Besides of the intrinsic planetary magnetic dipole, PMM considers among the main magnetic field sources also the electric current system of magnetotail, magnetopause currents, and the ring current of magnetodisk. The key element of the considered model consists in taking into account the effects of expanding upper atmosphere of a Hot Jupiter heated by the stellar XUV radiation. The escaping atmospheric material is ionized and builds up an extended magnetodisk around the planet. The magnetic field produced by magnetodisk ring currents, dominates above the contribution of intrinsic magnetic dipole of a Hot Jupiter and finally determines the size and shape of the whole magnetosphere. It is 40 - 70 % larger than that, traditionally estimated for the case of only the planetary dipole taken into account. The size and shape of the magnetospheric obstacle of an exoplanet influence the character of the exoplanet transit curve in EUV and in specific spectral lines. This opens a way for observational probing of exoplanetary magnetospheres and stellar winds parameters.

EP 3.7 Tue 15:45 V55.02

VARLET eine neue Filtermethode zur besseren Detektion von Exoplaneten in Lichtkurven. — •Sascha Grziwa, Judith Korth und Martin Pätzold — Rheinisches Institut für Umweltforschung, Abteilung Planetenforschung, an der Universität zu Köln (RIU-PF)

Seit 2006 wird mit dem Weltraumteleskop CoRoT nach neuen Exoplaneten gesucht. Durch Weltraummissionen wie CoRoT und Kepler ist der Anteil der entdeckten Planeten und damit die Bedeutung der Transitmethode stark gestiegen. Hierbei müssen hunderttausende Lichtkurven nach möglichen planetaren Transits durchsucht werden. Diese Suche ist nur durch den Einsatz automatischer Detektionsalgorithmen möglich. Da eine Vielzahl verschiedener Variationen den Transit überlagert, ist vor der Detektion eine möglichst gute Filterung nötig. In den hochaufgelösten Lichtkurven erschweren insbesondere die Summe vieler intrinsischer Variationen der Sterne (Flecken, Pulsationen, Flares...) die Detektion schwacher erdähnlicher Planeten. Das RIU-PF hat als eines der CoRoT Detektionsteams im Laufe der Mission eine Vielzahl von verschiedenen Filtermethoden eingesetzt und entwickelt. Wir präsentieren als Ergänzung unserer Pipeline den neuentwickelten Filter VARLET. Mit diesem auf Wavelet-Transformationen basierenden Filter können ein Großteil der intrinsischen Variationen des Sterns aus den Lichtkurven entfernt werden. Das ermöglicht die Detektion von Transits kleinerer Planeten. Des Weiteren wird die Rate der Fehldetektionen der automatischen Tranistdetektion minimiert. Der zeitliche Aufwand für die Nachkontrolle wird dadurch deutlich verringert.