EP 4: Planetary atmospheres

Time: Tuesday 18:00–19:00 Location: ZEU/0160

EP 4.1 Tue 18:00 ZEU/0160

Jupiter moon Ganymede's atmosphere observed with the Hubble Space Telescope — •Lorenz Roth[1], Gregorio Marchesini[1], Tracy Becker[2], Jens Hoeijmakers[3], Philippa Molyneux[2], Kurt Retherford[2], Joachim Saur[4], Shane Carberry Mogan[5], and Jamey Szalay[6] — [1]KTH Royal Institute of Technology, Stockholm Sweden / ESO Garching bei München — [2]Southwest Research Institute, San Antonio, TX, USA — [3]Lund University, Sweden — [4]Universität zu Köln — [5]University of California, Berkeley, CA, USA — [6]Princeton University, Princeton, NJ, USA

Jupiter's moon Ganymede is the largest moon in the Solar System and the only one that generates its own magnetic field in the interior. Ganymede also possesses a tenuous water-based atmosphere, produced by the solar and Jovian plasma irradiation of its icy surface. Here we report results from far-ultraviolet observations by the Hubble Space Telescope of Ganymede transiting across the planet's dayside hemisphere. Within a targeted campaign on 9 September 2021 two exposures were taken during one transit passage to probe for attenuation of Jupiter's hydrogen Lyman-α dayglow above the moon limb. The background dayglow is slightly attenuated over an extended region around Ganymede. The obtained vertical H column densities are consistent with previous results. Constraining angular variability around Ganymede's disk, we derive an upper limit on a local H2O column density such as could arise from outgassing plumes in regions near the observed moon limb.

EP 4.2 Tue 18:15 ZEU/0160

Investigation of the Influence of Stellar Particle Events and Galactic Cosmic Rays on the Atmosphere of TRAPPIST-1e — •Andreas Bartenschlager[1], Miriam Sinnhuber[1], John Lee Grenfell[2], Benjamin Taysum[2], Fabian Wunderlich[2], and Konstantin Herbst[3] — [1]Karlsruher Institute of Technology, Germany — [2]German Aerospace Center, Berlin, Germany — [3]University of Kiel, Germany

The launch of the James Webb Space Telescope (JWST) in December 2021 opens up the possibility of studying the composition of exoplanetary atmospheres in habitable zones in the near future. We investigate the influence of stellar energetic particles (SEPs) on the atmospheric chemistry of exoplanets around a very active M-star TRAPPIST-1, using the ion chemistry model ExoTIC. We perform model experiments with different N_2 or CO_2 dominated atmospheres, depending on the initial CO_2 partial pressure, as well as humid and dry conditions, taking into account the ionization rates for such events. A further specification is the distinction between dead and alive atmospheres, whose atmospheric composition is characterized by a lower or higher oxygen fraction in the initial conditions. Within ExoTIC we calculate the impact of the ionization events on these atmospheres both as a single and as a series of events with different strengths. Preliminary results show a significant impact of SEP events on the chemical composition of the atmosphere, including biosignatures such as O_3. The strength of these impacts depends on the starting atmospheres' relative oxygen, nitrogen and water vapour content.

EP 4.3 Tue 18:30 ZEU/0160

Simulating exoplanetary atmospheres in the laboratory: comparing experimental data with output from an atmospheric model — •Florence Hofmann[1], Paul Mabey[1], Egemen Yüzbasi[1,2], John Lee Grenfell[2], Heike Rauer[1,2,3], and Andreas Elsaesser[1] — [1]Freie Universitaet Berlin, Germany — [2]Institute for Planetary Research, Berlin, Germany — [3]Berlin University of Technology, Germany

Since the discovery of the first exoplanet, several thousand have have been found including some rocky planets in the habitable zone. The new generation of instruments such as the James Webb Space Telescope will search for spectroscopic signals of atmospheric biosignatures on these worlds. Correctly interpreting such signals requires atmospheric models with consistent and flexible climate and chemical modules over a wide parameter range. With our new Planetary Simulation Chamber at FU Berlin, we are capable of simulating a large set of atmospheric parameters for Earth-like planets in the laboratory. We are able to vary the incoming spectra to simulate the photochemical and climate effects of Earth-like planets orbiting different stars. Many telescopes operate in the VIS/NIR range that corresponds to the fingerprint regions of interesting organic molecules. Our facility allows continuous spectroscopic in-situ monitoring of samples in the UV/IR region and simultaneous mass spectroscopic analysis. In collaboration with our partners at the DLR institute for planetary research, we compare experimental results from our chamber with output from their climate-chemistry model 1D-TERRA.

EP 4.4 Tue 18:45 ZEU/0160

Simulating Atmospheric Climate and Chemical Responses on a hypothetical, Earthlike Planet orbiting AD Leonis — •Julian Graupner[1], John Lee Grenfell[1], Hella Garny[2], Anna Goetz[2], and Heike Rauer[1,3,4] — [1]Department of Extrasolar Planets and Atmospheres, Instiute of Planetary Research, German Aerospace Centre (DLR), Berlin, Germany — [2]Department of Earth System Modelling, Institute for Atmospheric Physics, German Aerospace Centre (DLR), Oberpfaffenhofen-Wesling, Germany — [3]Centre for Astronomy and Astrophysics, Berlin Institute of Technology, Berlin, Germany — [4]Institute for Geological Science, Free University of Berlin, Berlin, Germany

Simulating a hypothetical Earth orbiting the active M-dwarf star AD Leonis is well-established since the stellar spectrum is well-characterized and there are numerous model studies in the literature. A long-term aim is to estimate the transport, climate and photochemical effects using a column climate-photochemical model loosely coupled with a parameterized 3D model. The column model is integrated over a range of latitudes which then generates a temperature map used as input for the 3D transport model. In the present study we report only results from the 1D model study for Earth placed around AD Leonis at an orbit where it receives the same instellation. Compared with previous column model studies we find that recent improvements in our climate and chemistry modules has led to modest changes in our simulated cold trap, hence water vapor abundances and also in the middle atmosphere ozone amount.