Studying the impact of cosmic rays on the atmosphere of TRAPPIST-1e with the model suite INCREASE

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Exoplanets are as diverse as they are fascinating. They vary from ultrahot Jupiter-like low-density planets to presumed gas-ice-rock mixture worlds that feature twice the Earth's bulk density. But much remains to be explored regarding the great diversity of exoplanetary atmospheres. With the James Webb Space Telescope (JWST) observing the first potential Earth-like exoplanetary atmospheres, we are now on the verge of entering a new era of exoplanetary science in which potential atmospheric biosignatures (such as ozone, nitrous oxide, and methane) are interpreted with increasing sophistication in terms of the evolution of the planet-star system, to assess and discount so-called false positives. However, to interpret the upcoming observations, model studies of planetary atmospheres that account for various processes — like an atmospheric escape, outgassing, climate, photochemistry, the physics of air showers, and the transport of cosmic rays through astrosphers, planetary magnetic fields, and planetary atmospheres — are necessary. Utilizing our unique model suite INCREASE (Herbst et al., 2019; 2022), we will present our most recent results of the impact of cosmic rays (CRs) on the habitability of the Earth-like exoplanet TRAPPIST-1e. We will discuss the CR-induced radiation hazard on water-based life forms at the planetary surface of TRAPPIST-1e and the impact of CRs on atmospheric biosignatures and their temporal changes due to potential stellar super-events, paving the way to better understand the upcoming JWST observations of TRAPPIST-1e.

References:

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