The flux of galactic cosmic rays to the atmosphere of close-in Earth-like exoplanets

Jean-Mathias Griessmeier (jean-mathias.griessmeier at obspm.fr), LESIA, CNRS-Observatoire de Paris, Meudon, France
Anja Stadelmann, Technische Universitat Braunschweig, Germany
Helmut Lammer, Space Research Institute, Austrian Academy of Sciences, Graz, Austria
Lee Grenfell, Deutsches Zentrum fuer Luft- und Raumfahrt (DLR), Berlin, Germany
Beate Patzer, Technische Universitat Berlin, Germany
Philip von Paris, Deutsches Zentrum fuer Luft- und Raumfahrt (DLR), Berlin, Germany
Uwe Motschmann, Technische Universitat Braunschweig, Germany

Habitable zones of M stars are located at small orbital distances. Earth-like extrasolar planets in such habitable zones are synchronously rotating with their host star because of strong tidal interaction. This leads to rotation rates which are much lower than those expected for planets not subject to tidal locking, resulting in relatively small magnetic moments. We found that an Earth-like extrasolar planet, tidally locked in an orbit of 0.2 AU around a M star of 0.5 solar masses (i.e. within the region where liquid water is expected to be stable on the planetary surface), has a rotation rate of 2% of that of the Earth. This results in a magnetic moment of less than 15% of the Earth's current magnetic moment. We find that because such a close-in extrasolar planet is not protected by an extended Earth-like magnetosphere, the flux of galactic cosmic rays to the planetary atmosphere is strongly enhanced. The magnetospheric protection is slightly more efficient for more massive planets. Implications of such enhanced cosmic ray fluxes on the concentration of biomarker molecules are discussed in a poster by Grenfell et al. Clearly, these studies have important consequences for missions like TPF/DARWIN which aim for the detection and analsis of biosignatures in the spectra of Earth-like exoplanets.