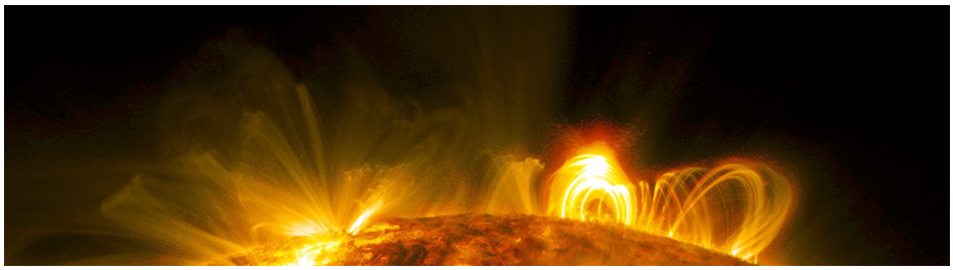

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Transport of stellar energetic particles in the habitable zones of young active stars

Thursday 18 November 2021 09:45 (1 hour)

Charged particles energized by coronal flares or travelling shocks at young active stars may significantly impact the habitability of exoplanets. We used test-particle simulations to investigate the diffusive transport of ~GeV protons throughout turbulent active astrospheres, from stellar corona to planet atmosphere. The 3D turbulent and magnetised stellar wind of a TRAPPIST-1-like system has been reconstructed by using observed magnetograms and overlapping a synthetic magnetic turbulence with a given power spectrum. We find that only a few percent of particles injected within half a stellar radius from the stellar surface can escape, and that the escaping fraction increases strongly with increasing injection radius. Particles injected further out by travelling shocks strongly focus onto two caps within the fast wind regions and centered on the equatorial planetary orbital plane. Due to the very close-in orbit of Trappist-1e (0.03 AU) and the very high activity of the host star, on the basis of a scaling relation between far-UV emission and energetic protons for solar flares, we found that the innermost putative habitable planet, TRAPPIST-1e, is bombarded by a proton flux up to 6 orders of magnitude larger than experienced by the present-day Earth. We present preliminary results of the chemical response of the upper planetary atmosphere to the particle flux at various phases of its orbit around the star.

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