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CONFINEMENT AND ANISOTROPY OF ULTRAHIGH-ENERGY COSMIC RAYS IN ISOTROPIC PLASMA WAVE TURBULENCE

M. VUKČEVIĆ

Faculty of Natural Sciences and Mathematics, University of Montenegro, Montenegro

Abstract. The mean free path and anisotropy of galactic cosmic rays is calculated in weak plasma wave turbulence that is isotropically distributed with respect to the ordered uniform magnetic field.

The modifications on the value of the Hillas energy, above which cosmic rays are not confined to the Galaxy, are calculated. The original determination of the Hillas limit has been based on the case of slab turbulence where only parallel propagating plasma waves are allowed.

We use quasilinear cosmic ray Fokker-Planck coefficients to calculate the mean free path and the anisotropy in isotropic plasma wave tuurbulence.

In isotropic plasma wave turbulence the Hillas limit is enhanced by about four orders of magnitude to Ec = 2.03 · 104An1/2 e (Lmax/1 pc) resulting from the dominating influence of transit-time damping interactions that obliquely propagating magnetosonic waves undergo with cosmic rays.

Below the energy Ec the cosmic ray mean free path and the anisotropy exhibit the well known E1/3 energy dependence for relevant undamped waves. In case of damped waves, the cosmic ray mean free path and the anisotropy do not depend on energy. At energies higher than Ec both transport parameters steepen to a E3-dependence for undamped and damped waves. This implies that cosmic rays even with ultrahigh energies of several tens of EeV can be rapidly pitch-angle scattered by interstellar plasma turbulence, and are thus confined to the Galaxy.