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Anomalous Transport and Acceleration of Energetic Particles

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The theoretical description of energetic particle transport near interplanetary shocks in the inner and outer Heliosphere and in other astrophysical contexts usually follows a diffusive paradigm. By means of scattering of particles at magnetic irregularities upstream and downstream of the shock, particles can be moved back and forth across the shock discontinuity and gain energy, forming power-law energy spectra. In recent years, it has become clearer that this scattering does not necessarily adhere to a Gaussian diffusive picture, i.e. it can be an anomalous transport process, possibly caused by inhomogeneous structures in the plasma turbulence, such as small-scale flux tubes. This anomalous transport is, as a first approximation, often characterized by a non-linear behavior of the mean-square displacement of particles. Here we discuss the theory and implications of this assumption in the context of interplanetary shocks. In particular, we will address how this behaviour can be modeled with non-Gaussian probability distributions together with a stochastic differential equation scheme.

Keywords

energetic particles; anomalous diffusion; cosmic rays; solar eruptions

Collaboration

other Collaboration

Subcategory

Theoretical Results

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