ASYMMETRIC DIFFUSION IN TURBULENT PLASMAS

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Cosmic ray transport in the ISM, i.e., the plasma with turbulent magnetic fields in the presence of a gradient of the mean magnetic field and weak pitch-angle diffusion, is analyzed. We demonstrate that such transport is described by asymmetric diffusion: the generalization of the conventional random walk process to the case of unequal transition probabilities. We construct a toy 1D Markov chain model and analytically demonstrate that the particle density distribution becomes exponential in distance, instead of linear as is the case of the standard diffusion process. The results, of course, are general and applicable to any particle transport, not just cosmic rays.