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From Scatter-Free to Diffusive Propagation of Energetic Particles: Exact Solution of Fokker-Planck equation[1] MIKHAIL MALKOV, UCSD — Propagation of energetic particles through magnetized turbulent media is reconsidered using the exact solution of Fokker-Planck equation [PRD, 2017]. It shows that the cosmic ray (CR) transport in weakly scattering media is nondiffusive. Poor understanding of the CR transport obscures their sources and acceleration mechanisms. We present a simplified approximate version of the exact solution of Fokker-Planck equation that accurately describes a ballistic, diffusive and transdiffusive (intermediate between the first two) propagation regimes. The transdiffusive phase lasts up to 5-7 collision times and starts at about one-half of collision time. Since the scattering rate is energy-dependent, a large part of the energy spectrum propagates neither diffusively nor ballistically. Its treatment should rely on the exact solution. Significant parts of the spectra affected by the heliospheric modulation, for example, falls into this category. We present a new approximation of an exact Fokker-Planck propagator. It conveniently unifies the ballistic and Gaussian propagators, currently used (separately) in major Solar modulation and other CR transport models. The maximum deviation of the new propagator from the exact solution is less than a few percents.

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