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Theoretical derivation of diffusion-tensor coefficients for the transport of charged particles in magnetic fields

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The transport of charged particles in various astrophysical environments permeated by magnetic fields is described in terms of a diffusion process, which relies on diffusion-tensor parameters generally inferred from Monte Carlo simulations. In this contribution, a theoretical derivation of the diffusion coefficients is presented. The approach, based on a few approximations to model the 2-point correlation function of the magnetic field experienced by the particles between two successive times, is shown to describe both the high-rigidity regime, in which the Larmor radius is greater than the larger wavelength of the turbulence, and the gyroresonant regime regime, in which the Larmor radius of the particles is in resonance with the wavelength power spectrum of the turbulence. The results are shown to be consistent with those obtained with a Monte Carlo generator.

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