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New Method for Determination of Diffusion Coefficients in Turbulent Plasmas

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The transport of charged particles in turbulent magnetic fields is a topic of great interest in astrophysics, since our ability to successfully use cosmic rays as astronomic messengers depends on our understanding of the transport processes. One of the primary effects is the scattering of particles on magnetic irregularities leading in the first instance to a change in the pitch-angle μ of the particle. Further transport parameters e.g. diffusion coefficients or the mean free path can then be inferred from $\Delta\mu$.

We introduce new numerical methods to evaluate the pitch angle diffusion coefficient $D_{\mu\mu}$ and the perpendicular diffusion coefficent $D_{\perp}$ that work well in both weak and strong turbulence scenarios and compare with analytic results from Quasi Linear Theory.
We present results obtained by applying these methods to test-particle data from simulation of heliospheric conditions with our spectral MHD code Gismo. The results are then compared with test-particle simulations of the novel Perlin-noise-type pseudo-turbulence to show its viability for large-scale particle transport simulations.

Collaboration

– not specified –

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Author: IVASCENKO, Alex (North-West University)

Co-authors: SPANIER, Felix (North-West University); GANSE, Urs (University of Helsinki)

Presenter: IVASCENKO, Alex (North-West University)

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