TOR VERGATA
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Dipartimento di Fisica

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Seminar

Wednesday, 20 March 2024 - h. 14:30

Fisica della Materia room (Department of Physics)

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"A Lagrangian perspective on magnetic turbulence with energetic charged tracer particles

Abstract

Magnetohydrodynamic turbulence is characterized by the complex interplay between plasma flow and magnetic field, which leads to a mixture of large-scale coherent and small-scale chaotic structures. The coherency arises from local suppression of non-linearity due to spontaneous alignment of plasma flow and magnetic field fluctuations, which leads to sheet-like structures with extreme aspect ratios (spanning from outer scale to dissipation scale). Due to the Lorentz force, charged particles in such systems trace the fieldlines within coherent structures and experience confinement due to frequent scattering within chaotic structures. This behaviour gives rise to two distinct transport regimes — fast parallel streaming and slow perpendicular diffusion — which admit a clear geometric classification by means of the fieldline curvature, as well as a statistical classification by means of the magnetic field structure function scalings along particle trajectories. Additionally, magnetic mirror configurations need to be taken into account, which are low-curvature structures where particles appear to be free streaming locally, but can be confined globally for long times. Finally, modeling charged particle trajectories as a correlated random walk and by means of generative diffusion models is discussed.

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