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Spectral properties of passive scalars in MHD turbulence
MAXIME KINET, PAOLO BURATTINI, DANIELE CARATI, BERNARD KNAEPEN, Physique statistique et plasmas - Université Libre de Bruxelles, B-1050 Brussels, Belgium — Magnetohydrodynamics (MHD) — which deals with the flow of an electrically conducting fluid in presence of a magnetic field — finds applications in the steel industry (where magnetic fields are used to damp or to stir the turbulent motion) and in nuclear fusion devices (e.g. tokamaks). There, the liquid lithium, used as coolant, undergoes the effect of the plasma-confining magnetic field. Here, we focus on MHD at low magnetic Reynolds number, for a magnetic field applied in one direction only. In this case, the flow is known to become anisotropic, in that the velocity fluctuations parallel to the magnetic field are damped. Using direct numerical simulations in a cubic domain with periodic boundary conditions, we analyse the transport properties of a passive scalar embedded in the flow. Three cases, having increasing magnetic field strength, and two Schmidt numbers (0.1 and 1) are considered. The Fourier-space distributions of the scalar variance, mean dissipation rate, and transfer indicate that the anisotropy of the velocity field is reflected on the scalar. In order to evaluate the interchange between these quantities, their contributions in wavenumber space are decomposed in radial and angular directions.

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