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Dispersed-phase structure in homogeneous MHD turbulence at low magnetic Reynolds number

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Abstract

Studies published over the past decade have demonstrated that one-point, Reynolds-averaged turbulence models lack information about the morphology of turbulent flow structures (Kassinos et al. 2001). Such information becomes important, for example, when the turbulence is subjected to anisotropic influences. Although new tensor statistics have been developed to provide this information for the fluid flow, none describe the resulting flow-induced structure observed in dispersed phases. This talk will introduce the dispersed-phase structure dimensionality tensor, which describes the preferred orientation of particle clusters. Results will be presented from direction direct numerical simulations of passive, Stokesian particles in magnetohydrodynamic turbulence upon which a magnetic field acts to induce anisotropy at low magnetic Reynolds numbers. Results are presented for five magnetic field strengths as characterized by magnetic interaction parameters in the range 0-50. The response times of the investigaged particles spanned four decades bracketing the Kolmogorov time scale and the Joule time. The results demonstrate that the new tensor distinguishes between uniformly distributed particles, those organized into randomly oriented clusters, and those organized into two-dimensional sheets everywhere tangent to the magnetic field lines (see figure). Lumley triangles will be used to demonstrate how the degree of structural anisotropy depends on the particle response time, the interaction parameter, and the time span over which the magnetic field is applied.

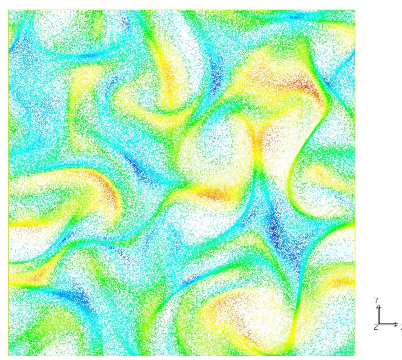

Figure 1: Particle locations color-coded for speed: red (fastest) and blue (slowest).