On the nature of space plasma turbulent fluctuations at sub-ion scales: a Langevin approach

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Space plasmas in the Heliosphere are in a turbulent dynamical state. At large scales, say at frequencies lower than 0.1–1 Hz, magnetic field fluctuations display a power-law spectrum with spectral exponents approaching those expected from theories of fluid-like turbulence. Conversely, at scales smaller than the ion-inertial length, i.e., ion/sub-ion scales, ions' inertia decouples from that of electrons and the spectrum of the magnetic field fluctuations displays a novel dynamical regime that is still not fully understood. In this talk, we show recent results on the Markovian features of the fluctuations at these scales, recasting the scale-to-scale coupling in this regime in terms of a stochastic Langevin-like dynamics. The occurrence of a simple/global scale invariance at sub-ion scales suggests that a stochastic redistribution of energy is not relevant in this domain. A link between the Langevin drift term and the observed scale invariance of fluctuations at these scales is found in a non-diffusive limit.