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Fluid simulations of space plasmas at ion scales

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We present three-dimensional simulations of turbulence in collisionless plasmas in the absence of cyclotron resonance, by using a fluid model which extends the anisotropic MHD to transverse scales comparable to or smaller than the ion gyroradius. Retaining ion and electron Landau damping and finite Larmor radius(FLR) corrections, this model provides an accurate description of the linear properties of kinetic Alfvén waves and, in the presence of temperature anisotropy, accurately reproduces the mirror instability at all scales. Simulations of turbulence with Alfvénic driving lead to power law spectra for the electric and magnetic fields which compare well with Solar Wind data. It turns out that, at least in the regimes where the turbulence level is moderate, the dissipation due to ion and electron Landau dampings permits simulations without filtering or artificial dissipation, leading to power-law spectra extending to the smallest retained scales. In physical space, density fluctuations take the form of elongated filaments. Similar structures are also observed after the saturation of the mirror instability. However, the magnetic compressibility spectrum displayed by this "mirror" turbulence, that possibly develops in planetary magnetosheaths, differs significantly from that of Alfvénic turbulence.