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Plasma turbulence vs. fire hose instabilities: 3D hybrid expanding box simulations

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Interaction between proton fire hose instabilities and plasma turbulence in the solar wind is studied using 3D hybrid simulations where effects of the solar wind expansion are included using the expanding box model. The simulations are initialized by isotropic large-scale (magnetic and velocity) fluctuations with zero cross helicity. An anisotropic turbulent cascade rapidly develops and leads to proton anisotropic energization. This heating is however not sufficient to counteract the anisotropic proton cooling owing to the expansion and the proton temperature anisotropy eventually becomes strong enough to drive proton fire hose instabilities. These instabilities reduce the proton temperature anisotropy and generate electromagnetic fluctuations at ion scales at quasi-parallel/oblique angles with respect to the ambient magnetic field. Properties of the nonlinear system of coexisting plasma turbulence and fire hose waves
will be discussed.