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The (in)efficiency of plasma mixing in collisionless turbulence

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A relevant mixing between the solar wind and the magnetospheric plasma is observed at low latitude even in northward magnetic field conditions, when the solar wind and magnetospheric magnetic fields are nearly parallel thus preventing the development of magnetic reconnection. An alternative mechanism to reconnection can be found in the Kelvin-Helmholtz instability, able to provide an efficient mechanism for the formation of a mixing layer.
The nonlinear evolution of the Kelvin-Helmholtz instability indeed enables to efficiently mix two media separated by a velocity shear when the collisionality is high enough, through the effect of viscosity and/or resistivity. But what happens in the case of collisionless media such as most space plasma?
Using full kinetic plasma simulations from MHD to kinetic electron scales, we show that the nonlinear evolution of a magnetized, collisionsless shear plasma flow forms a turbulent layer that is however highly inefficient from a mixing point of view. The results are discussed in the context of the magnetosphere-magnetosheath boundary, where we show that the magnetosphere and magnetosheath plasma remains well separated even in the turbulent layer.

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