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Kinetic properties of magnetosheath jets from 5D Vlasov equilibrium and 3D numerical simulations

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Magnetosheath jets are plasma irregularities characterized by an excess of the dynamic pressure (due to density and/or speed increase) with respect to the background plasma flow. We present a summary of the insight gained on their kinetic properties from quasi-stationary 5D (2D in physical space and 3D in velocity space) Vlasov equilibrium models and 3D electromagnetic Particle-in-Cell numerical simulations. We show that the excess of the dynamic pressure sustains a parallel component of the electric field that breaks the frozen-in condition and decouples the jet from the background flow. We also demonstrate that the velocity distribution function (VDF) of electrons and ions in the interface layer between the jet and the background plasma is not a displaced Maxwellian but a morphological transition between the VDF in the core of the jet and the VDF of the background plasma. Numerical simulations demonstrate that when the jet has enough dynamic pressure and its velocity is normal to a tangential discontinuity (like the dayside magnetopause) it can move across. The physical mechanism is due to polarization of charges in jet's boundary layers. We also discuss non-gyrotropic properties of the electron VDF obtained from numerical simulations of jets interacting with tangential discontinuities like the magnetopause.

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