Boundary conditions for plasma fluid models at the magnetic presheath entrance

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Abstract. For the first time, a rigorous definition of the magnetic presheath entrance (MPSE) is provided, as the location where the drift-reduced approximation breaks down. We consider a weakly collisional electrostatic plasma with cold ions in contact with an absorbing wall in the presence of $\mathbf{E} \times \mathbf{B}$ drifts. We provide expressions at the MPSE for the parallel ion and electron velocities, the gradients of plasma density and potential, and the vorticity. In particular, we show that the plasma potential with respect to the wall increases when the angle of incidence of the magnetic field is smaller. A fully kinetic PIC code simulating the plasma wall transition has been developed to validate these local relations [1], showing an excellent agreement with the theory. This work represents a first step towards a complete formulation of the boundary conditions for fluid codes used to simulate the edge of magnetic confinement devices. Moreover, the presented results make predictions that are relevant for blob control experiments.

References

[1] J. Loizu, P. Ricci and C. Theiler, Physical Review E **83**, 016406 (2011)