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Investigation of Presheath and Sheath Using a Full-Vlasov Simulation[1] KENTARO HARA, IAIN BOYD, University of Michigan, VLADIMIR KOLOBOV, CFD Research Corporation — A direct simulation method is used to solve the Vlasov equation coupled with collision terms. In comparison to particle simulations, statistical noise is significantly reduced in a direct Vlasov simulation making it attractive for resolution of velocity distribution functions (VDFs) in low-temperature plasmas.[2] Here, a one-dimensional full-Vlasov simulation is used to investigate the interaction of plasma and a floating wall. Firstly, a collisionless case is considered that assumes a Maxwellian VDF shifted by the Bohm velocity for ions at the sheath edge. The Vlasov solution shows good agreement with the analytic solution. Secondly, by including collisions and applying a quasineutral boundary condition, a smooth transition from presheath to sheath is observed without imposing the Bohm criterion. For a xenon plasma of 5 eV and 10^{15} m^{-3}, the sheath potential is 5.5 T_e/e when the sheath edge is defined as the point where the ion mean velocity equals the ion acoustic velocity. This result agrees with the classical theory that suggests the sheath potential is 5.27 T_e/e. It is also observed that momentum exchange collisions are needed for a converged solution of the presheath-sheath structure.

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[2]V. Kolobov, R. Arslanbekov, J. Comput. Phys., 231 (2012), 839

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