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Theory of the Electron Sheath and Presheath[1] BRETT SCHEINER, SCOTT BAALRUD, University of Iowa, BENJAMIN YEE, MATTHEW HOPKINS, EDWARD BARNAT, Sandia National Laboratories — Electron sheaths are commonly found near Langmuir probes collecting the electron saturation current. The common assumption is that the probe collects the random flux of electrons incident on the sheath, which tacitly implies that there is no electron presheath and that the flux collected is due to a velocity space truncation of the velocity distribution function (VDF). This work provides a dedicated theory of electron sheaths, which suggests that electron sheaths are not so simple. Motivated by VDFs observed in recent Particle-In-Cell (PIC) simulations, we develop a 1D model for the electron sheath and presheath. In the model, under low temperature plasma conditions, an electron pressure gradient accelerates electrons in the presheath to a flow velocity that exceeds the electron thermal speed at the sheath edge. This pressure gradient allows the generation of large flows compared to those that would be generated by the electric field alone. It is due to this pressure gradient that the electron presheath extends much further into the plasma (nominally by a factor of $\sqrt{m_i/m_e}$) than an analogous ion presheath. Results of the model are compared with PIC simulations.

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