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Plasma-Surface Interaction with Strong Electron Emission — A New Solution to an Old Problem*

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The first solution to the fundamental sheath-presheath problem with strong emission was reported a half century ago by Hobbs and Wesson. In their original theory [1], it was assumed for any emission coefficient that the floating sheath potential is negative and the presheath accelerates ions to the sound speed, similar to the case without emission. This "space-charge limited" (SCL) model has long been used to predict the plasma-surface interaction at strongly emitting surfaces in applications. However, recent theory and simulation studies demonstrated a new type of solution where the sheath potential is positive, repelling ions. In this inverse regime [2], the dynamics of electrons and ions in the sheath and presheath, as well as their fluxes into the surface, drastically differ from the SCL theory. Very recently, it was shown that SCL states are unstable when the emission coefficient exceeds unity and therefore only inverse states should exist [2]. This could have significant consequences for applications where intense emission is possible including tokamak divertor plates, Hall thruster channel walls, emissive probes, dust grains, hot cathodes and the lunar surface.

[1] G. D. Hobbs and J. A. Wesson, Plasma Phys. 9, 85 (1967).

[2] M. D. Campanell and M. V. Umansky, *Strongly Emitting Surfaces Unable to Float Below Plasma Potential*, to appear in Phys. Rev. Lett.

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