Strong Electron Emission Could Enable a New Plasma-Surface Interaction Regime in Divertors

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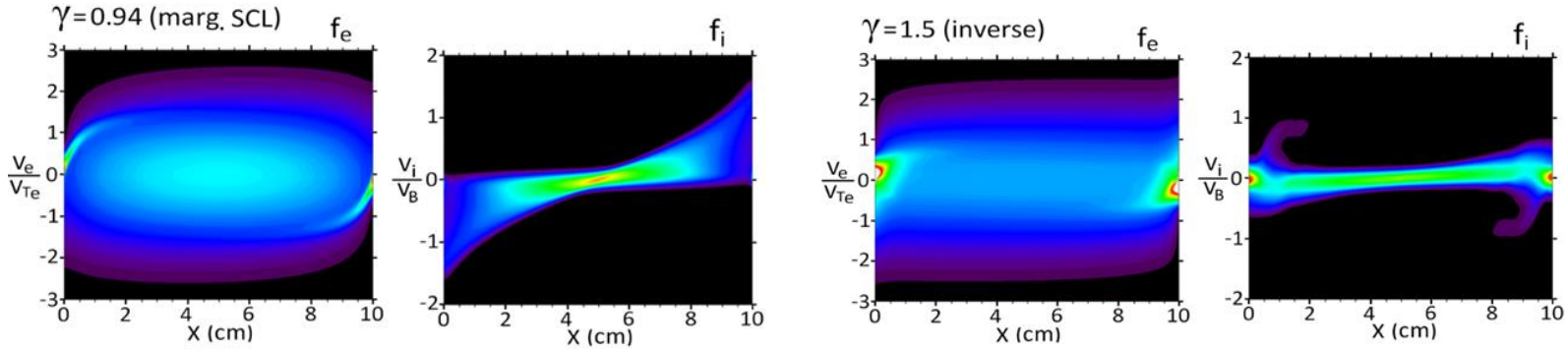
- It was recently shown that when the emission coefficient exceeds unity, the sheath potential must be positive valued. In this "inverse" sheath regime, the presheath is also fundamentally restructured [1].
- In the inverse regime, ions do not get accelerated towards the boundaries. Also, a high density cloud of cold (< 1 eV) electrons dominates the quasineutral plasma near the boundaries.



Simulations show a sharp difference of the particle distribution functions $f_{e,i}(x,v)$ when the emission coefficient γ is below unity (left) compared to above (right). Note the lack of ion acceleration in the inverse f_i.

This result opens a possibility that thermionic emission from heated tungsten divertor tiles could be used to mitigate the plasma-wall interaction:

- In the inverse regime, ion impact energies would be reduced by a few T_e compared to the conventional regime [2], drastically reducing physical sputtering from PFC's such as W.
- A cloud of cold electrons near the plasma boundary could aid with achieving detachment conditions.

[1] Campanell, M. D. and Umansky, M.V., Physical Review Letters **116** (2016) 085003. *Work supported by the U.S. DOE

[2] P. C. Stangeby, *The Plasma Boundary of Magnetic Fusion Devices*, Plasma Phys. Series (IOP, Bristol, 2000).