Emissive cathode biasing controls drift velocities in a plasma column

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Controlling drift velocities in a plasma column is essential for various applications: to develop plasma centrifuges [1], to master drift waves and electrostatic turbulence and to mitigate anomalous transport [2] , to study astrophysical mechanisms [3] and to study flow related instabilities in ionospheric like plasmas [4]. So far, only cold conductive biased electrodes such as concentric rings, end plates or grids have been used to try to control plasma flows in linear plasma experiments. These setups to be efficient in controlling the plasma parameters profiles, however they are limited by the strong Debye shielding in plasmas.

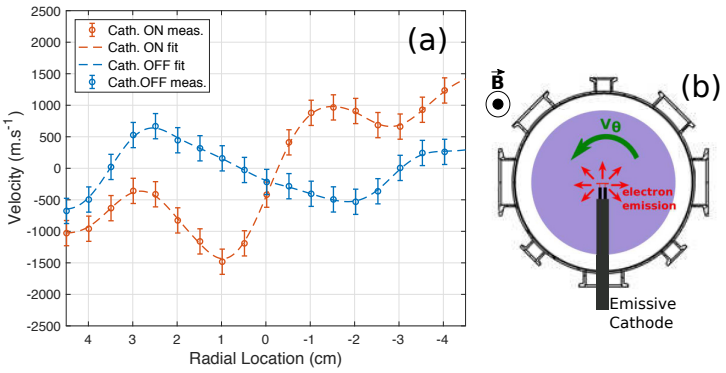

Figure 1: *(a.) Measured ion velocity for two cases: cathode floating at plasma potential (blue) and biased and emitting electrons (orange); (b.) Schematic drawing of the stirring setup*

We report here a new tool to control drift velocities. Using a negatively biased hot emissive cathode (fig1.b.), we show the ability to control V_p and n_e profiles by injecting locally strong electron currents into the plasma. Direction, shear and amplitude of the plasma flow profile can also be controlled changing the cathode location and the intensity of the injected current (fig1.a.). These modifications of the plasma equilibrium have been studied extensively using Langmuir probes, emissive probes, mach probes and LIF measurements. We show that the rotation profiles may be explained by electric and diamagnetic drifts and are directly related to the amount of current emitted by the cathode.

References

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