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P4.4006 Plasma potential profile shaping using strongly emissive cathodes in a plasma column

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The control of plasma potential profile in plasmas is crucial for various applications ranging from space propulsion [1], the development of plasma centrifuges [2] or the mitigation of turbulent transport by sheared flows [3].
We report here a detailed experimental investigation of the plasma potential control using emissive cathodes in a moderately magnetized plasma column [4]. Negatively biased hot emissive cathodes are inserted in a low pressure Argon plasma column confined by a moderate axial magnetic field (from 35 to 600 G) with ionisation rates ranging from 2 to 30%. When injecting strong electron currents in the plasma from the emissive cathodes, we demonstrate the ability of our setup to control the plasma potential and the plasma density radial profiles - in particular the plasma potential decreases at radii at which emissive cathodes are inserted. The experimental plasma potential profiles are compared to theoretical computations assuming ambipolar transport in the presence of strong electron beams imposed by the emissive cathodes.
Controlled shaping of the plasma potential profile also allows a direct control of the plasma rotation profile - the dominant drive being the electric and diamagnetic drifts. We demonstrate that the amplitude, the direction and the shear profile of the plasma column rotation may be controlled at will using strongly emissive cathodes. Experimental plasma flow profiles are in excellent agreement with the electric drift computed from the controlled plasma potential profile, taking into account finite Larmor radius effects as well as friction between ions and neutrals.
The scheme proposed here complements previous studies using concentric rings, end plates or grids used to shape the plasma potential. References
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