Plasma potential control in a weakly magnetized plasma column using negatively-biased emissive electrode

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The possibility to control plasma parameters such as the density n, the electron temperature T_e or the plasma potential V_p is of crucial importance for applications (for instance plasma centrifuges [1]). We present an extensive investigation of the influence of a hot and negatively-biased emissive electrode on the plasma parameters of a pre-existing magnetized plasma column.

Experiments using a negatively-biased emissive electrode were conducted in an Argon plasma column [2] at pressures p_0 around 1 mTorr and magnetic fields $B \sim 20$ mT. The 10 cm in diameter plasma column is created by an RF source (power P_w from 1 to 3 kW) resulting in ionization rates up to 20%, while the biased emissive electrode faces the opposite side of the column. The cathode is biased at a fixed potential V_b up to -60 V (i.e. $\sim 20\ T_e$) and heated at temperatures T_k up to 2900 K.

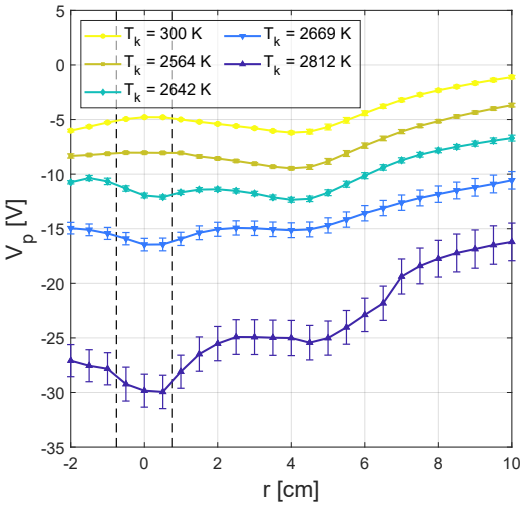

Figure 1: *V_p along r with various temperatures T_k. $r = 0$ is the center of the column, dashed lines indicate the electrode.*

A comprehensive dataset spanning the parameters space (p_0, B, P_w, V_b and T_k) was obtained with measurements of density and electron temperature using an advanced triple probe, and plasma potential measurements using emissive probes.

A typical example (Fig. 1 with $V_b = -60$ V) shows that electron emission is an efficient mean to control the plasma potential: as the temperature of the cathode T_k increases, the cathode sheath reduces, allowing to control the value V_p from the external bias V_b. Our dataset is interpreted in light of recent models [3, 4], and refinements of these models will be discussed.

References

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