

Plasma potential dependence on local density and temperature across the magnetic field in a CCRF discharge

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For bounded plasma, the necessity to remain quasi-neutral leads to the ambipolar diffusion of the constituent charge particles towards the boundary/walls. However, the presence of magnetic field leads to an anisotropic loss of charge particles; still maintaining the global flux balance. Owing to this magnetic field, the electron temperature could also be different at different flux tubes, which in turns also influence the transport.^[1] Furthermore, the shape, conductivity and material properties of the boundary can also significantly alter this transport, e.g. the presence of grounded walls perpendicular to the magnetic field lines can short-circuit the electron flux while ions can easily flow perpendicular to the field lines.^[2] Nevertheless, in a case where the parallel and perpendicular transport independently shows flux balance, there the cross-field transport of electrons would be significantly different from the one having short-circuited effect, which would then change the potential profile too.

To mimic this situation, an experiment has been settled up in which two parallel annular plates have been used

facing the radial direction and placed in the uniform magnetic field. And a CCRF discharge has been created in a push-pull configuration maintaining the zero mean current at both electrodes to ensure the independent flux balance in the axial and radial direction as shown in figure 1.

In this study, we present a fluid model using the radial flux balance for low pressure and partially magnetized cylindrical plasma column, which provide an analytic solution to the radial plasma potential profile as a function of local plasma density and electron temperature. This work also briefly discusses the theoretical model and the experimental results, which shows qualitative match among self.

References

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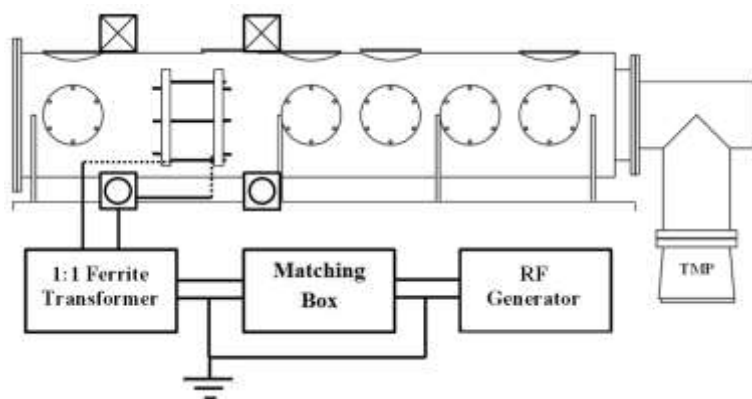


Figure 1: Schematic of the experimental setup.