ELECTRON EMISSION MODELLING IN IONISATION GAUGES FOR MAGNETIC CONFINEMENT FUSION

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ABSTRACT

In magnetic confinement fusion, neutral gas density measurements are a critical diagnostic parameter for plasma control. The ASDEX ionisation gauge is a diagnostic instrument capable of providing spatially and temporally resolved measurements of neutral gas pressure around the vessel in the presence of strong magnetic fields. Its design features a linear electrode configuration comparable to a vacuum tube triode [1]. The internal physics of the device have been studied through qualitative computational modelling [2] and experimental optimization campaigns [3]. While prior simulation efforts using electrostatic particle-in-cell (PIC) methods successfully reproduced diagnostic characteristics under specific equilibrium conditions, they failed to predict a broader range of operational parameters and dynamic state transitions. This talk presents ongoing work at the Max-Planck-Institute for Plasma Physics (IPP) to develop a capable, synthetic ASDEX ionisation gauge model based on a self-consistent, fully dynamic PIC-MCC (Particle-in-Cell with Monte Carlo Collisions) using an open-source framework. If successful, this work would not only enable further design optimization for next-generation fusion experiments but also provide a better understanding of signal instabilities observed during diagnostic operation [4].

The focus of the talk will be placed on the numerical methods used, as well as the benchmarking of thermionic electron emission from a heated cathode. First simulation results for different emitter configurations, materials, and biasing potentials are validated against measurement data. Emphasis will also be placed on tractable model simplifications and their empirical impact on prediction accuracy.

References

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