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Predictive Fluid Model for Self-Consistent Description of Inductive RF Coupling in Powerful Negative Hydrogen Ion Sources

RF-driven negative hydrogen ion sources are operated at low frequencies around 1 MHz, gas pressures around or below 1 Pa and large power densities up to 10 Wcm^{-3} . Owing to these conditions and further design criteria, such as discharge geometry and antenna layout, the RF power coupling is far from optimized, i.e. only a fraction η of the power delivered by the generator is absorbed by the plasma. This considerably limits the performance and reliability of RF-driven ion sources. To study the bidirectional RF power coupling a self-consistent fluid model is introduced. The model validation shows how the interplay between the nonlinear RF Lorentz force and the electron viscosity (which is usually neglected in state-of-the-art fluid models, where no steady state is obtained) yields a steady state discharge structure and trends as in the experiment. In a companion contribution by S. Briefi et al. to this conference, the predictive fluid model is applied to optimize η in RF ion sources.

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