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INVESTIGATION ON WAVE STRUCTURE AND POWER DEPOSITION IN A HELICON PLASMA THRUSTER

Abstract

A wave-particle interaction code is developed to calculate the Helicon and TG wave structure and radial power deposition in a Helicon Plasma Thruster(HPT). The code mainly consists of three different characteristic parts: The vacuum-chamber wall adjacent region, antenna-vacuum region and the plasma region. The waves in vacuum region are calculated as a mixture of TM and TE waves. Helicon and TG wave amplitudes are calculated from the analytical solutions of Maxwell equations for uniform density plasma; radial power distribution is obtained as a sum of Helicon and TG wave. Nagoya III type antenna is used to compare the simulation results with typical experiments conducted in laboratories. Magnetic field intensity range from 100G-800G, plasma density range from 1018-5.01018m-3 are studied to give an insight to wave behavior and find appropriate parameter regions which is possible to be used in a HPT. The results shows that short wave length, electrostatic characteristic TG wave are damping heavily when propagating inward to the bulk plasma, while the long length, electromagnetic characteristic Helicon wave is weakly damped. The wave properties and power deposition in bulk plasma are mainly controlled by Helicon wave, but the amplitudes are far less than in edge region which is decided by TG wave. As magnetic field intensity is raised, when plasma density is relatively lower, TG wave can propagate deeply into bulk plasma region and the power absorption in radial direction is relatively uniform. As it increases, edge energy deposition enhanced, indicating that high density, large magnetic field limits TG wave propagation, which is in consistent with previous experiments.