Electron-wall interactions and their consequences on transport

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The purpose of the talk is to give an overview of accomplishments at PPPL in predictive control of electron kinetics in low-pressure plasmas relevant to ExB discharges. We show using specific examples that this progress was made possible by synergy between full-scale particle-in-cell simulations, analytical models, and experiments. For low-pressure devices, the electron velocity distribution function (EVDF) is non-Maxwellian and, correspondingly, the wall potential is strongly modified. Electron emission strongly influences the wall potential and also leads to the enhanced ExB transport [1]. Nonlinear coupling between EVDF and the wall potential causes additional kinetic instabilities and can cause the relaxation sheath oscillations [2]. We also studied electron beam interaction with the plasma and collisionless transfer of the beam energy to plasma electrons [3]. When secondary electron emission (SEE) needs to be controlled, special surfaces can be used for the SEE mitigation [4]. Our current work includes implementing modern Poisson solvers into the Large Scale Plasma (LSP) particle-in-cell (PIC) code [5] which enables multidimensional PIC simulations. This enhanced PPPL-modified LSP code is being applied to study several low-temperature plasma technologies, including anomalous transport in closed drift ExB devices [6,7].

References:

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