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Overview and challenges of partially magnetized plasma modeling

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The current status and challenges of the discharge plasma modeling capabilities in crossed field devices are reviewed. The plasma flows in such sources, e.g., Hall effect thrusters and magnetron discharge, are partially magnetized, i.e., electrons are magnetized while ions are not magnetized. The partially magnetized plasmas present unique and complex phenomena in that collisions with neutral atoms (a feature of low-temperature plasmas) and instabilities and turbulence (a feature of high-temperature plasmas) coexist. A discharge plasma model is constructed by choosing the numerical methods, e.g., fluid or kinetic, for individual plasma constituents, including neutral atoms, ions, and electrons. In this talk, various models are used to illustrate device-scale phenomena, including the breathing mode and azimuthally rotating spokes, as well as small-scale physics, such as the electron cyclotron drift instability. Additionally, the limitation of drift-diffusion approximation is discussed for magnetized electrons.

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