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Insights into instabilities and electron dynamics in low-temperature magnetized plasma discharges

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Valuable throughout industry, magnetized low-temperature plasma devices are also home to rich and complex physics, including plasma instabilities, anomalous transport, anisotropies and self-organization across different length scales. The ability to understand the physics associated with such features is key for the exploitation of these devices. Planar magnetrons used in plasma-assisted deposition are now increasingly operated in pulsed, dense, high-current plasma states. Access to electron properties and dynamics in these regimes would facilitate an understanding of how plasma behavior affects deposition properties and aid modeling efforts. Similarly, an ability to identify and describe instabilities involved in Hall thruster anomalous transport would provide information required for predictive code development, currently beyond reach. Fortunately, with the recent development and application of advanced laser diagnostics to such plasmas, we are a step closer to mastering the physics of such devices. In this talk, insights from implementations of uniquely-sensitive coherent and incoherent laser Thomson scattering diagnostics are discussed. Coherent Thomson scattering applied to both devices is the source of insights on plasma waves, including time-resolved wave behavior in transient regimes. Incoherent Thomson scattering applied to both devices provides information not only on electron properties, but also electron drifts and anisotropies. These implementations offer a path forward to answering long-standing questions on the physics of such magnetized discharges.