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Models, assumptions, and experimental tests of flows near magnetized boundaries[1]

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We present a history of research on the magnetized plasma boundary and recent first measurements of particle flows in such structures in laboratory plasmas using multi-dimensional laser-induced fluorescence (LIF). Our measurements show that the canonical model for this boundary proposed in 1982 [*Chodura, Phys. Fluids (1982)*] is inaccurate for systems where the ion-neutral collision length is less than at least 4 times the ion gyro radius. Rather, our measurements validate more sophisticated plasma boundary fluid models that take neutral collisions into account [*Riemann, Phys. Plasmas (1994); Ahedo, Phys. Plasmas (1997); Siddiqui et al., Phys. Plasmas (2014)*]. In light of these results, we show that both three-dimensional ion and neutral velocity distribution functions are strongly affected near the boundary. We discuss effects of these perturbed distributions on wall loading and erosion in experiments and applications such as divertor tokamak scrape-off layers and Hall thrusters. Finally, we propose modern definitions of the oft-used term, "magnetic presheath."

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