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**The path toward self-consistent, kinetic simulation of detached divertors** GEORGE WILKIE, DAREN STOTLER, MICHAEL CHURCHILL, ROBERT HAGER, JULIEN DOMINKSI, SEUNG-HOE KU, CHOONG-SEOCK CHANG, Princeton Plasma Physics Laboratory — Achieving predictive theoretical capability for divertor detachment is complicated by several outstanding challenges. Among these include: the plasma turbulence and transport across the separatrix, in the scrape off layer, and in the private flux region; the role of impurities; and robust kinetic predictions of neutral atoms and molecules. We simulate the behavior of neutrals with the Monte Carlo particle code DEGAS2, coupled to the XGC edge gyrokinetic code for the plasma dynamics. Ensuring energy conservation in the coupling between these computational models will be critical. The lower electron temperatures of the detached divertor mean that volume recombination must be included as a source of neutrals and sink of plasma ions and electrons. The low temperatures also result in longer lifetimes for molecular hydrogen. The associated higher neutral densities increase the importance of neutral-neutral collisions and radiation trapping. In this poster, we will present a roadmap outlining how these key challenges are to be addressed and the solutions consolidated into a unified theoretical framework for predicting divertor performance.

George Wilkie
Princeton Plasma Physics Laboratory

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