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P1.1069 Advances Towards Modeling a Simplified Lithium Vapor Box Design

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The surface heat flux in a fusion Demonstration power reactor operating under attached conditions has been predicted to reach values far beyond the capabilities of any solid surface [1]. The injection of gaseous impurities to cause divertor detachment can result in strong radiation at the X-point [3], causing the pedestal temperature to decrease. This can have detrimental effects on plasma confinement. The lithium vapor box is a divertor design that aims to radiate a large fraction of the loss power volumetrically via lithium line radiation, while localizing the lithium vapor to the divertor region. Even in a simple divertor configuration without special-purpose baffles, [2], local evaporation and condensation can create a strong differential pumping effect, minimizing lithium vapor near the X-point while keeping a high enough lithium density to detach the plasma [4, 5]. This system is resilient to changes in power loss, because the lithium ionization increases as the divertor leg extends towards the target. Due to the presence of regions with high neutral fractions, self-consistent investigation of lithium-plasma interactions in this configuration necessitates the use of a coupled fluid plasma - kinetic neutrals code. SOLPSITER is capable of modeling both the neutral-dominated regions near the lithium evaporator and the plasma-dominated regions further upstream. Here, SOLPS-ITER is used along with relevant PFC geometries and EFIT equilibria to simulate a simplified lithium vapor box divertor within the Experimental Advanced Superconducting Tokamak (EAST). SOLPS-ITER neutral transport results are benchmarked against the SPARTA Direct Simulation Monte Carlo code. Lithium fractions, electron densities and temperatures, and radiation distributions are presented for detached cases in EAST.

References

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