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Measurements of high-Z divertor impurity sourcing and divertor leakage using isotopic tungsten tracer sources in DIII-D

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DIII-D carried out experiments using novel, isotopic tungsten (W) tracer sources in the outer divertor and has characterized how the W leakage from this region depends on botz the exact source location and ELM behavior. The W sources are toroidally-symmetric and poloidally-localized to two regions: (1) the outer strike point (OSP), a natural-W source; and (2) the far-target, i.e., 3-5 heat flux widths from the OSP, a W-182 source. With the use of a dual-faced collector probe (CP) in the main SOL near the outside midplane (OMP), it is found that the far-target W source has the smallest upstream deposition efficiency on the CP, i.e. divertor leakage, with high input power and small ELMs; conversely the far-target divertor leakage is highest with large ELMs. Additionally, without ELMs, it is also found that large deposition asymmetries on the opposite CP faces are consistent with model predictions of W accumulation in the near-SOL at the tokamak crown region. This unique experimental setup, together with source (W-I) and core spectroscopic measurements, provide information on the transport link between different W source locations within the divertor and the W content of the plasma outside the divertor, i.e., divertor leakage. These studies are elucidating the physics driving high-Z divertor impurity sourcing and leakage, both with and without ELMs, and are shedding light on this the weakest link, to date, in the chain connecting wall impurity sources to core impurity levels in MFE devices, like ITER.

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