Investigating Pedestal Structure with Isotopes

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The isotope effect, a positive scaling of energy confinement with increasing ion mass has been demonstrated in L-mode and H-mode plasmas yet is usually found to be weaker in the latter. Recent work on JET [1] has demonstrated experimentally how the H-mode pedestal region's stability boundaries change indirectly with isotope mass. Because heat diffusivity is much higher in H than D discharges, the power required to enter and maintain similar H-modes causes a higher separatrix temperature in H. This decreases the ballooning boundary by moving the pressure gradient outward into the region of higher magnetic shear, and also destabilizes the peeling boundary by placing more bootstrap current on the separatrix as the pressure gradient moves outward. Our work involves expanding this analysis onto DIII-D by matching shots with both dimensional and dimensionless cases. Using this wide range of parameters for matching H and D plasmas, we will investigate the degree to which the pedestal is set by the scrape-off layer vs. the core plasma. For example, by matching the Mach number at the edge, we will examine how higher NBI heating in H required to reach H-mode increases torque and rotational shear which could couple with the pedestal pressure moving outward (from higher separatrix temperature) and cause a change in the MHD stability boundaries.

[1] L. Horvath *et al.*, "Isotope dependence of the type I ELMy H-mode pedestal in JET-ILW hydrogen and deuterium plasmas," *Nucl. Fusion*, vol. 61, no. 4, p. 046015, Apr. 2021, doi: 10.1088/1741-4326/abdd77.

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