Effects of isotopes on pedestal structure in DIII-D

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Using a database of hydrogen and deuterium H-modes on DIII-D we examine how the isotope effect alters the fueling and transport of plasmas to change the pedestal stability and structure calculated by EPED [1]. The isotope effect is an empirical positive scaling of beneficial plasma parameters, such as confinement and decreased L-H transition power, with an increase in hydrogenic isotope mass. This empirical scaling conflicts with Bohm diffusion which predicts the opposite. The majority of this positive scaling originates from the edge pedestal region, raising the question if the isotope effect in part arises from a change of edge turbulence, transport, or fueling behavior. In this study, we compare hydrogen and deuterium discharges to predictions of the EPED model which uses MHD stability limits to calculate a scaling for pedestal pressure width and height. While the model uses the pressure profile, the individual differences in the temperature and density profiles often indicate the underlying physics of the pedestal. DIII-D hydrogen discharges, compared to similar deuterium shots, often exhibit an increased outward shift of the density profile relative to the temperature profile (Figure 1 bottom) which increases separatrix density and significantly alters the ballooning stability. Hydrogen discharges generally have narrower density pedestals compared to deuterium despite the increased neutral mean free path with lower isotope mass. We also compare transport and fueling relevant parameters such as $\eta_e = \frac{L_{n_e}}{L_{T_e}} = \frac{(n_e/\nabla n_e)}{(T_e/\nabla T_e)}$ (Figure 1 top) to explore the differences between experiment and the EPED model in hydrogen and deuterium. **Work supported by US DOE under DE-FC02-04ER54698 and DE-SC0019302.**

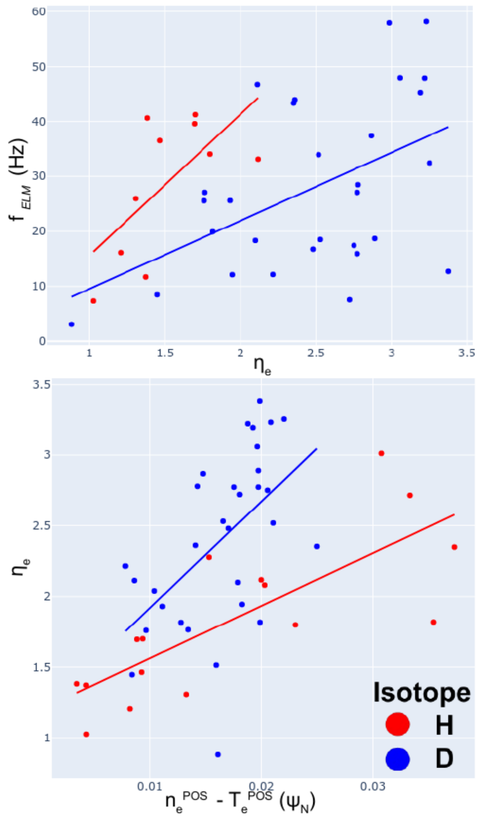

Figure 1: *(top) ELM frequency is correlated with η_e (transport driven) and (bottom) η_e is correlated with profile shift.*

References

[1] P.B. Snyder, Physics of Plasmas **16**, 056118 (2009); doi: 10.1063/1.3122146