Experimental separation of core transport and edge pedestal isotope dependencies by variation of the plasma shape

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The mass dependence of energy confinement in fusion plasmas is still not fully understood. One of the main reasons is the difficulty of making direct comparison studies. Often the cause for this difficulty is multiple different mechanisms influencing confinement. A variety of these mechanisms depending on the hydrogen isotope mass have been reported on in the past [1–4]. If not separated properly, understanding one of these mechanisms always relies on accurate knowledge of the others. In this contribution we present a possibility to separate the influence of the core transport and the edge pedestal on confinement.

In H-mode plasmas there are two major contributions which determine the energy confinement. The heat and particle transport in the core and the stability of the edge transport barrier. Both are largely independent, so for transport studies the pedestal top can be in good approximation regarded as boundary condition. However, in experiments with different isotopes, here hydrogen and deuterium, the assumption of the pedestal as boundary condition does not hold anymore. The reason for this is a strong degradation of the pedestal in hydrogen compared to deuterium for similar heat and particle fluxes. To recover the quality of a boundary condition the pedestal top values need to be matched for comparable source terms. This can be achieved by utilizing the effect the plasma triangularity has on the edge transport barrier.

We will present a variation of the shape between plasmas in hydrogen and deuterium with matched edge confinement - meaning same pedestal top values for the same ion and electron heat fluxes as well as gas puff levels. The pedestal is then found to be close to peeling-ballooning stability for both isotopes. In the core the plasma shows similar transport properties when the heat fluxes are matched despite the different isotopes. Implications for the understanding of isotope dependencies are discussed.

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