DPP16-2016-000656

Abstract for an Invited Paper
for the DPP16 Meeting of
the American Physical Society

Pedestal shape, stability and inter-ELM evolution for different main ion species in ASDEX Upgrade[1]

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In tokamak plasmas with different main ion species as hydrogen isotopes or helium, a change of confinement occurs, known as isotope effect. To identify the processes defining the pedestal structure and evolution, experiments comparing hydrogen (H), deuterium (D) and helium (He) plasmas have been performed. Their goal was to match the pedestal top electron density and temperatures and compare the pedestal shape and stability. A factor of almost 10 higher gas puff as well as a factor of 2 higher heating power were required in H to achieve the same pedestal top values as in the D reference. While the pedestal electron temperature profiles do not differ, the density profile in H has shallower gradients. These can be explained by a lower particle confinement in H, if the ionization source profile is assumed to be similar. In He plasmas owing to the larger effective charge, the stored energy at similar pedestal top electron density is roughly a factor of 1.5 smaller than in the references, leading to the absence of ELMs. In summary the experimental results suggest different particle and energy confinement for different main ion species, however, peeling-ballooning theory can sufficiently describe the pedestal stability and ELM behavior.

[1]This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053.