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P2.1090 Effect of the isotope mass on the turbulent transport of ASDEX Upgrade and JET-ILW L-modes edge

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Since the first comparisons between different hydrogen isotope plasmas in tokamaks it appeared that deuterium (D) plasmas have generally better performances than hydrogen (H) plasmas [1-4]. The energy and particle confinement times [1-3], the L-H power transition [4,5] and the H-mode pedestal [3,6], essential parameters for a reactor, have all been found to depend on the isotope mass. A general experimental observation is that the isotope mass has a strong impact at the plasma edge [3,6]. Past studies on the tokamak edge suggested a large variety of micro-instabilities and turbulence to explain the turbulent transport in this region [7-11]. However the effect of the isotope was not the focus in these studies. We use local gyro-kinetic simulations with the GENE code [12] to study the nature of the
turbulent transport at the edge of ASDEX Upgrade and JET-ILW plasmas (ρ_(tor) ~ 0.95) and the effect of the isotope mass on the micro-instabilities and turbulence in this region. For both devices pairs of D and H L-mode plasmas with matched density and temperatures have been analyzed. As reported in Ref. [3,13], higher input power and gas puff were needed in the H discharges to match the D profiles. For the JET discharges, EDGE2D/EIRENE simulations predicted diffusivity coefficients in H twice as in D in the edge region [3]. Our simulations indicate that the main micro-instability in the edge region of both machines is an electron
drift-wave-like mode destabilized by collisions (ν_(ei)/c_s), driven by R/L_(Te) (=R| \nablaT_e|/T_e) and connected to the kinetic electron dynamics, confirming what was found in past gyro-fluid simulations [8]. We find that the isotope mass has a strong impact on the micro-instability, effect enhanced by the high collisionality of the edge region. The effect of the ion mass appears already in linear electrostatic simulations and translates into a lower critical threshold in R/L_(Te) with lower isotope mass. Electromagnetic effects are found to play a strong role in non-linear simulations, with an enhancement of the level of the turbulence at low-k_y wavenumbers, similar to what was found in Ref. [7,8]. The external ExB shear is found to have a stabilizing effect on this type of turbulence, suggesting a possible role in the L-H transition. These results are valid for both JET-ILW and ASDEX Upgrade. Overall, our simulations are able to reproduce the experimental observations, in both the fluxes and their dependence on the isotope mass. These findings can help to predict the performance of future reactors such as ITER. A better understanding of the edge transport is an essential element for extrapolation to future reactors, affecting important aspects such as the L-H power threshold and the H-mode pedestal.

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