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P3.044 Sensitivity of fast ion losses to magnetic perturbations in the European DEMO

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The limits for the heat loads on the DEMO first wall are significantly stricter compared to those of ITER due to cooling and breeding blanket requirements. In addition to the thermal particle and radiation loads, fast particles in the form of fusion alphas and NBI ions with high energies can escape the confinement due to various magnetic perturbations and produce a significant heat load on the first wall.

Previously, the losses of fusion alpha and NBI ions have been found to be manageable, with wall loads remaining below 10% of the limit of 1 MW/m² envisaged for the DEMO first wall. This is primarily due to the plasma profiles that allow the 800 keV NBI ions to penetrate deep into the plasma before ionizing, and the generous gap of up to 20 cm between the separatrix and the first wall panels. Additionally, only losses due to toroidal field ripple were accounted for, while significant perturbations would be introduced by the possible addition of ELM control coils.

In this contribution, we present ASCOT simulation results for fast ion confinement and losses under the effects of additional perturbations, including increased toroidal field ripple due to reduced ferritic inserts and reduced number of toroidal field coils, and the addition of resonant magnetic perturbations (RMP) due to ELM control coils. Additionally, the effect of NBI ionization in the scrape-off layer is discussed, which can introduce localized loads due to high-energy prompt losses.

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