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Experimental study of RMP induced fast-ion transport using FIDA spectroscopy at the ASDEX Upgrade tokamak

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Resonant magnetic field perturbation (RMP) coils are used in multiple fusion devices to mitigate magneto-hydrodynamic (MHD) instabilities known as edge localised modes. The coils produce a radial magnetic field component that is small compared to the toroidal field strength, but breaks the axi-symmetry of the flux surfaces near the edge. This increases heat and particle transport at the plasma edge which reduces the pressure and gradients that drive the instability [1]. Additionally, it has been found that the use of RMP coils lead to enhanced fast-ion losses [2, 3, 4]. Recent work has shown that RMPs produce an edge resonant transport layer (ERTL) inside the plasma separatrix that leads to enhanced fast-ion transport in this region [5]. However, a quantitative study on the impact of RMPs on the fast-ion density profile including the radial extent of modifications is yet to be performed on the ASDEX Upgrade tokamak (AUG). Previous studies have relied on measurements from static fast-ion loss detectors (FILDs) which do not provide radial information of the confined fast-ion density. The availability of a dedicated edge fast-ion D-alpha (FIDA) diagnostic at AUG [6] allows to now additionally measure the distribution function of confined fast-ions near the edge.

Dedicated discharges have been performed during the 2021 experimental campaign to investigate the impact of RMPs on the edge fast-ion density. Configuration scans of n=2 applied perturbation fields and coil current scans to vary the perturbation strength have been carried out. A strong response in the FIDA emission profile is observed when the RMP coils are applied. Modulation of the field perturbation by means of rigidly rotating the perturbations has allowed to make use of the light ion beam probe [7] method to calculate the RMP induced fast-ion displacement from FIDA measurements. These are compared to values calculated from FILD measurements as well as predicted values from modelling using the full fast-ion orbit code ASCOT5 [8]. A combined analysis of the FIDA and FILD measurements as well as those from the diamagnetic loop diagnostic is performed to asses the reduction in fast-ion content. Lastly, the radial impact of the RMP coils on the fast-ion density profile is characterised and compared to numerical predictions which include for the effect of plasma response to the perturbation fields.

[1] W. Suttrop et al, Fusion Eng. Des. **88**, 446-453 (2013)
[2] M. Garcia-Munoz et al, Nucl. Fusion **53**, 123008 (2013)
[3] M. A. Van Zeeland et al, Nucl. Fusion **55**, 073028 (2015)
[4] K. G. McClements et al, Plasma Phys. Control. Fusion **57**, 075003 (2015)
[5] L. Sanchis et al. Plasma Phys. Control. Fusion **61**, 014038 (2019)
[6] A. Jansen van Vuuren et al, Rev. Sci. Instrum. **90**, 103501 (2019)
[7] X. Chen et al, Rev. Sci. Instrum. **85**, 11E701 (2014)
[8] E. Hirvijoki et al., Comput. Phys. Commun. **185** (2014)

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