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Non-linear 3D hybrid kinetic-MHD simulations of ELMs in the ASDEX Upgrade tokamak with MEGA

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A strong interplay between edge perturbations, such as edge localized modes (ELMs) and fast-ions has been observed experimentally [1]. Furthermore, beam-ion acceleration during an ELM was observed for the first time in the ASDEX Upgrade tokamak [2]. All these findings indicate that kinetic effects of fast-ions should be considered in ELM modelling. For this purpose, non-linear hybrid kinetic-MHD simulations of an ASDEX Upgrade reference case [3] have been performed using the code MEGA [4]. First, large type I ELMs are simulated with the code MIPS [5], the MHD component of MEGA, utilising both standard and extended MHD models in a fully 3D and realistic X-point geometry. Standard MHD simulations reveal a linear phase in which medium n ballooning modes are the most unstable. In the non-linear phase, lower n modes grow due to non-linear coupling between different harmonics until a saturated phase is reached [6]. During this phase, heat flux and particle transport towards the scrape-off layer (SOL) is enhanced. On the other hand, extended MHD simulations including diamagnetic, toroidal and the recently implemented neoclassical flows, show a stabilizing effect on the ballooning modes obtained with the standard MHD model. Preliminary results on the interaction between fast-ions and ELMs will be presented.

[1] M. Garcia-Munoz et al., Nucl. Fusion 53 (2013), 123008.

[2] J. Galdon-Quiroga et al., Phys. Rev. Lett. 121 (2018), 025002.

[3] A. F. Mink et al., Nucl. Fusion 58 (2018), 026011.

[4] Y. Todo et al., Phys. Plasmas 5 (1998), 1321.

[5] Y. Todo et al., Plasma and Fusion Res. 5 (2010), S2062.

[6] I. Krebs et al., Phys. Plasmas 20 (2013), 082506.

§ H. Meyer et al, Nucl. Fusion 57 (2017), 102014.

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