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Investigation of beam-ion transport and acceleration during edge localized modes in the ASDEX Upgrade and MAST Upgrade tokamaks

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Observations of beam-ion acceleration during edge localized mode (ELM) crashes have been recently reported in the ASDEX Upgrade tokamak [1, 2]. In this work, fast-ion transport during ELMs is investigated using full orbit simulations with the ASCOT code [3] and measurements from a fast ion loss detector (FILD) [4, 5, 6, 7]. Time-evolving 3D electromagnetic fields have been coded up in ASCOT to compute fast-ion orbits in the presence of fast MHD events such as ELMs, in which the perturbed electromagnetic field changes on fast-ion orbital time-scales. The time-dependent module uses a 4D cubic spline interpolation of the evolving magnetic and the electric field vectors, computed on a uniform cylindrical grid. The module has been successfully tested against a model that describes perturbations using a Fourier decomposition along the field lines. The time-evolving electromagnetic field in ASCOT, together with a 3D model of the tokamak wall, makes it possible to evaluate the velocity-space distribution of the fast-ions impinging on the FILD probe, which is used to construct a synthetic FILD signal during the ELM crash.
Using electromagnetic fields of an ELM crash in ASDEX Upgrade modelled with the hybrid kinetic-MHD code MEGA [8] and a continuous NBI-birth fast-ion distribution from ASCOT, a synthetic signal of the ASDEX Upgrade FILD array is obtained that can be compared with experimental measurements. Similarly, a synthetic signal of the FILD in MAST Upgrade is constructed using the electromagnetic field during an ELM crash simulated with the non-linear resistive MHD code JOREK [9] and the NBI birth distribution from ASCOT, making it possible to investigate the presence of a high-energy component in the signal and giving a first prediction of the fast-ion losses during an ELM crash in MAST Upgrade.

[1] J. Galdon-Quiroga *et al.*, Phys. Rev. Lett. **121** (2018), 025002.
[2] J. Galdon-Quiroga *et al.*, Nucl. Fusion **59** (2019), 066016.
[3] E. Hirvijoki *et al.*, Comput. Phys. Commun. **185** (2014), 1310-1321.
[4] M. Garcia-Munoz *et al.*, Rev. Sci. Instrum **80** (2009), 053503.
[5] J. Gonzalez-Martin *et al.*, Rev. Sci. Instrum **89** (2018), 10I106.
[6] J. Gonzalez-Martin *et al.*, J. Instrum submitted (2019).
[7] J.F. Rivero-Rodriguez *et al.*, Rev. Sci. Instrum **89** (2018), 10I112.
[8] Y. Todo *et al.*, Phys. Plasmas **5** (1998), 1321.
[9] G.T.A. Huysmans and O. Czarny, Nucl. Fusion **47** (2007), 659.
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