

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

Wednesday, 4 September 2019 11:00 (35 minutes)

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.

* See author list of "B. Labit *et al.*, 2019 Nucl. Fusion accepted (<https://doi.org/10.1088/1741-4326/ab2211>)".

Country or International Organization

Spain

Primary authors: RIVERO RODRIGUEZ, Juan Francisco (University of Seville); GARCIA-MUNOZ, Manuel (Max Planck Institute for Plasma Physics); GALDON-QUIROGA, Joaquin (University of Seville); SNICKER, Antti (Aalto University); MCCLEMENTS, Ken (CCFE); AKERS, Robert (UKAEA); Mr DOMINGUEZ-PALACIOS, Jesus (University of Seville); Dr GARCIA-VALLEJO, Daniel (University of Seville); Mr GONZALEZ-MARTIN, Javier (University of Seville); PAMELA, Stanislas (CCFE - UKAEA); SALEWSKI, Mirko (Technical University of Denmark); Mr SARKIMAKI, Konsta (Aalto University); Mrs SMITH, Siobhan (CCFE); VIEZZER, Eleonora (Max-Planck-Institut fuer Plasmaphysik)

Presenter: RIVERO RODRIGUEZ, Juan Francisco (University of Seville)

Session Classification: Plenary

Track Classification: Transport of Energetic Particles