Experimental observations of fast-ion losses correlated with Global Alfvén Eigenmodes in MAST-U

J.F. Rivero-Rodriguez[1], K. McClements[1], S.E. Sharapov[1], J. Oliver[1], M. Dreval[2], M. Fitzgerald[1], N. Crocker[3], J. Galdon-Quiroga[4], M. García-Muñoz[4], C. Michael[3], L. Velarde[5], E. Viezzer[4], and the MAST-U Team*

[1] *United Kingdom Atomic Energy Authority, Culham Campus, Abingdon, Oxon, OX14 3DB, UK*

[2] *Institute of Plasma Physics, National Science Center, Kharkov Institute of Physics and Technology, 61108 Kharkov, Ukraine*

[3] *Department of Physics and Astronomy, University of California Los Angeles, Los Angeles, CA 90095-7099, USA*

[4] *Departamento de Física Atómica, Molecular y Nuclear, Universidad de Sevilla, Sevilla, Spain*

[5] *Departamento de Ingeniería Energética, Universidad de Sevilla, Sevilla, Spain*

Due to their relatively higher $V_{beam}/V_{Alvén}$ ratio, spherical tokamaks like MAST-U are ideal to investigate high-frequency beam-ion driven modes such as Compressional Alfvén Eigenmodes (CAEs) and Global Alfvén Eigenmodes (GAEs) [1, 2]. Besides, the scintillator-based Fast-Ion Loss Detector (FILD) [3] in MAST-U, provides enough sampling frequency to detect fast-ion losses induced by such instabilities. Fourier analyses of the MAST-U FILD revealed coherent fast-ion losses in the range of 1 – 2 MHz, which is 0.3 – 0.45 times the cyclotron frequency of deuterium at the magnetic axis. The modes are identified as Global Alfvén Eigenmodes (GAEs) formed above the maxima of the Alfvén continuum [4]. To date, this is the most direct measurement of fast-ion losses induced by GAEs, showing for the first time that instabilities in the ion cyclotron range can trigger fast ion losses. Since the Neutral Beam Injectors in ITER will provide such a super-Alfvénic fast-ion distribution, they may be susceptible to drive GAEs unstable. Thus, understanding these losses becomes of paramount importance for ITER, as they can affect the heating and current drive capabilities to achieve burning plasmas.

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* See author list of J. Harrison, et al. 2024 Nucl. Fusion 64 112017