Investigations of Alfvén Eigenmode stability via active antenna excitation in JET hydrogen, deuterium, and tritium plasmas

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The interaction of Alfvén Eigenmodes (AEs) and energetic particles (EPs) can lead to EP transport and deconfinement and should be avoided in future burning plasmas, especially in the presence of alpha particles. While predicting growth rates is relatively well in hand, the multitude of damping mechanisms that depend on detailed plasma conditions is still under investigation and needs better experimental and theoretical verification. To study this, eight in-vessel antennas – collectively called the Alfvén Eigenmode Active Diagnostic (AEAD) – actively probe *stable* AEs in JET with frequencies f = 25-250 kHz and toroidal mode numbers $|n| < 20$ [1,2]. Thousands of stable AE resonances – and their properties f, n, and net damping rates $\gamma < 0$ – were measured in hundreds of plasmas during the recent hydrogen, deuterium, and tritium JET campaigns. From this database, we investigate trends versus a variety of plasma parameters, operational scenarios, and isotope effects. Importantly, for the first time in JET EP experiments, we report on a stable AE tracked by the AEAD only ~300 ms after its transition from being destabilized by ICRH-accelerated fast ions to being damped in a high-performance plasma discharge. Computational studies of mode stability with the kinetic-MHD code NOVA-K [3-5] and gyrokinetic code GTC [6] are being compared with experiment and will be reported in this presentation. Finally, we present first AEAD results from the JET DT campaign.

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This work was supported by the US DOE through grants DE-FG02-99ER54563, DE-AC05-00OR22725, DE-AC02-05CH11231, and DE-AC02-09CH11466. This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training program 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.