Validation of 3D MHD simulations of mixed Ne-D_2 shattered pellet injection against H-mode experiments in JET

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Shattered pellet injection (SPI) is the technique selected for disruption mitigation in ITER, and is being tested in several tokamaks including JET [1]. In this work, we present results of nonlinear 3D MHD simulations of mixed Neon-Deuterium SPI into H-mode JET plasmas, and their validation against experiments. We consider a medium size pellet with 8.1 mm diameter as shot from barrel B in JET, and we focus on the pre-thermal quench and thermal quench (TQ) phases. Simulations are performed with the 3D MHD code JOREK [2] using parameters as close as possible to experimental conditions. In particular, we perform free boundary simulations with realistic JET vessel, separate electron and ion temperatures, realistic edge plasma resistivity, and distributions for the sizes and velocities of fragments in the SPI plume consistent with laboratory measurements [3]. A scan in the pellet mixture ratio ranging from 5% Ne-95% D_2 to pure Ne is carried out, as done in the series of target experimental pulses [4]. It is found that all the mixture ratios can produce a TQ, triggered by the MHD activity (and the related global magnetic field stochastization) induced by radiation cooling from injected impurities. Good quantitative agreement is found between JOREK simulations and JET pulses, regarding several key aspects such as bolometry radiation patterns, the increase of radiation power and line integrated density, and the decrease of plasma thermal energy and core temperature during the TQ. This demonstrates the capability of JOREK as a fundamental interpretative tool of these experimental observations. In particular, the code can be used to provide insights about the toroidal asymmetry of radiation, which cannot be measured properly at JET due to the lack of diagnostic capability. Present simulations predict a level of radiation asymmetry at the TQ consistent with experimental estimates reported in [1].

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