Interpretative 3D MHD modelling of deuterium shattered pellet injection into a JET H-mode plasma

M. Kong[1], E. Nardon[2], M. Hoelzl[3], D. Bonfiglio[4], D. Hu[5], U. Sheikh[6],
A. Boboc[1], P. Carvalho[1], T.C. Hender[1], S. Jachmich[7], K.D. Lawson[1], S. Silburn[1],
Ž. Štancar[1], R. Sweeney[8], G. Szepesi[1], the JOREK team[*] and JET contributors[†]

[1] UKAEA-CCFE, Culham Science Centre, Abingdon, Oxon, OX14 3DB, UK
[2] CEA, IRFM, F-13108 Saint-Paul-lez-Durance, France
[3] Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching b. M., Germany
[4] Consorzio RFX, Corso Stati Uniti 4, 35127 Padova, Italy
[5] School of Physics, Beihang University, Beijing, 100191, China
[6] École Polytechnique Fédérale de Lausanne (EPFL), Swiss Plasma Center (SPC), CH-1015 Lausanne, Switzerland
[7] ITER Organization, Route de Vinon sur Verdon, CS 90 046, 13067 Saint Paul-lez-Durance, Cedex, France
[8] Massachusetts Institute of Technology, Cambridge, MA 02139, USA

Shattered pellet injection (SPI), with research started in recent years, is the current concept for the ITER disruption mitigation system (DMS) to prevent disruption-related damage. Compared with impurity SPI, pure deuterium (D2) SPI could contribute to runaway electron (RE) avoidance in ITER via a strong dilution cooling before the thermal quench, as has been highlighted by predictive MHD modelling [1-3]. However, the drift of the ablation plasmoid towards the tokamak low field side (LFS) [4] and the existence of background impurities [2] could put this strategy (especially LFS D2 SPI injection) into question. These need to be clarified for the ITER DMS design, for which the validation of D2 SPI simulations against present experiments is crucial. In this work, we will present latest results on the modelling of D2 SPI into a JET H-mode plasma with JOREK [5], focusing on the (pre-)thermal quench dynamics and a detailed comparison with the experimental data. Our earlier simulations were in qualitative agreement with the radiation pattern of the JET bolometry system, whereas the total radiated power tended to be underestimated when assuming pure tungsten as the background impurity [6]. We will explore a more realistic mixture of background impurities (such as tungsten and neon) and investigate their role in the radiative cooling and thermal quench onset of the D2 SPI discharge. We will also discuss the evident drifts of the ablation plasmoids towards the LFS observed by the fast camera and study their role in the relatively small density rise measured by the central chord of the JET polarimeter [7]. These interpretative modelling could provide key information on the effectiveness of D2 SPI on RE avoidance for the ITER DMS design.

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[6] M. Kong et al "3D non-linear MHD simulations of deuterium shattered pellet injection into H-mode JET plasma", 19th European Fusion Theory Conference (2021) [7] A.Boboc et al RSI 86 091301 (2015)

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[*] See the author list of M. Hoelzl et al Nucl. Fusion 61 065001 (2021)
[†] See the author list of 'Overview of JET results for optimising ITER operation' by J. Mailloux et al. in press in Nuclear Fusion (https://iopscience.iop.org/article/10.1088/1741-4326/ac47b4)