

P4.1045 Modelling of shattered pellet ablation: a discussion

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The massive injection of material into a tokamak is a technique considered for disruption mitigation. Presently, several shattered pellet injectors (SPIs) [1] are foreseen for the ITER disruption mitigation system. According to reference [2], the assimilation of 14 kPam³ of deuterium fully prevents the conversion of magnetic energy into runaway electrons during the induced current quench of a 15 MA ITER plasma. This amount of gas corresponds to a volume averaged density increase of the order of 41021 m⁻³, which should take place in a time interval of the order of 10 ms. In addition, the density increase has to occur in the plasma centre where the plasma current peaks and the toroidal electric field is maximum. It is presently not known, whether this is physically and technically doable. The Neutral Gas Shielding (NGS) model has been implemented in JOEREK and used to simulate the interaction of shattered pellets with JET-like plasmas [3]. The simulations were done with injected amounts of deuterium of the order of 1022 molecules, which correspond to a density rise of the order of 1020 m⁻³. These quantities are one order of magnitude smaller than the one needed for RE suppression in a full current ITER mitigated disruption. This conference contribution reports on calculations of deuterium pellet ablation and density increase carried out with the HPI2 code [4] for different ITER- and DEMO-relevant [5] plasma and pellet (shattered and not) parameters. The comparison between the NGS model and the HPI2 results and the limitations of the two models are also discussed. The ultimate purpose of this exploratory work is to understand whether RE suppression by massive material injection is possible in a future fusion reactor.

[1] L. Baylor et al., 27th IAEA Fusion Energy Conference FIP/P1-1 (Gandhinagar, 2018) [2] J.R. Martin-Solis et al., Nuclear Fusion (2017) 57 066025 [3] D. Hu et al., Nuclear Fusion (2018) 58 12605 [4] F. Koechl et al., "Modelling of pellet particle ablation and deposition: the hydrogen pellet injection code HPI2", Report EFDA-JET-PR(12)57 [5] M. Siccino et al., to be published in Nuclear Fusion (2019)

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