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Study of the companion plasma during runaway electron mitigation experiments with massive material injection in the JET tokamak

Disruptions are a major issue for operation of future tokamaks like ITER and may generate runaway electrons (REs) which can melt the plasma facing components. The present ITER disruption mitigation strategy is to avoid the RE beam formation using Shattered Pellet Injection (SPI). If a RE beam is still generated, the thermal plasma cools down to 1-20 eV forming a so called companion plasma sustained by the RE beam. The characterization of the companion plasma is important to study how the RE beam interacts with a possible "second injection"designed to mitigate the RE beam.
The characteristics of the argon companion plasmas resulting from MGI or SPI are compared quantitatively using VUV spectroscopy[a]. A qualitative spectral study of D2 SPI second injection in the argon companion plasma is also performed. The deuterium lines dominate after the D2 SPI second injection which likely indicates that the argon concentration in the plasma is reduced. The rate of plasma current increase following the D2 SPI is correlated with the initial argon MGI amount. Rapid changes in the VUV spectra a few tens of milliseconds before the RE beam termination are also reported.
The dependency of the companion plasma characteristics on the argon MGI amount are simulated using a 1D diffusion model[b] and are compared with experimental observations. The case of D2 SPI into the argon companion plasmas are also simulated using this model and the results are compared with the qualitative VUV spectra analysis. The effect of using CRETIN versus ADAS radiation models in this 1D diffusion code is assessed.

[a] Sridhar, S. et al. 46th EPS conference on Plasma Physics –Milan, Italy, July 2019
[b] E.M. Hollmann et al 2019 Nucl. Fusion 59 106014

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