A SIMPLIFIED APPROACH TO THE PHYSICS OF RUNAWAY ELECTRON BEAM DISSIPATION IN TOKAMAK DISRUPTIONS*

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ABSTRACT

The injection of large amounts of high-Z impurities by Massive Gas Injection (MGI) or Shattered Pellet Injection (SPI) constitutes the most promising candidate for the mitigation of runaway electrons during disruptions in large devices like ITER [1,2].

In this paper, the dissipation and decay of the runaway current by injection of high-Z impurities during tokamak disruptions is analyzed using a simplified approach, based on the kinetic treatment of Ref. [3], which includes the effect of the collisions with the plasma particles and the impurity ions, the synchrotron radiation losses associated with the pitch angle scattering of the runaway electrons when colliding with the impurity atoms as well as the bremsstrahlung radiation. The model allows to get simple estimates of the runaway current duration, the runaway distribution function and energy during the dissipation phase. A comparison of the effects associated with the different runaway loss mechanisms (collisions, synchrotron and bremsstrahlung radiation losses) will be presented . Extrapolations to ITER indicate that injection of a few $\mathrm{kPa \cdot m^3}$ of Ar could be a promising scenario for runaway electron dissipation during disruptions if the impurities can be efficiently delivered into the plasma. Effects associated with the runaway scraping-off due to the VDE of the runaway beam during the decay of the current will be also considered.

[**1**] E.M. Hollmann et al., Phys.Plasmas **22**, 021802 (2015).
[**2**] M. Lehnen et al., J. Nucl. Mater. **3948**, 463 (2015).
[**3**] P. Aleynikov and B.N. Breizman, Phys.Rev.Lett. **114**, 155001 (2015).

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