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TH/P4-05: Spatio-temporal Distribution of Runaway Electron Wall Loads in ITER due to Resonant Magnetic Perturbations

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Disruptions in large tokamaks can lead to the generation of a relativistic runaway (RE) electron beam that may cause serious damage to the first wall. To suppress the RE beam the application of resonant magnetic perturbations (RMP) has been suggested. In this work we investigate the effect of resonant magnetic perturbations on the spatial distribution of the RE wall loads by simulating the RE drift orbits in magnetostatic perturbed fields (RMP and TF ripple) and calculating the transport and orbit losses for various particle energies and different magnetic perturbation configurations. In the simulations we use model configurations with actual (TEXTOR) and planned (ITER) RMP systems and solve the relativistic, gyro-averaged drift equations for the runaway electrons including radiation losses and collisions.

The results indicate that runaway electrons are rapidly lost from regions where the normalised perturbation amplitude dB/Bi s larger than ~0.1% in a properly chosen perturbation geometry, and this can affect the maximum runaway current. This applies to the region outside the radius corresponding to the normalised flux psi=0.5 in ITER, when the ELM mitigation coils are used at maximum current in their most favourable configuration.

We found that the toroidal distribution of the runaway electron wall loads becomes more localised due to the 3D perturbations. However, the loss patterns are more widespread in the poloidal direction as compared to the unperturbed case. The exact loss pattern depends on the geometric properties of the RMP configuration such as periodicity or helicity. On the other hand, the loss patterns do not depend on the particle energies and starting positions.

The results indicate that the low n mode number perturbations can increase the risk of localised RE loads. Therefore the spatial localisation of the wall loads has to be considered when designing RMP configurations for RE suppression. We suggest an RMP configuration for ITER that balances effective RMP removal of runaway electrons and localised wall loads.

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