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On mechanisms of ELM mitigation by external magnetic field perturbations

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Particle and energy transport in the tokamak edge transport barrier is analyzed in the presence of magnetic field perturbations from external resonant coils. In recent experiments such coils have been verified as an effective tool for mitigation of the edge localized modes of type I. The observed reduction of the density in plasmas of low collisionality is explained by the generation of charged particle flows along perturbed field lines. The increase of the electron and ion temperatures in the barrier is interpreted by the reduction of perpendicular neoclassical transport with decreasing density and kinetic effects in the heat transport along perturbed field lines The found modification of the pressure gradient implies the stabilization of peeling-ballooning-MHD modes responsible for type I ELMs.
It is demonstrated that through non-linear interaction, leading to the generation of side bands which suck energy from the main mode, such perturbations can raise the threshold of MHD instabilities. The synergy of this effect with the influence of external perturbations on the particle and energy transport in the edge transport barrier can be beneficial for the plasma performance. In future experiments on JET and ITER it would lead to a noticeable increase of the pedestal pressure compared to the standard H-mode operation.

Topics:
Transport of energy in stochastic fields
Transport and exhaust of particles
Influence of stochastization on barriers / ELM mitigation