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Controlling runaway vortex via externally injected high-frequency electromagnetic waves ZEHUA GUO, CHRIS MCDEVITT, XIANZHU TANG, Los Alamos National Laboratory — One way of mitigating runaway damage of the plasma-facing components in a tokamak fusion reactor is by limiting the runaway electron energy under a few MeV, while not necessarily reducing the runaway current appreciably. Here we describe a physics mechanism by which such momentum space engineering of the runaway distribution can be facilitated by externally injected high-frequency electromagnetic waves such as the whistler waves. The drastic impact that wave-induced scattering can have on the runaway energy distribution is fundamentally the result of its ability to control the runaway vortex in the momentum space. The runaway vortex, which is a local circulation of runaways in momentum space, is the outcome of the competition between Coulomb collisions, synchrotron radiation damping, and runaway acceleration by parallel electric field. By introducing a wave that resonantly interacts with runaways at a particular range of energy that is mildly relativistic, the enhanced scattering would reshape the vortex by cutting off the part that is highly relativistic. The efficiency of resonant scattering accentuates the requirement that the wave amplitude can be small so the power requirement from external wave injection is practical for the mitigation scheme.

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