Alpha and Runaway-electron transport in SPARC due to field perturbations

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Numerical simulations of alpha orbits in the SPARC tokamak have been performed by the ASCOT and SPIRAL codes to determine alpha transport and loss by static perturbations of the magnetic field (error field correction coils) and by time-dependent perturbations (Alfven eigenmodes). The radial eigenmode structure of the Alfven instability was computed by the Nova-K code with its amplitude left as a free parameter. Most of the simulations terminate the orbit simulations at the last closed flux surface, which is ideal for studying internal redistribution of the alphas by the perturbed magnetic field. But because a concentrated loss of even a small fraction of the alphas could result in damage to plasma-facing components (PFCs), some simulations follow the orbits to CAD models of the PFC surface, whose shape has recently been finalized. The resulting pattern of surface heating is input to the HEAT code along with other heating terms to compute the PFC temperature response. Results for the SPARC ‘primary reference discharge’ (12.2 T, 8.7 MA, Pfusion ~ 100 MW) and other scenarios will be presented. Simulations of runaway electron transport during disruptions will also be presented, with and without the field perturbation generated by the Runaway Electron mitigation coils.

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