**SECOND DRAFT:**

Fusion alpha particles in SPARC are redistributed radially due to toroidal Alfven eigenmode (TAEs) even if they are not lost. Alpha particles are necessary to heat the plasma core and maintain the fusion reaction. TAEs can remove the alpha particles from the core before they transfer their energy to the thermal plasma. A standard SPARC equilibrium of 12.2T and 8.7MA was used in the full orbit following SPIRAL code. The alpha particle birth profile was generated using TRANSP in predative mode and the TAE radial structure was calculated from NOVA with a user supplied amplitude. The alpha particles were followed to slow-down time without and with TAEs. Alpha particle redistributions were observed and compared to calculations done in the ASCOT code, as well as the local energy deposited by particles.

**INITIAL DRAFT:**

The ASCOT and SPIRAL codes complete numerical simulations of alpha orbits. Several simulations were run in SPIRAL with static (error field correction coils) and time dependent (Alfven eigenmodes) perturbations of the magnetic field in the SPARC tokamak to evaluate alpha transport. The radial eigenmode structure of the Alfven instability was computed by the Nova-K code with its amplitude left as a free parameter. This instability was remodeled in SPIRAL. The effect of the launch point major radius location of each individual particle on the resonant energy was studied. The ASCOT and SPIRAL codes were also evaluated by comparing the results of fusion birth simulations with identical marker particle positions to benchmark speed as well as accuracy. Alpha transport to plasma facing components as a result of error correction coils and Alfven eigenmodes in SPARC was evaluated.

**STEVE’S ABSTRACT:**

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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