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Neoclassical Radial Electric Field and Transport with Finite Orbits[1] W.X. WANG, University of California, Irvine, F.L. HINTON, S.K. WONG, General Atomics — A low noise δf simulation is applied to study the self-consistent electric field and its effect on neoclassical transport. A considerable self-collision driven ion flux is found in the region within the inner half radius, resulting in the broken ambipolarity. Enforcing the ambipolarity condition requires the development of a radial electric field. Small orbit width analysis finds that the time scale for the development of the neoclassical electric field is $\tau_{\rm ii}(L/\rho_{\rm i\theta})^2$. In improved confinement modes where the average ion orbit width ($\rho_{\rm i\theta}$) is comparable to the plasma gradient length (L), this could be as fast as an ion collision time. By following the electric field dynamics, an equilibrium state with vanishing ion flux is established and the self-consistent steady-state electric field is obtained. Because of the finite orbit effect, the electric field is non-locally dependent on density and temperature profiles. With the electric field, ion energy flux near magnetic axis is largely reduced due to vanishing ion flux. Ion heat flux seems to be less affected. The comparison to the neoclassical theory will be presented and the difference between present results and previous work will be discussed.

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