Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Changes to neoclassical flow and bootstrap current due to a steep density gradient[1] MATT LANDREMAN, DARIN ERNST, MIT PSFC — In a tokamak pedestal, radial scale lengths can become comparable to the ion orbit width, invalidating conventional neoclassical calculations of flow and current. Here, we generalize neoclassical calculations to allow radial density and electron temperature scale lengths as small as the ion orbit width [1], considering a relatively weak ion temperature gradient so the distribution remains nearly Maxwellian. In this ordering, non-local effects alter the magnitude and poloidal variation of the flow and current. The approach is implemented in a new global δf continuum code using the full linearized Fokker-Planck collision operator. Arbitrary collisionality and aspect ratio are allowed as long as the poloidal magnetic field is small compared to the total magnetic field. Strong radial electric fields, sufficient to electrostatically confine the ions, are also included. In contrast to conventional neoclassical theory, we find analytically and numerically that a steep density gradient causes the parallel and poloidal flow coefficients to differ from each other, acquire poloidal variation, and possibly change sign.

[1] Landreman and Ernst, arXiv:1207.1795v1.

[1]Supported by the Fusion Energy Postdoctoral Research Program administered by the Oak Ridge Institute for Science and Education.

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Date submitted: 10 Jul 2012 Electronic form version 1.4