Application of GTC-Neo for NSTX Cases

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NSTX Results/Theory Review

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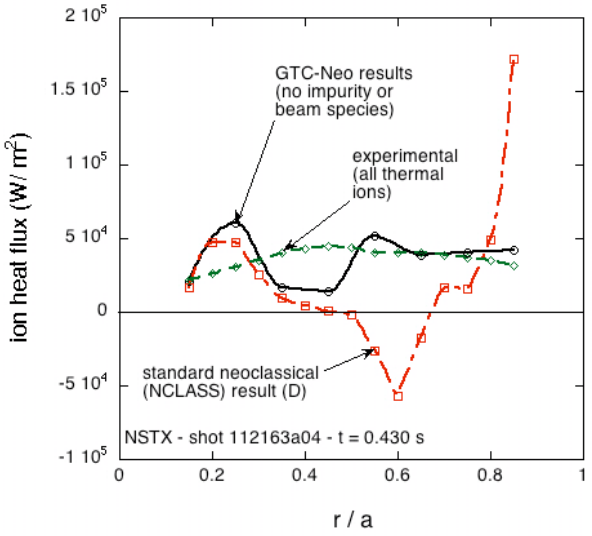
Introduction

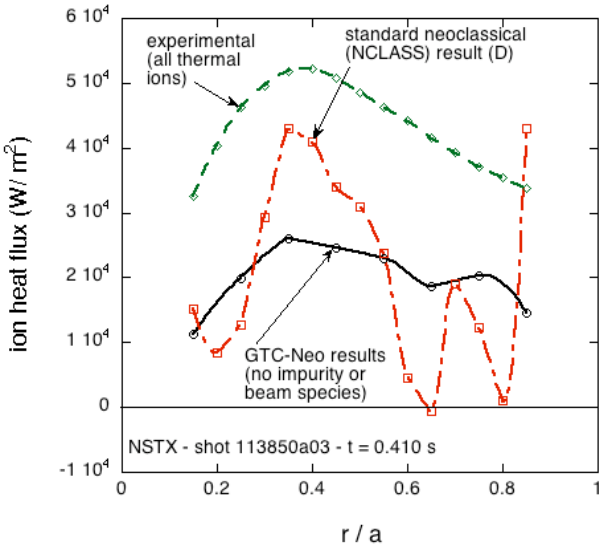
- GTC-Neo: Neoclassical δf particle-in-cell simulation code
- Refs.: W.X. Wang, *et al.,* Comp. Phys. Commun. **164**, 178 (2004); W.X. Wang, *et al.,* PPPL-4156, Phys. Plasmas, to be published (2006)
- Calculates radial fluxes of particles, momentum, & energy (heat), radial electric field, poloidal velocity, bootstrap current, etc., for numerically-calculated, non-circular MHD equilibrium
- Currently single (hydrogenic) ion species; impurity species to be added in future ; input is $n_e(r)$, $T_i(r)$, & $\Omega_{MWA}(r)$
- Generalization over standard neoclassical theory: finite orbit width, nonstandard orbits, self-consistent determination of E_r - gives nonlocal transport, extra smoothing

NSTX Application - q_i

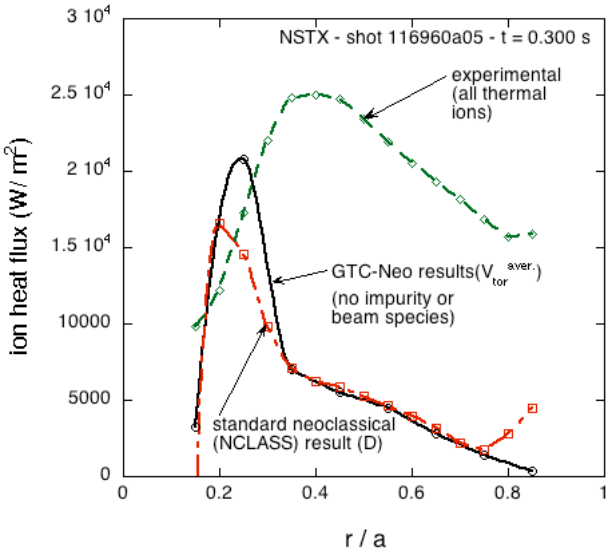
- Have now done 19 NSTX cases (shots & times)
- Normally calculate ion heat flux (q_i), radial electric field, & ion poloidal velocity; compare to NCLASS, &, for q_i, to experiment (TRANSP)
- q_i usually comparable to NCLASS results (but smoother), & sometimes closer to experiment
- Results suggest nonlocal features for ion heat flux near magnetic axis, breaking local, linear gradient-flux relation



Higher-B_T comparison shot (B_0=0.45 T)



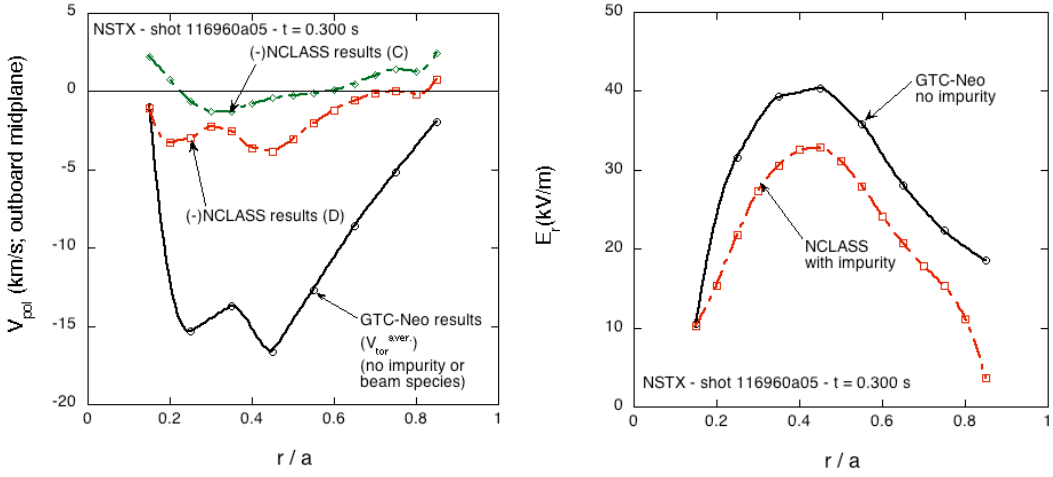
H-phase without ion ITB



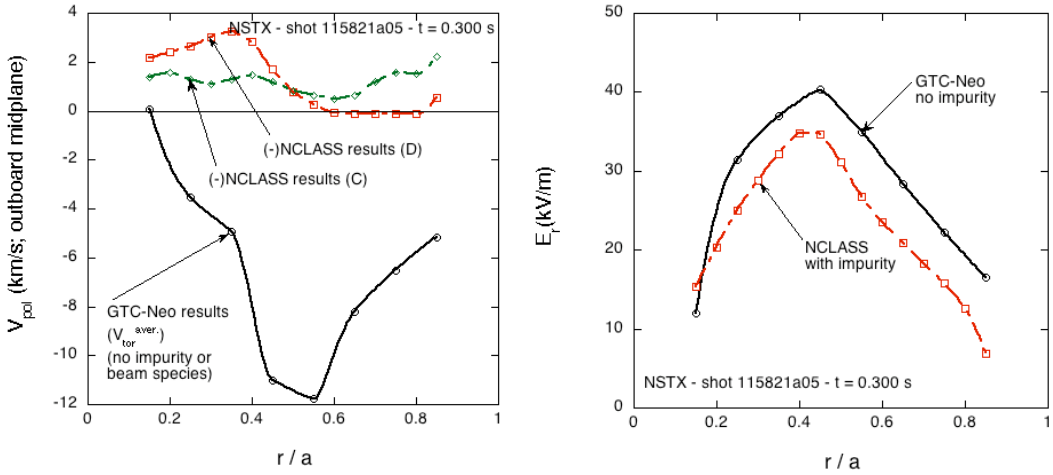
Reversed shear

NSTX Application - V_{pol} & E_r

- V_{pol} from GTC-Neo usually larger than that from radial force balance (NCLASS)
- However, E_r from GTC-Neo not so different from that from radial-force-balance result, since ∇p and V_{tor} contributions larger than V_{pol} contribution



reversed shear



monotonic q

Conclusions

- GTC-Neo now calculates neoclassical quantities, including finite-orbit-width effects and self-consistent E_r, routinely for NSTX experimental cases - wide variety of results. Will explore more cases & compare to NCLASS & experiment
- Also will be applying shaped-GTC code and GEM code for NSTX turbulence calculations, with realistic geometry, in future