Rotation-induced electrostatic-potentials and density asymmetries in NSTX

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The computation of rotation-induced electrostatic potentials is currently being used to study the associated two-dimensional distribution of impurity density asymmetries in NSTX and NSTX-U plasmas. This calculation relies on flux-surface quantities like electron and ion temperature ($T_{e,i}$) and rotation frequency (ω_ϕ) and finds the 2D electron, deuterium and carbon density profiles self-consistently assuming the presence of a poloidal variation due to centrifugal forces. The iterative solution [1] for the electrostatic potential difference [$\Delta\varphi = \varphi(\theta) - \varphi(\theta=0)$] are routinely obtained and compared with the values derived from the ideal solution to quasi-neutrality, which assumes that the main low-Z intrinsic impurity (e.g. carbon) is in the trace limit. An *ad-hoc* solution, which attempts to extend the ideal approximation beyond the trace limit [2], does not adequately captures the physics of finite mass and Z_{eff}. Nevertheless, the net-change of the plasma potential profile due to the presence of the rotation-induced electrostatic well is smaller than 6%. This calculation also finds 2D asymmetries for medium- to high-Z impurity density profiles that are at the trace limit with very small changes to quasi-neutrality and Z_{eff}. While the asymmetry in the core radiated power density from low-Z ions (e.g. D, C, O, Ne) is relatively small, the core density and radiation from medium- to high-Z's (e.g. Ar, Fe, Mo, W) will be strongly affected by centrifugal forces. This work is supported by the U.S. Department of Energy, Office of Fusion Energy Sciences under contract number DE-AC02-09CH11466.

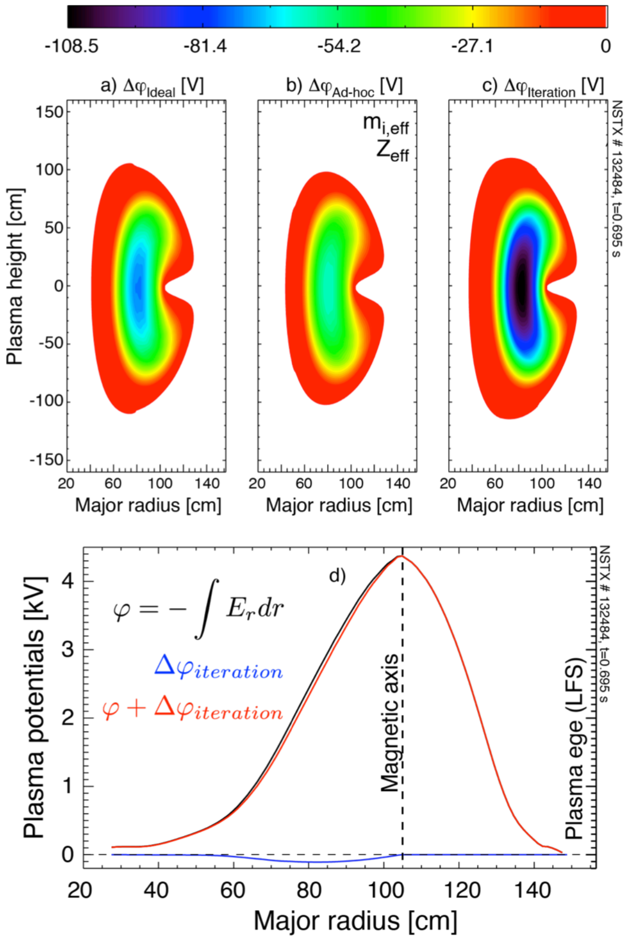

Fig. 1. Rotation-induced potential and overall effect in NSTX

[1] E. Belli and J. Candy, PPCF, **51**, 075018, (2009).
[2] T. Odstrcil, at al., PPCF, **60**, 014003, (2018).