

# Limitations of Bootstrap Current Models

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**Abstract.** We assess the accuracy and limitations of two analytic models of the tokamak bootstrap current: (1) the well-known Sauter model and (2) a recent modification of the Sauter model by Koh *et al.* For this study, we use simulations from the first-principles kinetic code NEO as the baseline to which the models are compared. Tests are performed using both theoretical parameter scans as well as core-to-edge scans of real DIII-D and NSTX plasma profiles. The effects of extreme aspect ratio, large impurity fraction, energetic particles, and high collisionality are studied. In particular, the error in neglecting cross-species collisional coupling – an approximation inherent to both analytic models – is quantified. Furthermore, the implications of the corrections from kinetic NEO simulations on MHD equilibrium reconstructions is studied via integrated modeling with kinetic EFIT.

PACS numbers: 52.25.Dg, 52.25.Fi, 52.65.-y

Submitted to: *Plasma Phys. Control. Fusion*