

Abstract Submitted
for the DPP10 Meeting of
The American Physical Society

Grad-Shafranov-like equation for stellarators with a non-planar magnetic axis ANTOINE J. CERFON, MIT Plasma Science and Fusion Center, FELIX I. PARRA, Christ Church College, University of Oxford, JEFFREY P. FREIDBERG, MIT Plasma Science and Fusion Center, HAROLD WEITZNER, Courant Institute for Mathematical Sciences, NYU — We derive an equation for the poloidal flux function in a large aspect ratio stellarator, similar to the Grad-Shafranov equation for toroidally axisymmetric plasma configurations. There are three key elements in our new formulation. (1) We choose an ordering in helical field amplitude and inverse aspect ratio that generalizes the original work of Greene and Johnson [1] to allow for a non-planar magnetic axis. Toroidal effects thus enter the analysis in the same order as helical effects, and more complex 3-D geometries can be treated than in [1]. (2) We use an asymptotic expansion in the small parameter $\delta \equiv |\mathbf{B}_p|/|\mathbf{B}_\phi|$, the ratio of the poloidal field to the toroidal field. (3) By exploiting the smallness of δ , we define a new set of poloidal coordinates which can be constructed order by order, effectively transforming the problem into a 2-D Grad-Shafranov-like equation containing coefficients averaged over toroidal angle.

[1] J.M. Greene and J.L. Johnson, Phys. Fluids **4**, 875 (1961)

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Date submitted: 26 Jul 2010

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