Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Asymptotic expansion for stellarator equilibria with a non-planar magnetic axis: Numerical results JEFFREY FREIDBERG, MIT PSFC, ANTOINE CERFON, NYU CIMS, FELIX PARRA, MIT PSFC — We have recently presented a new asymptotic expansion for stellarator equilibria that generalizes the classic Greene-Johnson expansion [1] to allow for 3D equilibria with a non-planar magnetic axis [2]. Our expansion achieves the two goals of reducing the complexity of the three-dimensional MHD equilibrium equations and of describing equilibria in modern stellarator experiments. The end result of our analysis is a set of two coupled partial differential equations for the plasma pressure and the toroidal vector potential which fully determine the stellarator equilibrium. Both equations are advection equations in which the toroidal angle plays the role of time. We show that the method of characteristics, following magnetic field lines, is a convenient way of solving these equations, avoiding the difficulties associated with the periodicity of the solution in the toroidal angle. By combining the method of characteristics with Green's function integrals for the evaluation of the magnetic field due to the plasma current, we obtain an efficient numerical solver for our expansion. Numerical equilibria thus calculated will be given.

[1] J.M. Greene and J.L. Johnson, Phys. Fluids 4, 875 (1961)
[2] A.J. Cerfon, J.P. Freidberg, and F.I. Parra, Bull. Am. Phys. Soc. 56, 16 GP9.00081 (2011)

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Date submitted: 18 Jul 2012 Electronic form version 1.4