Asymptotic expansion for stellarator equilibria with a non-planar magnetic axis: Numerical progress ANTOINE CERFON, JEFFREY FREIDBERG, FELIX PARRA, MIT Plasma Science and Fusion Center — We have recently presented a new asymptotic analysis [1], which reduces the complexity of the MHD equilibrium equations in stellarators and generalizes the asymptotic approach followed by Greene and Johnson in their classic paper [2]. As in [2], our expansion relies on the small ratio of the helical magnetic field to the vacuum toroidal field. However, our ordering relaxes the Greene and Johnson constraint which assumes a strong separation in length scales between the helical period and the major radius. In our expansion these two length scales are of comparable order, which provides a better match with modern stellarator experiments. Toroidal effects enter the analysis in the same order as helical effects, allowing the calculations of equilibria with multiple helicities and a non-planar magnetic axis. The end result of our analysis is a set of two coupled PDEs for the plasma pressure and the magnetic vector potential, which fully determine the stellarator equilibrium. We present simple analytic solutions to these equations, and discuss the numerical methods we are developing to calculate more general stellarator equilibria.

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

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