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Near-Axis framework for stellarator equilibrium: elimination of magnetic resonances to all orders[1] WRICK SENGUPTA, Courant Institute of Mathematical Sciences, HAROLD WEITZNER, Courant Institute of Mathematical Sciences, NYU — We systematize the near-axis expansion formalism developed by Mercier, Solovev-Shafranov through an extension of the framework developed by Weitzner. We use Merciers orthogonal coordinates and the Frenet-Serret framing of the magnetic axis that allows arbitrary curvature and torsion. Our formalism enables us to carry out the axis expansion systematically to all orders for vacuum, force-free as well as MHD equilibrium magnetic fields. We present a closed-form expression for the on-axis magnetic shear and point out the geometrical and physical interpretations of the various terms. Mercier and Solovev-Shafranov showed that in general, there are singularities near rational surfaces where the rotation transform is rational. Assumption of a highly irrational rotation transform still leads to small-divisors in higher orders of the expansion. Fortunately, the magnetic axis being a closed spatial curve allows us to exploit powerful analytical tools such as Floquet theory and Calugareanu-White-Fuller theorem. With the help of these, we show that it is possible to eliminate the magnetic resonances systematically order by order through the inclusion of resonant fields, provided the on-axis rotation transform is close to a rational number, and magnetic shear is weak.

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