An analytic functional form for characterization and generation of axisymmetric plasma boundaries

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Abstract. An analytic form to describe the boundary of an axisymmetric plasma is proposed. This new form uses a generalization of the family of superellipses. The plasma boundaries of existing tokamaks are well described using the compact notation. The form employs eleven parameters of which five are standard, two are generalizations of a standard parameter and four are introduced here. With these same parameters, a closed-form analytic solution can be used to generate new boundaries without x-points. If the desired boundary has x-points, the analytic form can be extended in a manner for which a closed-form solution has not been found, but does have an exact solution that can be found numerically. This new form should be useful for variety of physics studies that use MHD equilibria, such as the dependence of plasma stability on shape and design of poloidal field coil sets that can support a defined range of shapes.