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Simple, General, Realistic, Analytic, Tokamak Equilibria JEFFREY FREIDBERG, Massachusetts Institute of Technology - PSFC, LUCA GUAZZOTTO, Auburn University - Physics Department — The title of the abstract tells it all. We have extended the work of early authors to derive simple, general, realistic, analytic, solutions for tokamak equilibria as described by the Grad-Shafranov equation. What do we mean by all of these adjectives? "Simple" refers to the fact that our equilibria contain only a few, intuitively simple terms. Specifically, 7 terms for up-down symmetric systems and 12 terms for up-down asymmetric systems. These values are not empirical but based on solid mathematical reasoning. "General" indicates that our equilibria are valid for a wide range of configurations, including smooth surfaces, double null surfaces, single null surfaces, finite aspect ratio including spherical tokamaks, finite elongation, finite triangularity, and finite beta. "Realistic" implies that our profiles are continuous and monotonic with the pressure, pressure gradient, and toroidal current density smoothly vanishing at the plasma edge. Finite edge pedestals in pressure and toroidal current density are also allowed. This is a quantum improvement over the Solovev profiles which always have finite pressure gradient and current density at the edge. Lastly, "analytic" indicates that our solutions are exact solutions to the Grad-Shafranov equation, expressed in terms of known functions. Simple analytic expressions for the flux function and importantly its first and second derivatives have been derived. Examples for smooth, double null, and single null configurations will be presented.

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