Abstract Submitted
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Existence of Magnetic Surfaces in 3-D Configurations[1] A.D. TURNBULL, General Atomics — A general expression is derived for the existence of magnetic surfaces in 3-D. The expression is valid in an arbitrary coordinate system, which is important when axisymmetry is violated. In the general case, surfaces exist if and only if a simple 1-D equation, equivalent to $\mathbf{B}\bullet\nabla$F, has solutions F with certain desired conditions imposed. For example, F must be periodic in angle-like coordinates and monotonic in radial-like variable, s. Applied to a torus, the fact that surfaces are guaranteed to exist with any special symmetry, drops out trivially from this formulation. One can also use alternative representations for **B**, such as the Clebsch form, to obtain further insight into the conditions where solutions exist. Analogous expressions are also obtained for the existence of current surfaces. Conditions can then be obtained for the existence of both current and magnetic surfaces, yielding criteria for proper nested flux surfaces. Force balance then imposes additional conditions; for ideal MHD, the key condition is the obvious one that $\mathbf{B}$x(∇x$\mathbf{B}$) can be written as the gradient of a potential, which can then be equated to the pressure.

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