TOROIDAL LOW β EQUILIBRIUM AND MAGNETIC MAPPING

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Abstract

A magnetic field with non-closing lines of force yields a so-called magnetic mapping of a meridional plane to itself. The closed invariant curves of a magnetic mapping, if they exist, can be considered as the meridional cuts of so-called magnetic surfaces. These surfaces were computed asymptotically for the limit of small rotational transform. If the fundamental field is the toroidal vacuum field and the magnetic surfaces are nested toroids then the quantity $d^2V/d\phi^2$ is usually negative, where V is the interior volume of the toroid and ϕ the azimuthal magnetic flux. Extensive numerical calculations were made for larger rotational transform, yielding many configurations with negative V''. However, field line integrations of analytical magnetic vacuum fields show that magnetic surfaces do not exist in general. The linearization in the neighbourhood of a closed field line yields a necessary condition for the field line to belong to a magnetic surface. It was possible to satisfy this condition numerically with a high degree of accuracy by a certain field combination. It turned out that the so-called q -condition, necessary for a low β equilibrium to exist, was then also satisfied with the same accuracy.