Abstract Submitted
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Effects of nonlinear viscosity on plasma flow induced island healing in stellarators[1] C.C. HEGNA, University of Wisconsin — The theory of island healing by plasma flows in stellarators [1] is extended to include the effects of nonlinear neoclassical viscosity. The theory was developed in an effort to explain observations from LHD that showed spontaneous healing of vacuum islands when a critical β is exceeded. The theory uses torque balance and island evolution equations to describe transitions between states with large non-rotating islands to states where rotation shielding suppresses island formation. The balance of neoclassical damping and cross-field viscosity produces a radial boundary layer for the plasma rotation profile outside the separatrix of a locked magnetic island. The boundary layer width is related to the strength of the healing viscous torque. This work is extended by accounting for the nonlinear dependence of the neoclassical flow damping coefficients on the plasma flow. In the small flow limit, the resulting viscous torque is linear with the plasma flow. However, in sufficiently collisionless plasmas, nonlinear viscosity effects are important and the resultant viscous torque is proportional to the square-root of the plasma flow velocity. Implications for magnetic island/transport barrier interactions will be discussed.

[1] C. C. Hegna, Nucl. Fusion 51, 113017 (2011)

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