Abstract Submitted
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Nonlinear g Mode Theory in Extended MHD[1] P. ZHU, C.C. HEGNA, University of Wisconsin-Madison — Two-fluid (2F) and finite Larmor radius (FLR) effects can modify instability growth rates and relaxation physics of many macroscopic processes in high temperature plasmas. The dominant order of these effects can be captured by extended MHD models that include generalized Ohm's law and a gyroviscous stress tensor. Whereas these nonideal effects tend to stabilize linear growth of g modes with large perpendicular wavenumber, their influence on nonlinear g mode physics is not well understood. Previously, an analytic solution was found describing the intermediate nonlinear phase of the interchange-like modes in an ideal MHD model. In the present work, we address the question how the ideal intermediate nonlinear phase would be altered by the 2F and FLR effects. We develop an analytic theory for intermediate nonlinear g mode growth in an extended MHD model. The non-dissipative nature of 2F and FLR effects allows the construction of a theory that is based on conservation constraints using a Lagrangian framework. In particular, an electron fluid displacement $\boldsymbol{\xi}_e$ is introduced in addition to the ion fluid displacement $\boldsymbol{\xi}$. The displacements of the two fluids are related through the plasma current. The magnetic flux is conserved following the electron fluid motion $\boldsymbol{\xi}_e$. The Lagrangian theory has recovered the 2F and FLR effects on linear g modes previously obtained from Eulerian theory. Progress on the nonlinear analytic results will also be presented and discussed.

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Ping Zhu
University of Wisconsin-Madison

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