Isolating Magnetorotational Instability (MRI) Using Eigenmode Analysis in the Numerical Simulation of Princeton MRI Experiment

HI-MAWAN WINARTO, Princeton University, FATIMA EBRAHIMI, ERIK GILSON, Princeton Plasma Physics Laboratory, JEREMY GOODMAN, HANTAO JI, Princeton University, YIN WANG, Princeton Plasma Physics Laboratory — The behavior of Magnetorotational Instability (MRI) in the Princeton MRI experiment can be further isolated from background effects through global eigenmodes analysis. The analysis is done by artificially changing of the vertical magnetic field $B_z$ from the nonlinear MHD simulated flow profiles. Along the low $B_z$ boundary of the MRI unstable region of $(\Omega_1, B_z)$ parameter space (where $\Omega_1$ is the rotational speed of the inner cylinder), the calculated growth rate will exhibit double peaks which correspond to two competing effects: Rayleigh instability and MRI, which are comparable in strength. This eigenmode analysis will enable us to sensitively map the boundary of the MRI unstable regime. This new method can be used to optimize other experimental parameters, such as end caps inner ring speed ($\Omega_3$), to further isolate the effect of MRI in the system.

1This research was supported by NSF (Grant No. AST1312463), NASA (Grant No. NNH15AB25I), and DoE (Grant No. DE-AC0209CH11466).