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Identification of a novel non-axisymmetric mode in the Princeton Magnetorotational Instability Experiment[1] YIN WANG, KYLE CASPARY, FATIMA EBRAHIMI, ERIK GILSON, HANTAO JI, Princeton Plasma Physics Laboratory, JEREMY GOODMAN, HIMAWAN WINARTO, Princeton University — We report a new kind of magneto-hydrodynamic (MHD) instability in a modified Taylor-Couette experiment using Galinstan as the working fluid. In the experiment, the inner cylinder, outer cylinder and upper (lower) endcaps corotate independently at an angular speed of W_1, W_2 and W_3. A uniform magnetic field B_z is applied along the central axis. By using high-precision Hall probes installed at the inner cylinder surface, we obtained the radial magnetic Br at various azimuths. The new MHD instability is identified from the measured time sequence of B_r, which is non-axisymmetric with an azimuthal mode number m =1 and has a moderate frequency between W_1-W_3 and W_1-W_2. The new-found instability only exists at sufficiently large W_1 and moderate B_z, consistent with typical requirements for the magnetorotational instability (MRI), and detailed quantitative comparisons are underway with theoretical analysis and numerical simulations. Further analysis shows it is not the Rayleigh instability or the Shercliff layer instability. Our results therefore shed light on the direction for finding a non-axisymmetric MRI.

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