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Observation of a spiral instability in the Princeton MRI Experiment A.H. ROACH, E.J. SPENCE, C. GISSINGER, E.M. EDLUND, P. SLOBODA, H. JI, PPPL, Princeton University — The Princeton MRI Experiment is a modified Taylor-Couette device with a GaInSn working fluid used for the study of rotating MHD flows. An Ultrasound Doppler Velocimetry (UDV) system is used to measure the velocity field. It has revealed an instability causing large-amplitude velocity fluctuations when an axial magnetic field is applied to both hydrodynamically stable and hydrodynamically unstable background flow states with the split axial endcaps rotating differentially. The azimuthal velocity has a characteristic spiral mode structure at saturation, with an azimuthal mode number m=1. This instability appears in a region of parameter space distinct from that where the magnetorotational instability is expected to be present. Nonlinear 3D simulations have shown an instability of the Shercliff layer that forms at the split endcaps when a magnetic field is applied, and the resultant azimuthal flow patterns are largely consistent with experimental observations. Work is ongoing to measure the Shercliff layer in the experiment, and to clarify in simulations whether the shear of the azimuthal velocity in the Shercliff layer or the associated poloidal recirculation is the principle free energy source for the instability. Experimental measurements and possible mechanisms for the instability will be presented. This work was supported by DOE contract DE-AC02-09CH11466.

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