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Study of Magnetorotational Instability and Hydrodynamic Stability at Large Reynolds Numbers in a Short Couette Flow[1] HANTAO JI, Princeton University, MICHAEL BURIN, ETHAN SCHARTMAN, JEREMY GOODMAN, WEI LIU — Rapid angular momentum transport in accretion disks has been a longstanding astrophysical puzzle. Molecular viscosity is inadequate to explain observationally inferred accretion rates. Since Keplerian flow profiles are linearly stable in hydrodynamics, there exist only two viable mechanisms for the required turbulence: nonlinear hydrodynamic instability or magnetorotational instability (MRI). The latter is regarded as a dominant mechanism for rapid angular momentum transport in hot accretion disks ranging from quasars and X-ray binaries to cataclysmic variables. The former has been proposed mainly for colder protoplanetary disks, whose Reynolds numbers are typically large. Despite their popularity, however, both candidate mechanisms have been rarely demonstrated and studied in the laboratory. In this paper, I will describe a laboratory experiment in a short Taylor-Couette flow geometry intended for such purposes. Based on the results from prototype experiments and simulations, the apparatus containing novel features for better controls of the boundary-driven secondary flows has been constructed. Initial results on hydrodynamic stability have shown, somewhat surprisingly, robust quiescence of the Keplerian-like flows with million Reynolds numbers, casting questions on viability of the nonlinear hydrodynamic instability.

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