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Geophysical Turbulence Program Seminar

National Center for Atmospheric Research

Initial Results from Princeton Magnetorotational Instability Experiment: Hydrodynamic Stability of Quasi-Keplerian Flows at Large Reynolds Numbers

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Abstract:

Rapid angular momentum transport in accretion disks has been a longstanding astrophysical puzzle. Hot disks of sufficiently ionized and thus electrically conducting plasma can become turbulent via the linear magnetorotational instability (MRI). Cool disks, such as the planet-forming disks of protostars, may be too poorly ionized for MRI, hence essentially unmagnetized and linearly stable. But nonlinear hydrodynamic instability often occurs in linearly stable flows (e.g. pipe flows) at sufficiently large Reynolds numbers. Disks have extreme Reynolds numbers, but Keplerian rotation enhances linear stability. Whether nonmagnetic disks can be turbulent and transport angular momentum effectively is therefore headedly debated. In this talk, I will describe initial results from the well-controlled and diagnosed Princeton MRI experiment, showing that nonmagnetic quasi-Keplerian flows at Reynolds numbers as large as one million are essentially laminar. Scaled to accretion disks, rates of angular momentum transport lie far below astrophysical requirements. By ruling out hydrodynamic turbulence, our results indirectly support MRI as the likely cause of turbulence even in cool disks. This project is supported by U.S. DoE, NASA, and NSF

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Thursday, 2:00 pm (Refreshments at 1:45pm)

Where:
Center Green 1
Room 3131

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