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Hydrodynamic turbulence in quasi-Keplerian rotating flows?[1]

LIANG SHI, Max Planck Institute for Dynamics and Self-Organization, MARC AVILA, Friedrich-Alexander-Universität ErlangenNrnberg, BJOERN HOF, The Institute of Science and Technology Austria, LIANG SHI TEAM, MARC AVILA TEAM, BJOERN HOF TEAM — The origin of turbulence in astrophysical accretion discs has been under scrutiny for decades and remains still unclear. The velocity profiles of discs (Keplerien profiles) are centrifugally stable and therefore a different instability mechanism is required for turbulence to arise. While in hot discs turbulence can be triggered through magnetorotational instability, cooler discs lack sufficient ionization and it is unclear how turbulence sets in. In analogy to other linearly stable flows like pipe and Couette flow, subcritical transition to turbulence may be the mechanism. Recently, experimental studies of Taylor-Couette flow in quasi-Keplerian regime have given conflicting results and numerical simulations of above experimental flows showed that the top and bottom end-wall leads to strong deviations from the Keplerian velocity profile and drives turbulence. In order to clarify this, we perform direct numerical simulations of incompressible Taylor-Couette flow without end walls in the quasi Keplerian regime for Re up to 200000. Strong transient growth is observed and gives rise to strongly disorted motion, suggesting that for large enough Re this mechanism may lead to turbulence even for Keplerian flows.

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