

SIMULATIONS OF INSTABILITIES IN ACCRETION DISK TORUS



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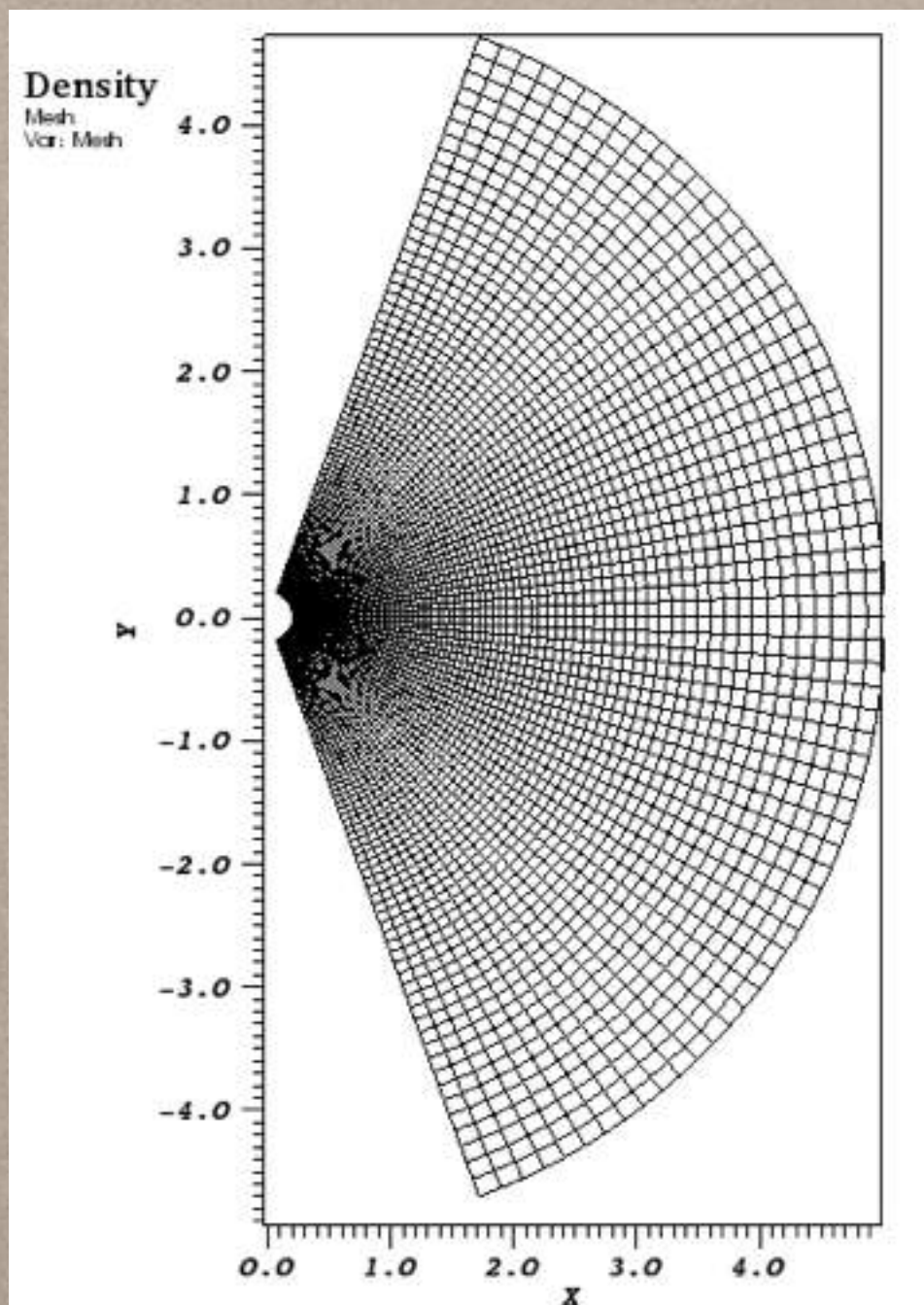
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ACCRETION DISKS IN ASTROPHYSICS

How does angular momentum get transported outward in an accretion disk?

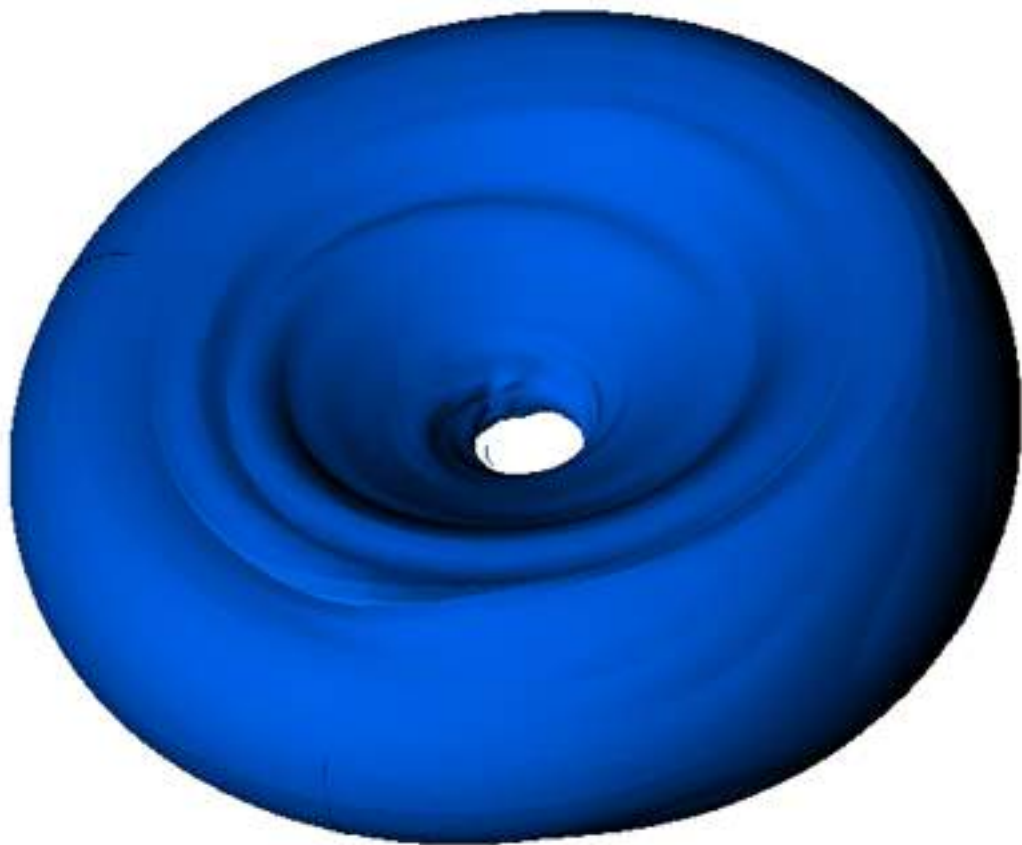
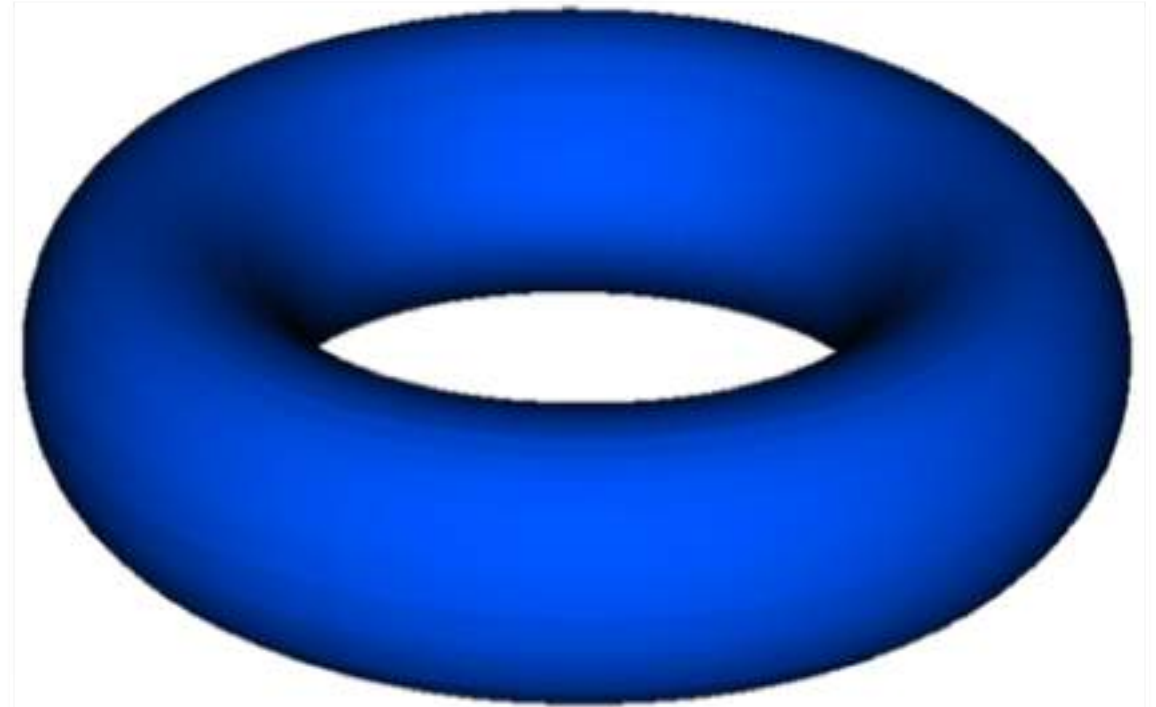
- Example:
 - Protostellar discs
 - Supermassive Black Holes in AGNs
 - Mergers of neutron star binaries

TOOLS FOR SIMULATING ACCRETION DISK PHYSICS



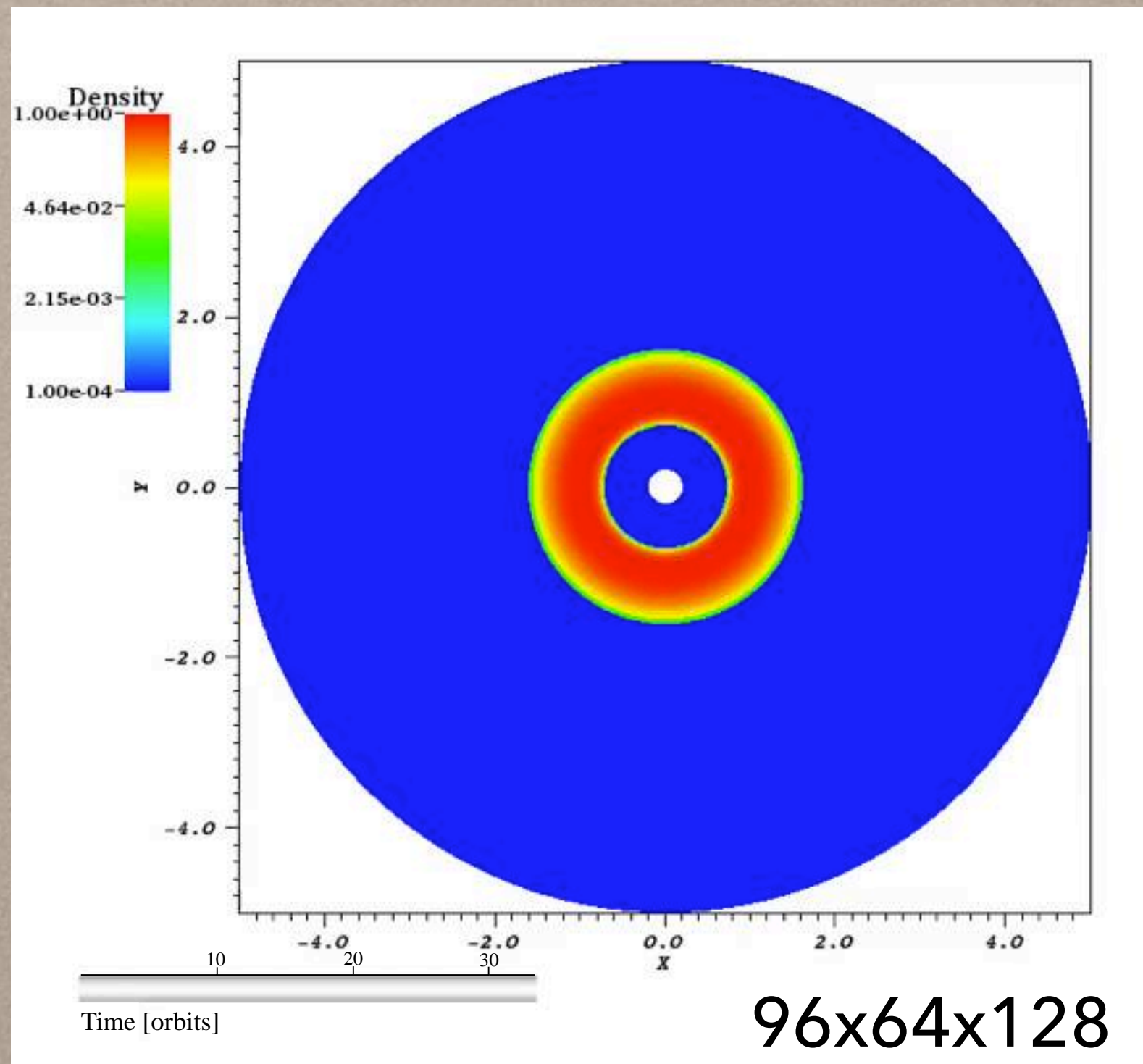
- Athena ++, HLLC Solver
- Radial Log-gridding
- Static Mesh Refinement
- Spherical polar coordinates
- 24~768 cores, MPI, NERSC

PAPALOIZOU- PRINGLE INSTABILITY

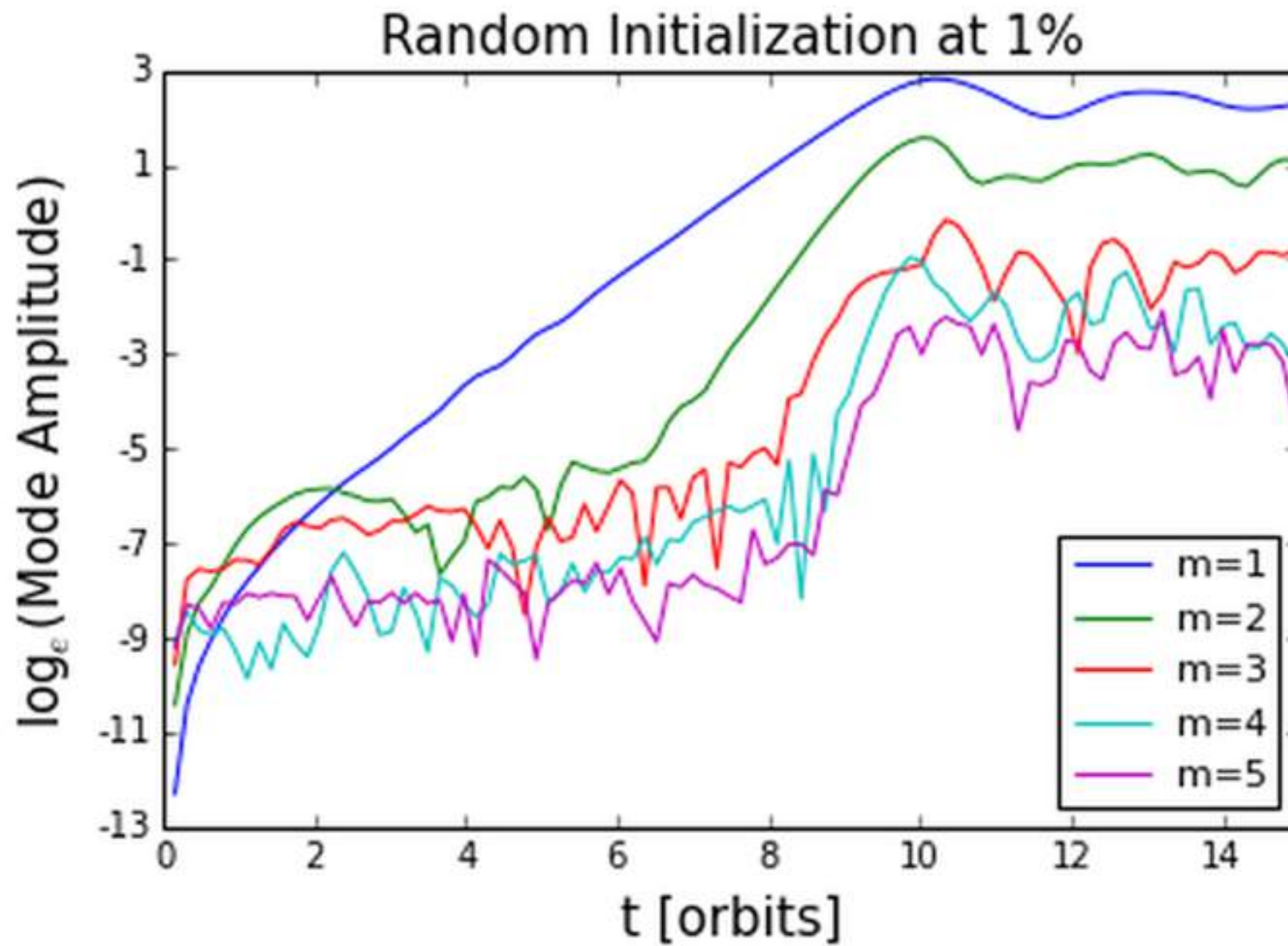


- hydrodynamic, global instability
- constant angular momentum
- Corotation amplification mechanism

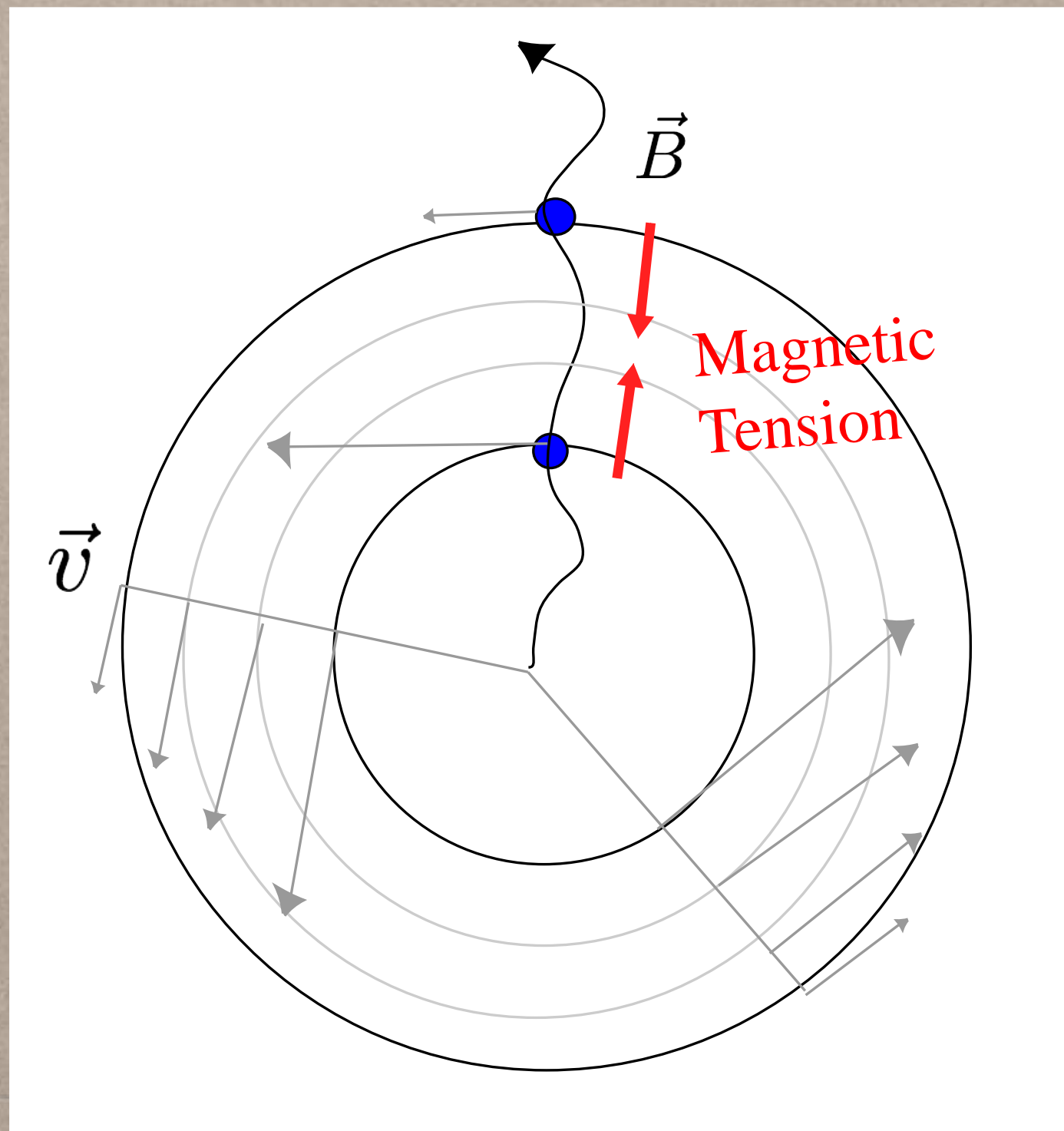
SIMULATION RESULTS



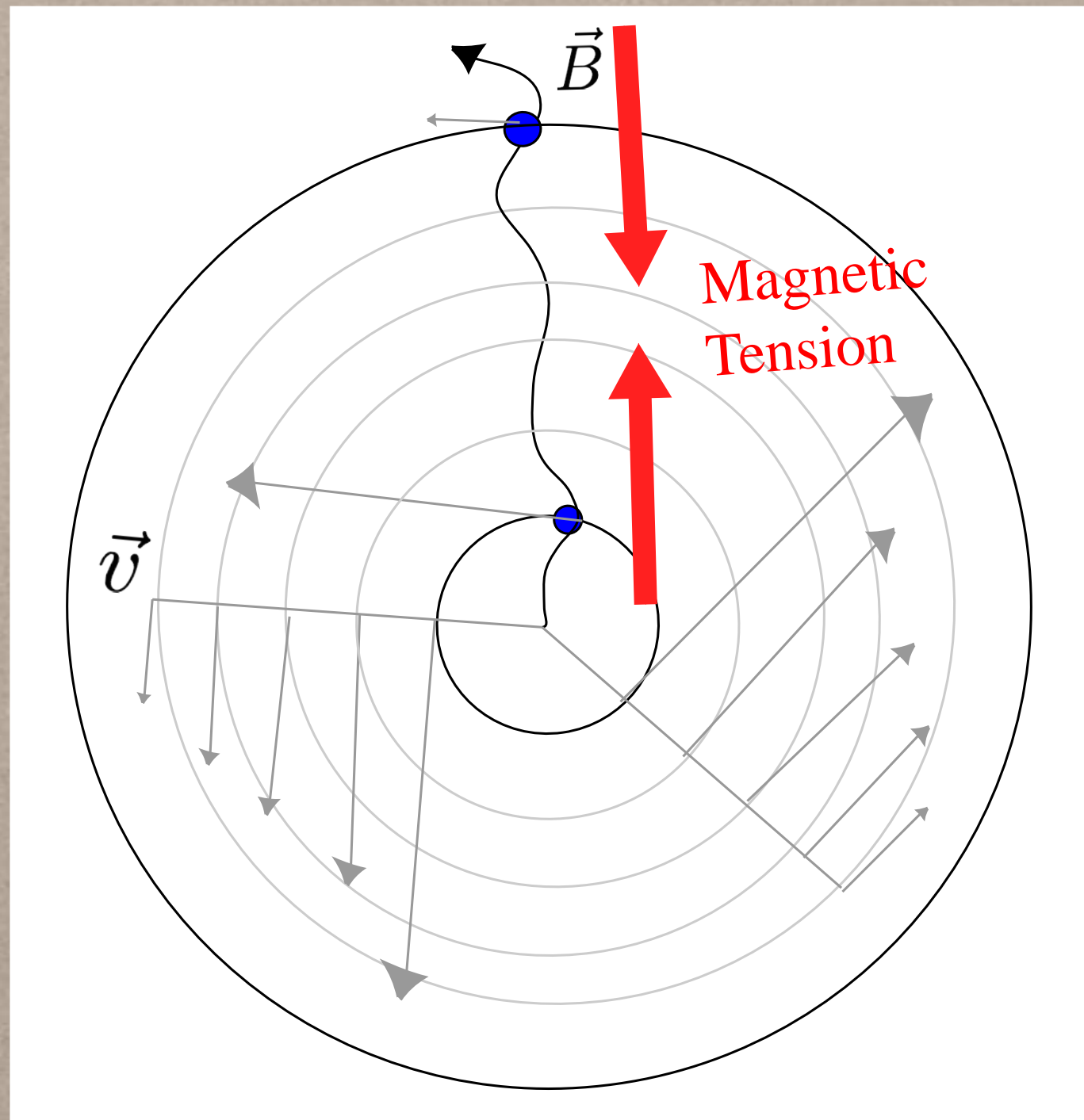
MODE GROWTH ANALYSIS



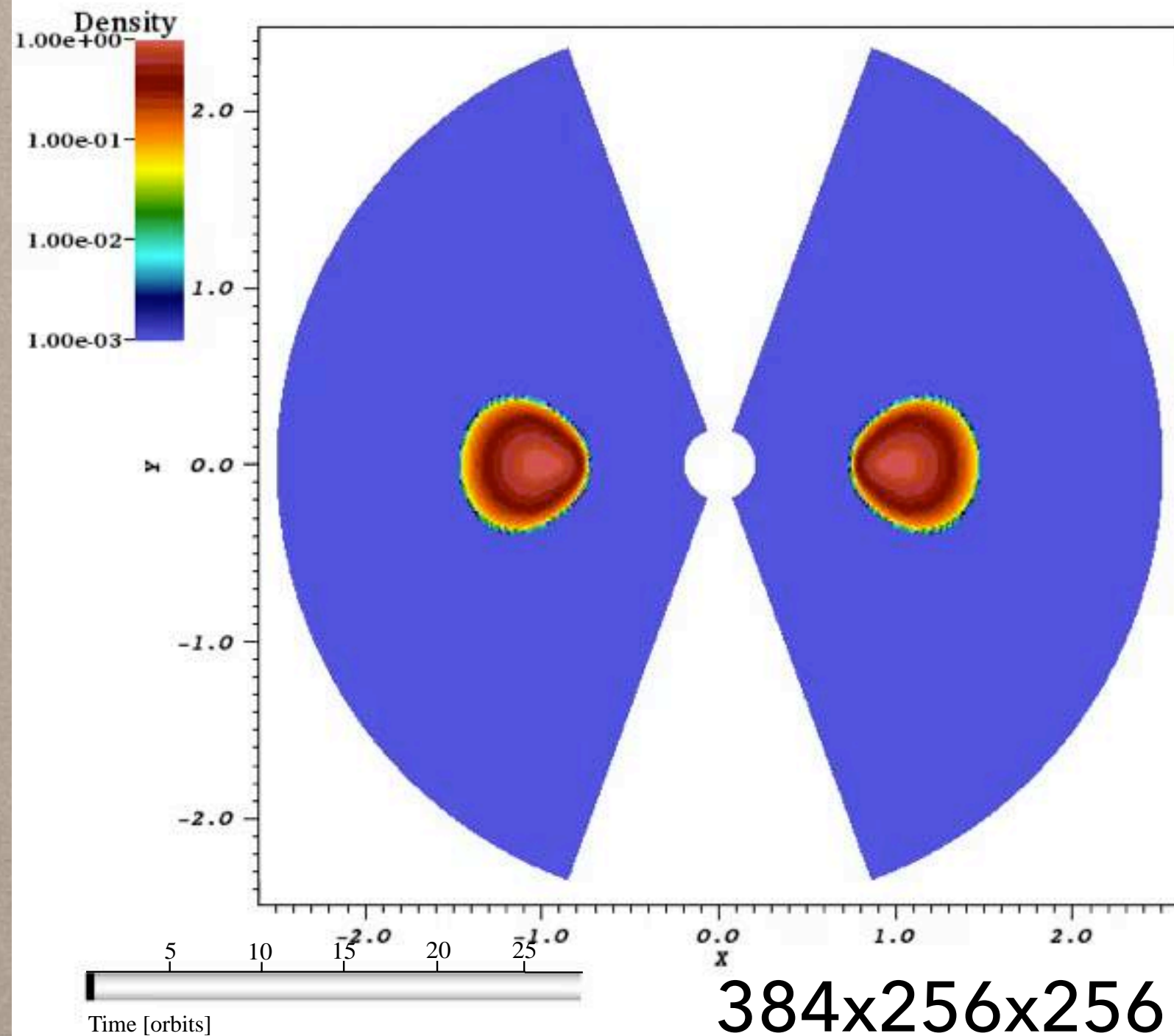
MAGNETOROTATIONAL INSTABILITY (MRI)



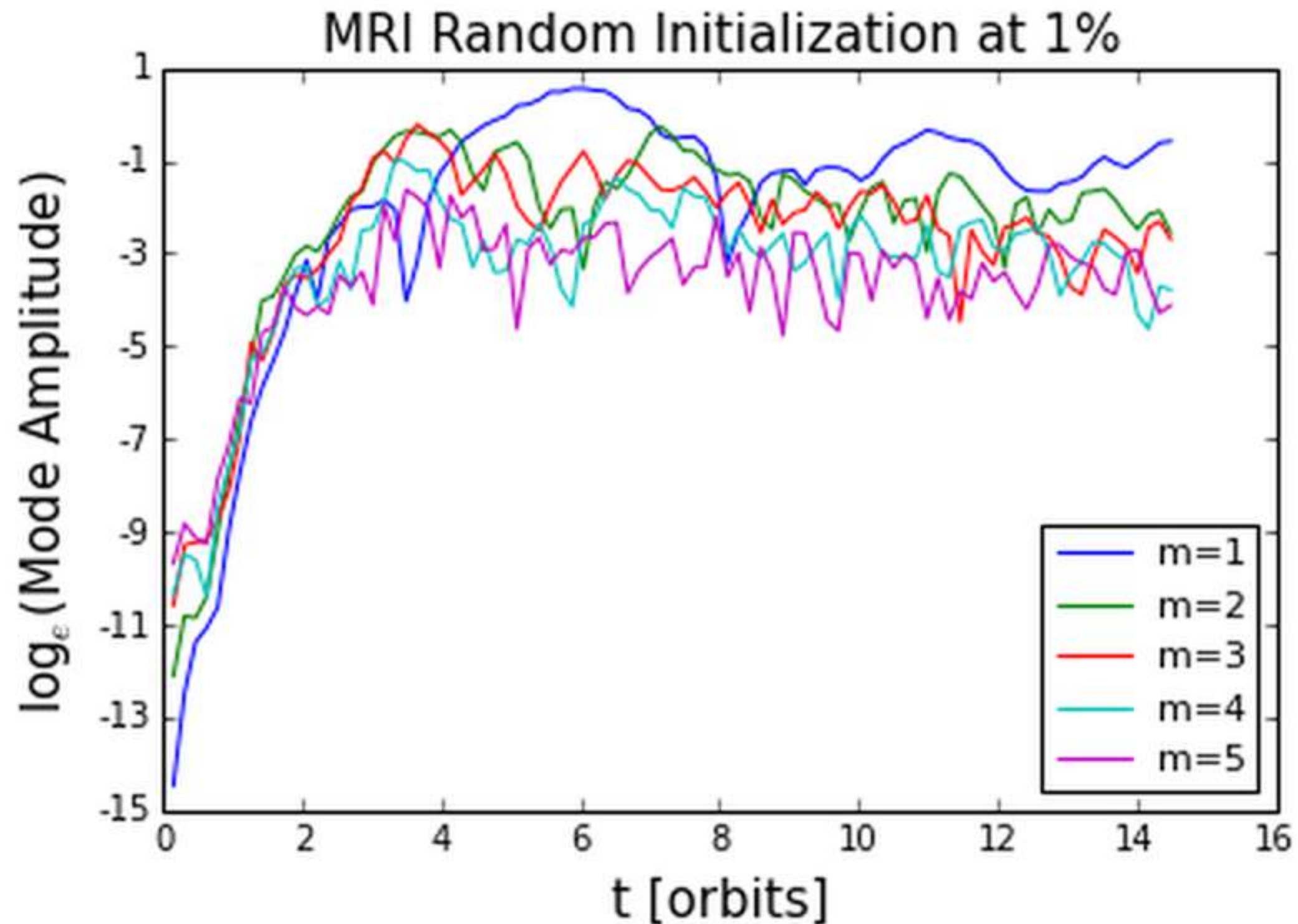
RUN-AWAY INSTABILITY



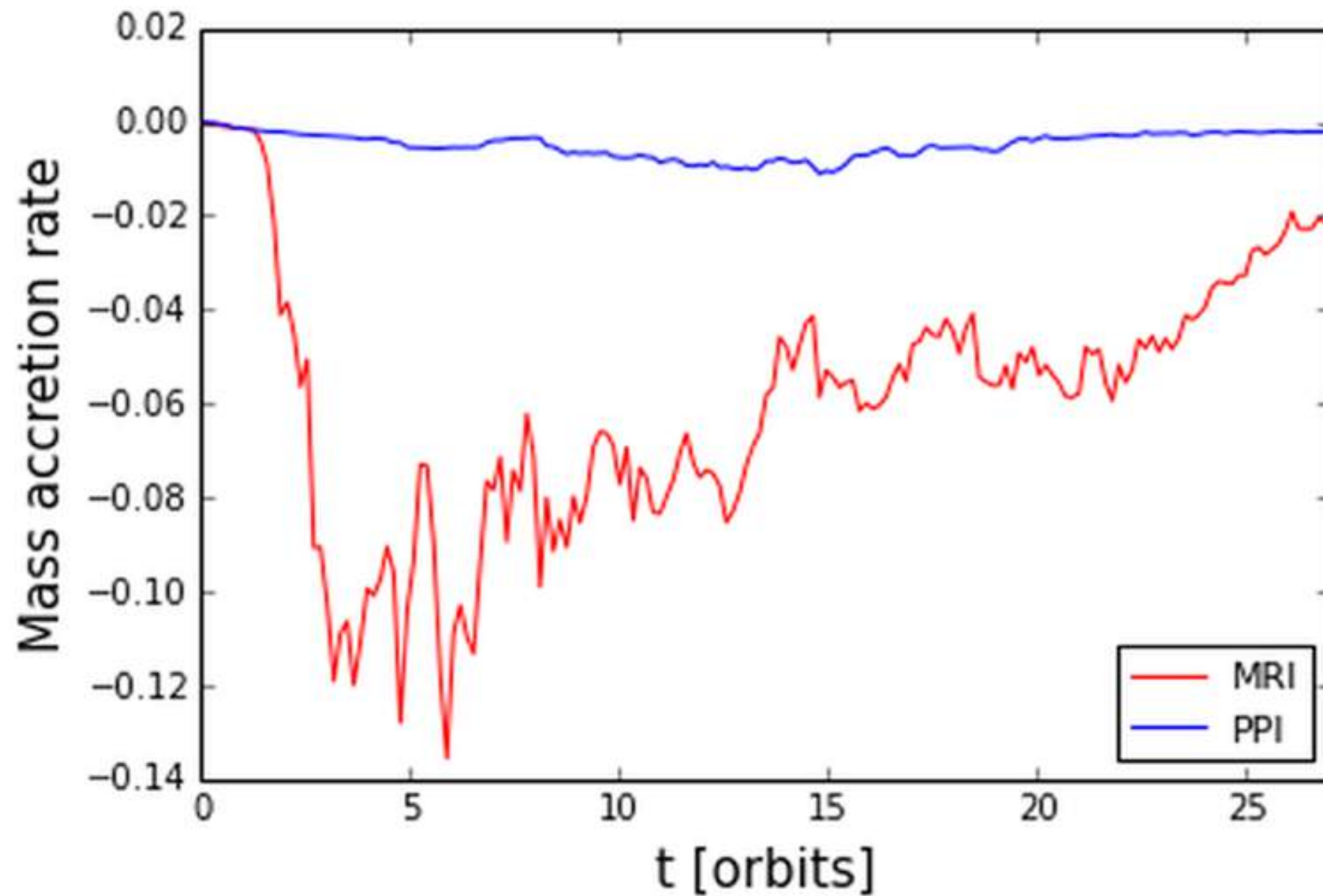
SIMULATION RESULTS



MRI MODE GROWTH ANALYSIS



MASS ACCRETION RATE HISTORY



SUMMARY

Papaloizou Pringle Instability	Magnetorotational Instability
Global, nonaxisymmetric, Hydrodynamical	Local, MHD
Constant Angular Momentum	Shearing $V_{\text{inner}} > V_{\text{outer}}$
m=1 mode dominant	higher order modes dominant
Provide angular momentum transport, but not as considerable as MRI.	Faster growth. More effective angular momentum transport .