Magnetorotational instability: a review

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The abstract goes here like this.

1. Introduction

Background info

What is MRI? Accretion disks? Maybe provide references to explain relevance of MRI tobirth of stars, geophysics, etc.

Also outline what the report will cover (probably as the last paragraph).

1.1. *Example citations*

General papers: Julien & Knobloch (2010), Chandrasekhar (1960), Acheson & Hide (1973), Balbus & Hawley (1991)

Experiments: Gailitis *et al.* (2002), Sisan *et al.* (2004), Stefani *et al.* (2006), Stefani *et al.* (2007), Ji (2010), Seilmayer *et al.* (2012)

Numerical simulations: Kageyama *et al.* (2004), Liu (2008), Gissinger *et al.* (2011), Travnikov *et al.* (2011), Kirillov *et al.* (2012), Zhao & Zikanov (2012)

2. Physical Explanation

Physical explanation of magnetohydrodynamic (MHD) equations, concept of "frozen-in-field", analogy of magnetic and string tension, main idea of MRI

3. Theoretical Work

Derive governing equations, linearize to small perturbations, and determine conditions for stability.

3.1. *Governing Equations*

Julien & Knobloch (2010) states the governing equations as

$$\rho\left[\frac{\partial u}{\partial t}+(u\cdot\nabla)u\right]=\nabla p-\frac{1}{2\mu_0}\nabla B^2+\frac{1}{\mu}(B\cdot\nabla)B \tag{3.1}$$

$$\frac{\partial B}{\partial t}+(u\cdot\nabla)B=(B\cdot\nabla)u \tag{3.2}$$

$$\nabla\cdot u=\nabla\cdot B=0 \tag{3.3}$$

where μ_0, B

3.2. *Linearization*

Linearize governing equations to small perturbations

3.3. *Normal Modes*

3.4. *Stability Analysis*

3.5. *Nonlinear Analysis*

4. Laboratory Experiments

Discuss on experimental work that has been done related to this topic.

Try to categorize experiments so we can group the discussion. Also, the main focus is to explain what has been done to attempt to recreate MRI in the lab.

NOTE: most literature on MRI experiments seem to be about either 1) axial-only magnetic fields (standard MRI) or 2) axial and azimuthal magnetic fields (helical MRI).

5. Numerical Work

Have there been any numerical experiments done that involve the topic.

There's probably numerical simulations of both standard and helical MRI that have already been tested in the lab, but there may also be more large-scale simulations (e.g. planet-scale).

6. Conclusion

Concluding remarks

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