GRRMHD accretion disk simulations

onto black holes

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Accretion disks

Accretion disks are a major topic in astrophysics:

- Accretion disks are formed in a wide range of astrophysical object from protostars and young stellar objects to galaxies.
- Accretion leads to release gravitational energy to radiation.
- The luminosity and the acretion rate in typical units:

$$L_{Edd} = 1.25 \cdot 10^{38} \, (M/M_\odot) \, \text{erg/s} \qquad \dot{M}_{Edd} = \frac{L_{Edd}}{0.057c^2}$$

To simulate accretion we use the GR Radiation MHD code KORAL (Sądowski et al. 2013–2017). My research focuses on simulations of accretion onto *Black Holes.*

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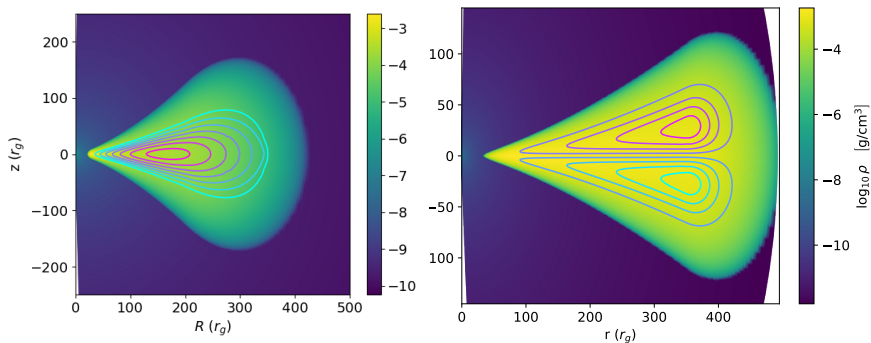
GRRMHD simulations

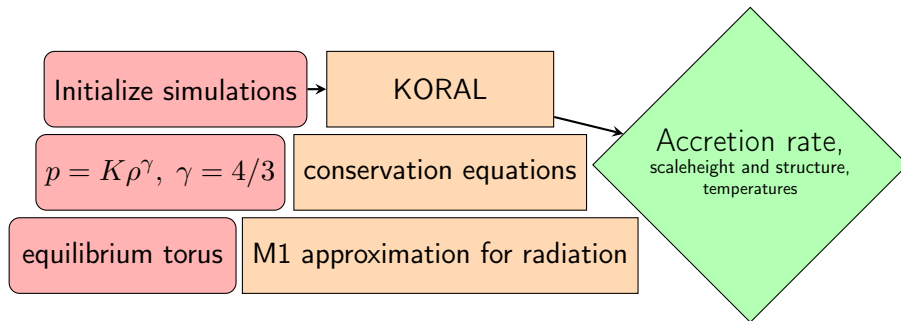KORAL: GR Radiation MHD code
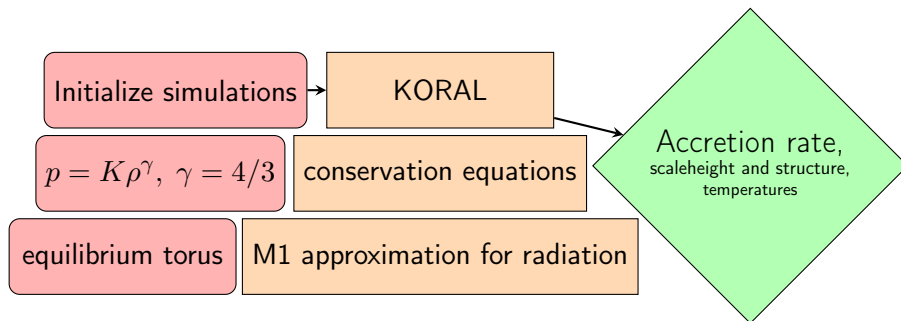
GRRMHD simulations

KORAL: GR Radiation MHD code

movie!

GRRMHD simulations
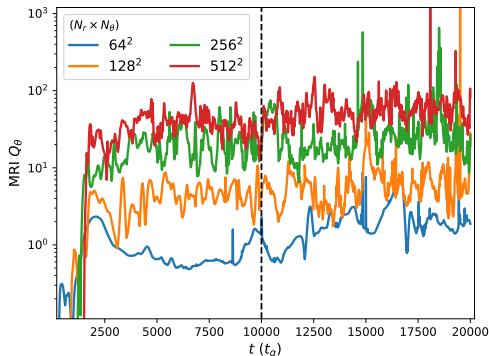
KORAL: GR Radiation MHD code

Results

MRI quality parameter

- Conduct a series of accretion simulations with different resolutions.
- Examine how different resolutions affect accretion flow and various quantitative values.

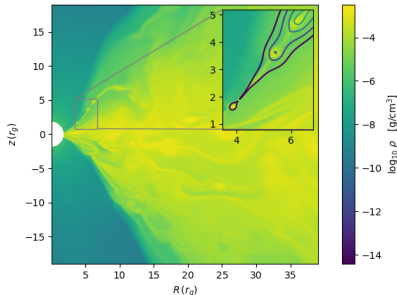We evaluate the number of cells within a wavelength of the fastest growing MRI mode
$Q \equiv \lambda_{\mathsf{MRI}}/\Delta x$,
$\lambda_{\mathsf{MRI}} = 2\pi u_A/\Omega$.

Rysunek: Magnetorotational Instability Q_θ parameter

Conclusions

- Fine grid cell resolution is required to capture MRI.
- Low resolution cannot resolve fine structures such us blobs and plasmoids.

Talks / conferences

- 24th Relativistic Astrophysics Group Meeting, RAGtime[1]
- Kolan-Mandre Discs & Black Holes Workshop
- Disks, tori, spheres. Accretion onto compact objects
- EAS 2023 Posters:
  - ① Sub-Eddington accretion: Puffy Disk simulations vs. thin disk models
  - ② Long term X-ray time-lags studies
- School of General Relativity, Astrophysics and Cosmology

[1] Karakonstantakis et al., (2023) GRRMHD Simulations of Accreting Tori: Resolution Study