相対論的磁気流体流中の星によって作られる衝撃波構造

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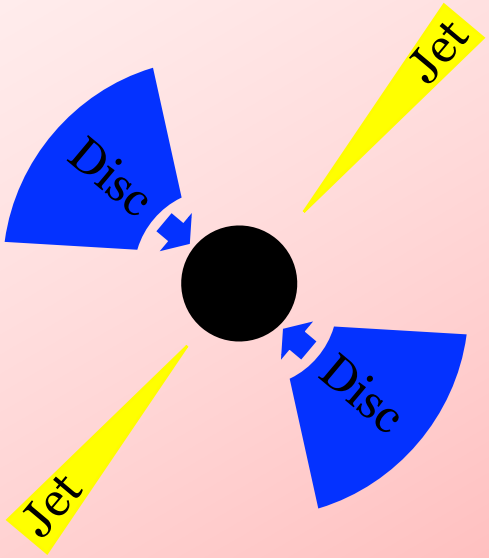
on behalf of
TMT revolution
Tanaka, Matsumoto, Toma & Shoda

Introduction

Relativistic Jet

- Powered by NS or BH
- Relativistic plasma outflow
- High-energy (non-thermal) emission
- Bipolar jets from engine

Common astrophysical phenomena phenomena in AGN, microquasar & GRB



- Gravitational energy (inflow -> outflow)

Same as pulsar wind

- Rotation powered?
- Role of magnetic field?
- How to accelerates to relativistic flow?
- How to collimate jets?

Turbulence Acceleration

TTT18
Tanaka&Toma20

$$\langle \nabla_\mu (n u^\mu) \rangle = 0,$$

$$\langle \nabla_\mu T^{\mu t} \rangle = -\gamma \frac{\Lambda_{\rm rad}}{c},$$

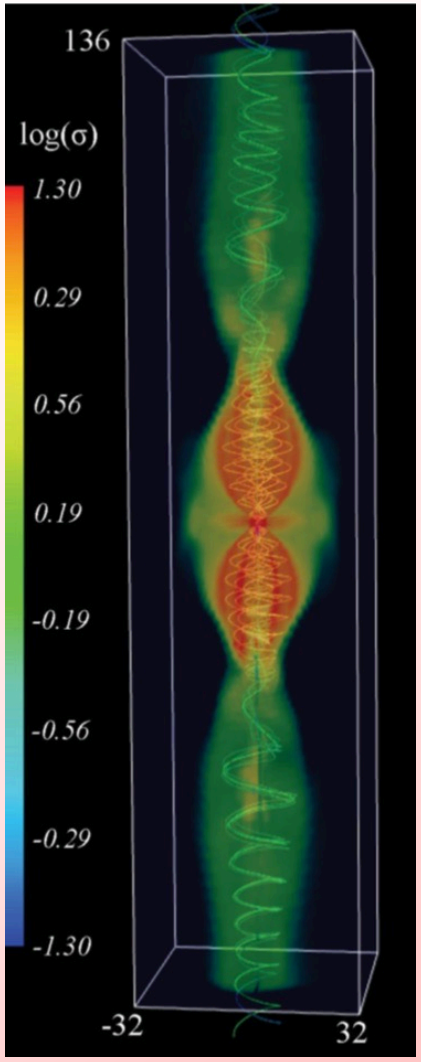
$$-\langle u_\nu \nabla_\mu T^{\mu\nu}_{\rm FL} \rangle = \frac{\delta b^2/2}{\tau_{\rm diss}} - \frac{\Lambda_{\rm rad}}{c},$$

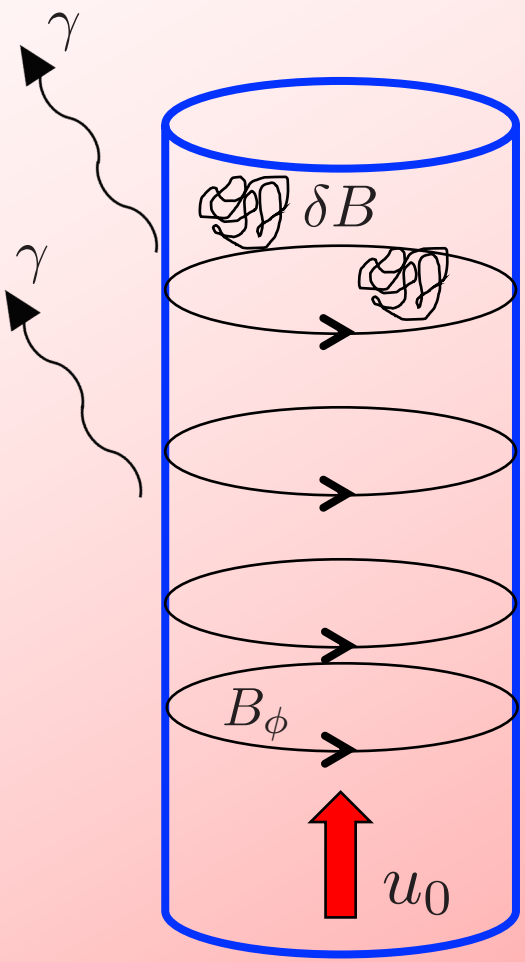
$$\frac{1}{2}\langle \bar{b}_\mu e^{\mu\nu\alpha\beta} \nabla_\nu F_{\alpha\beta} \rangle = -\frac{\bar{b}^2/2}{\tau_{\rm conv}},$$

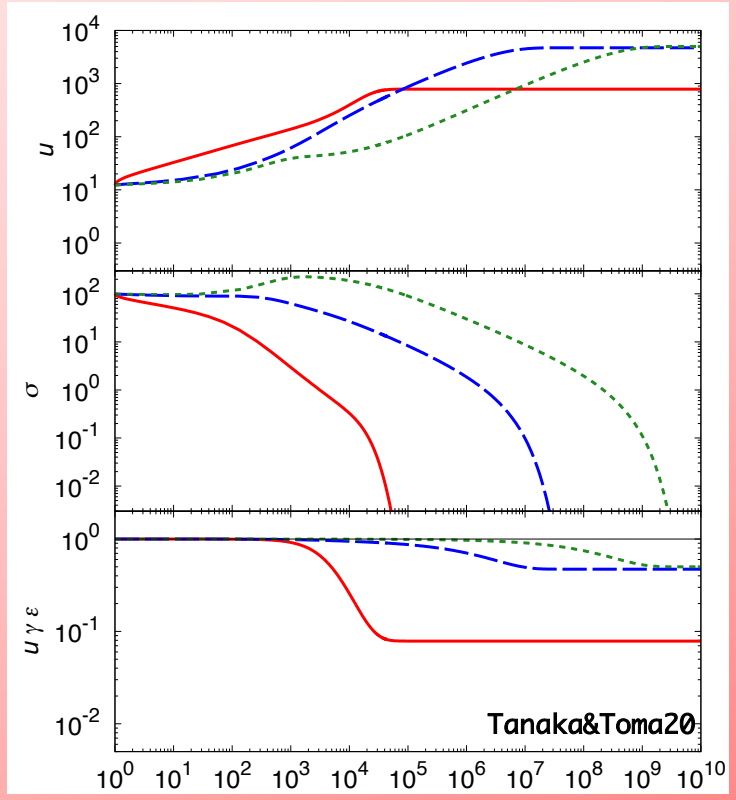
$$\frac{1}{2}\langle \delta b_\mu e^{\mu\nu\alpha\beta} \nabla_\nu F_{\alpha\beta} \rangle = \frac{\bar{b}^2/2}{\tau_{\rm conv}} - \frac{\delta b^2/2}{\tau_{\rm diss}}.$$

Asada+17

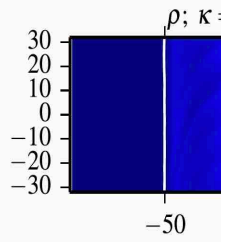
Bromberg&Tchekhovskoy16

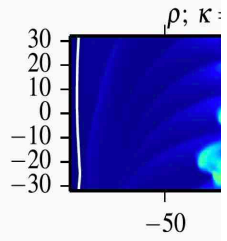


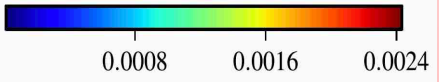




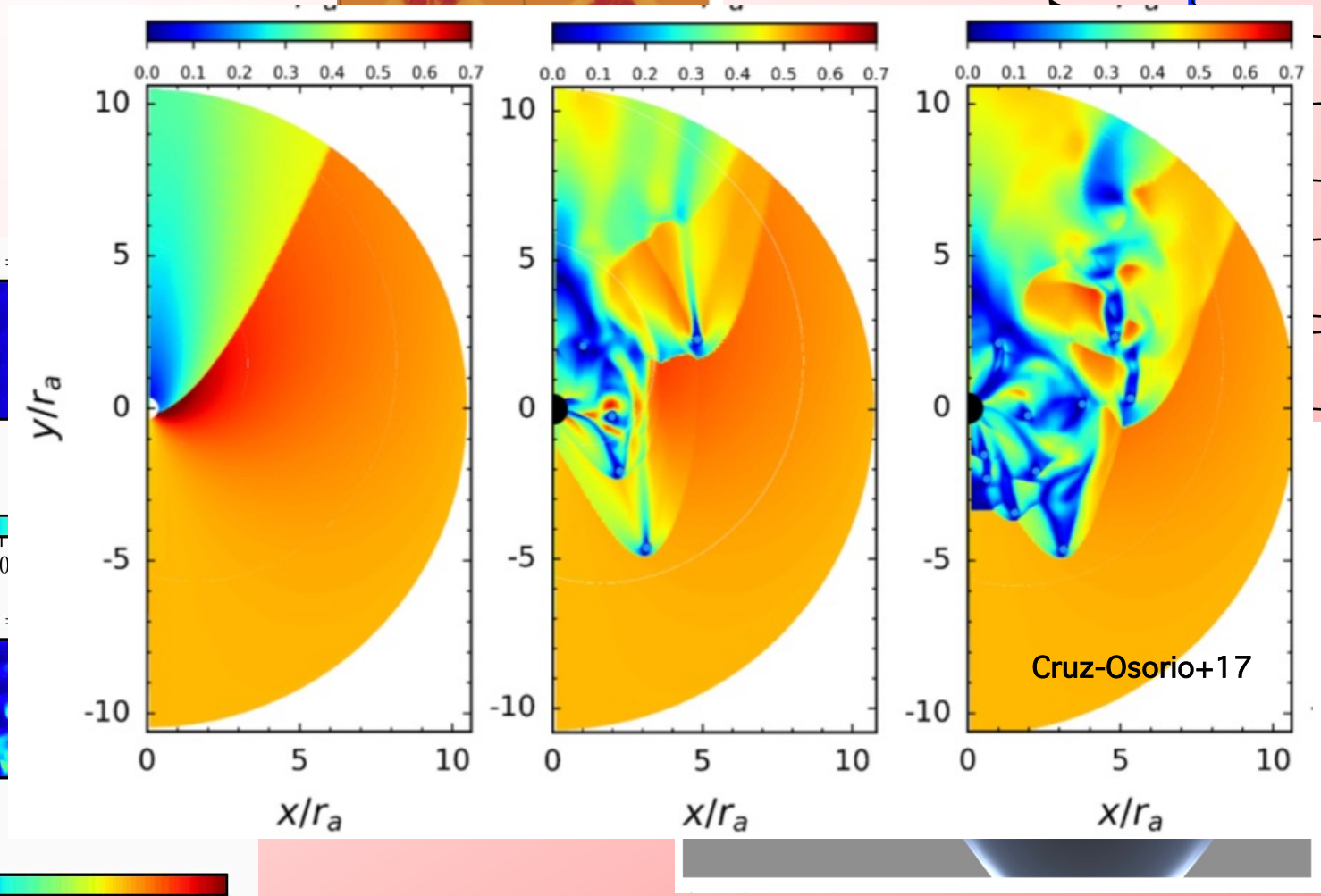
Turbulence Formation?



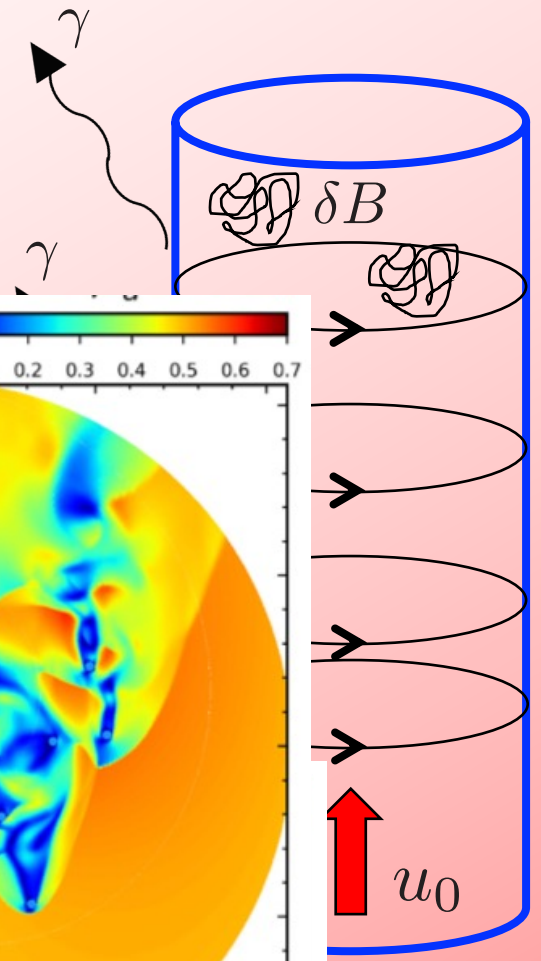




Porth&Komissarov15



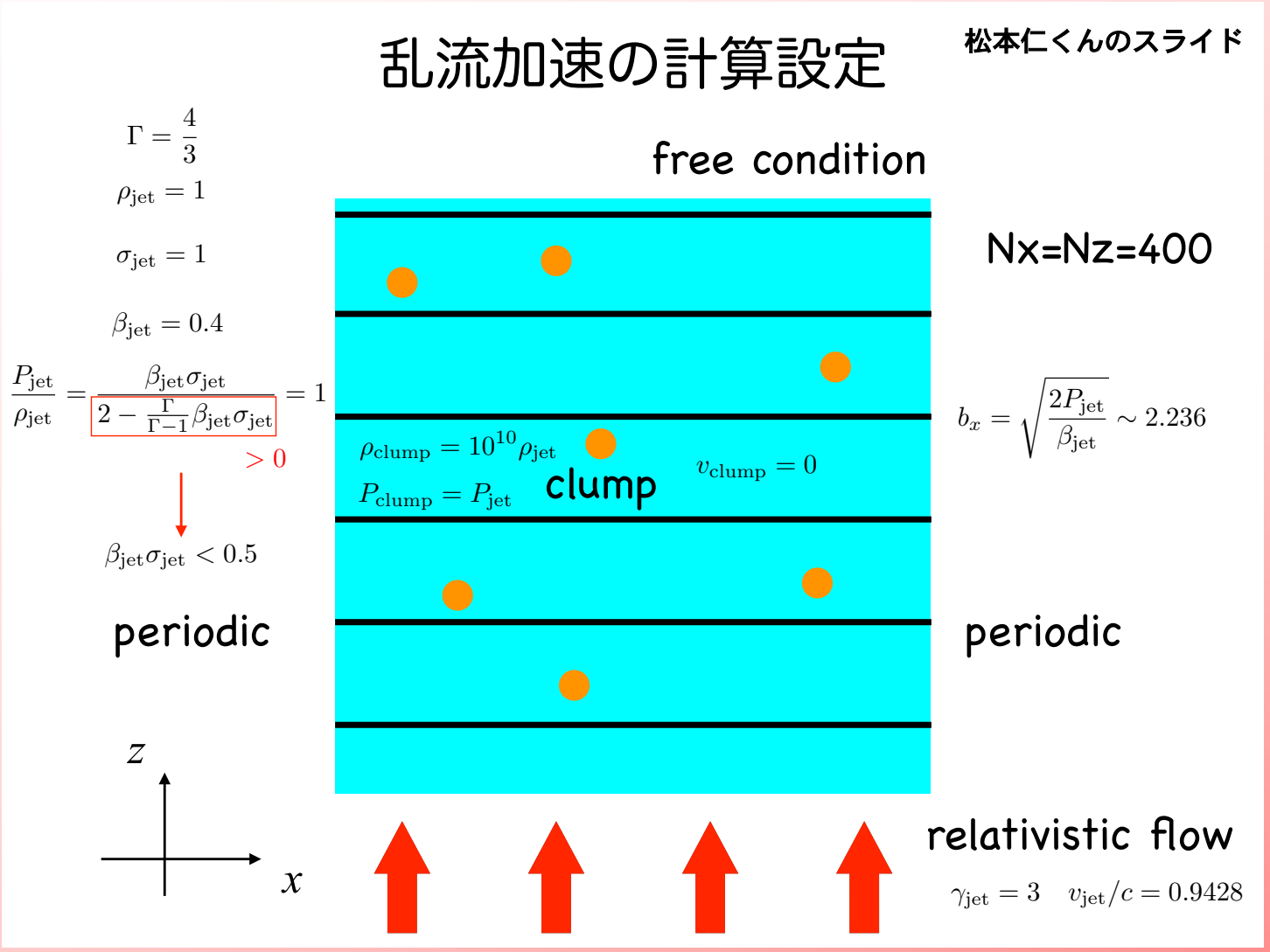
Khangulyan+13



Numerical Study

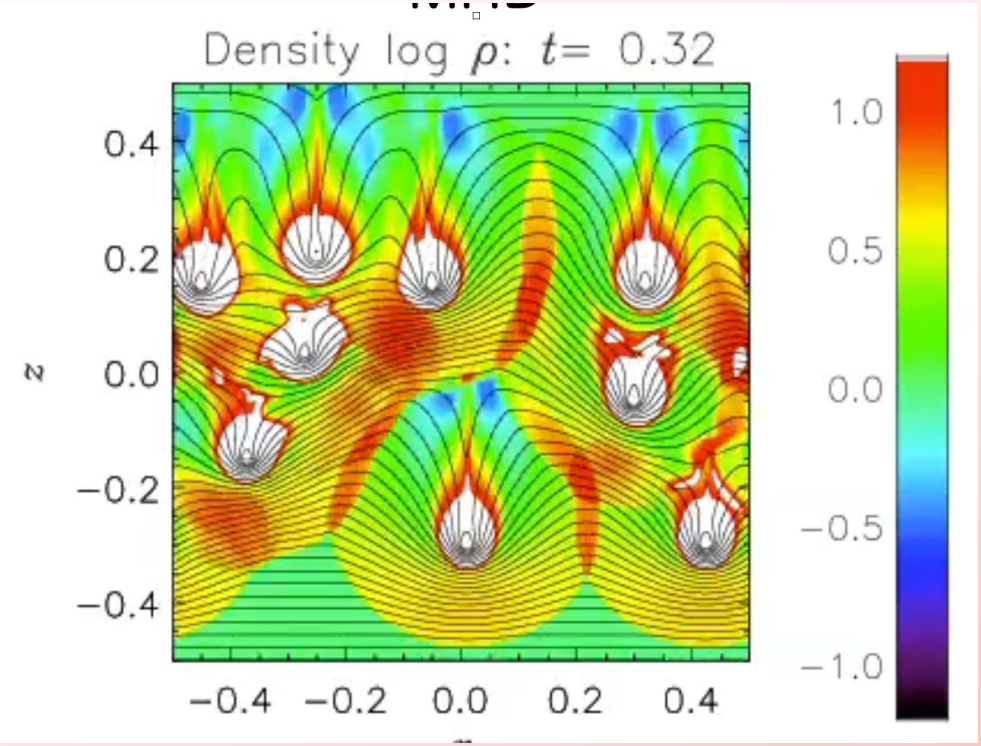
Set Up – 2D Rela. MHD

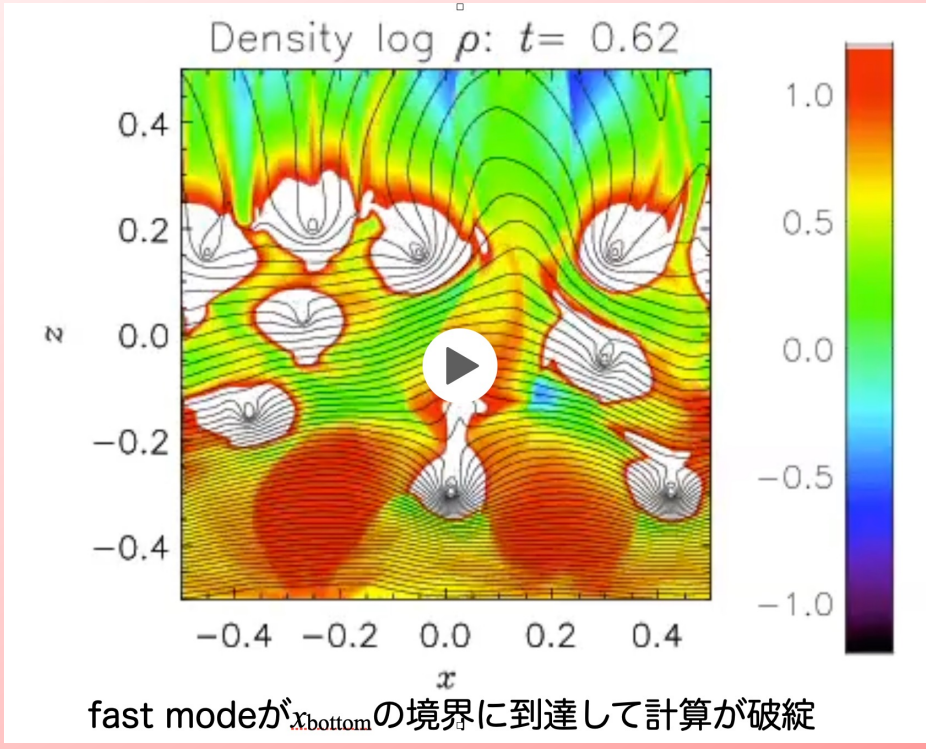
デカルト座標



Set Up – 2D Rela. MHD

松本仁くんのスライド





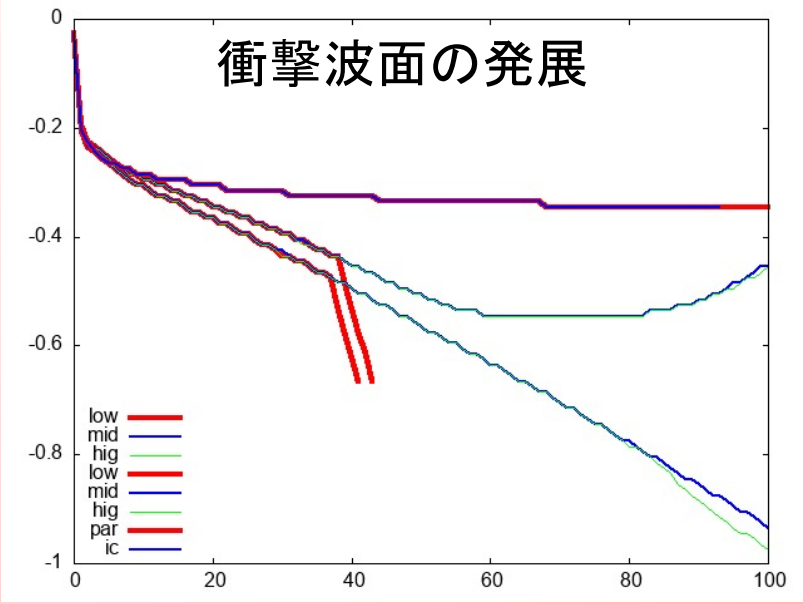
fast modeがx_{bottom}の境界に到達して計算が破綻

一つにして詳しく調べる

Blob → Pole

次元性の効果?

- 磁場
- 速度場
- Poleの向き



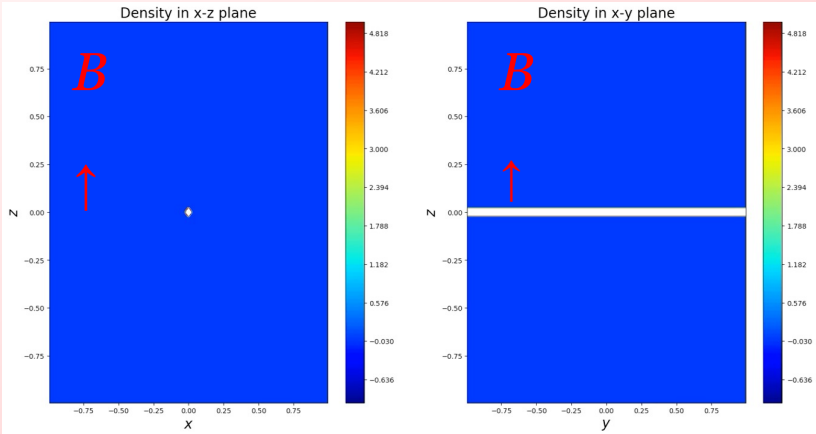
parallel

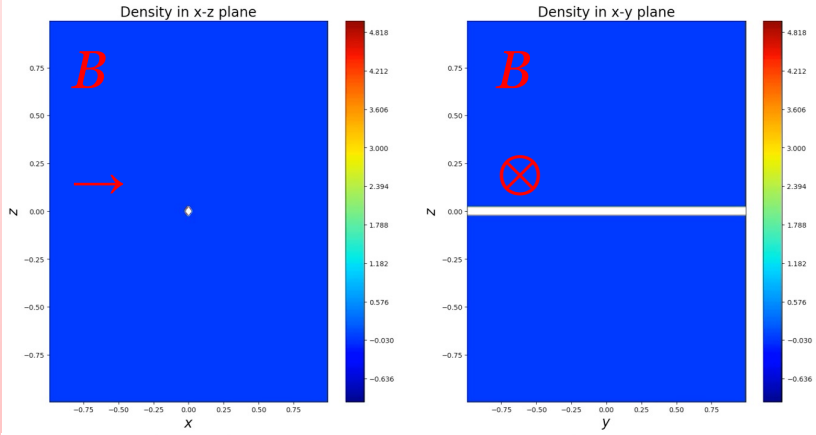
undular

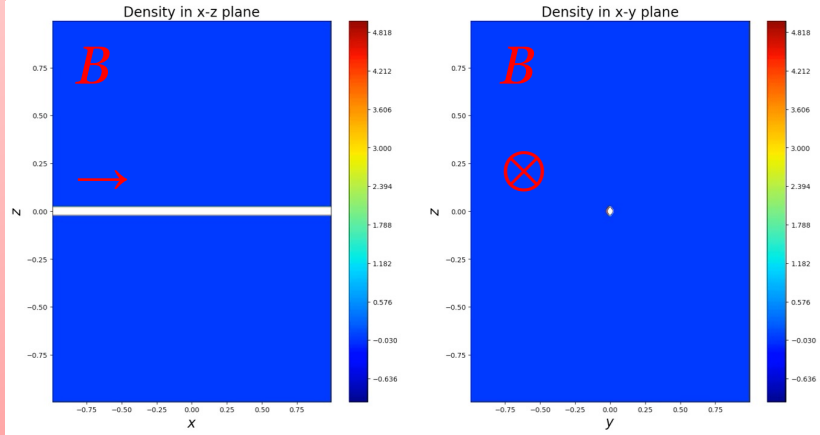
inter-

change

ρ

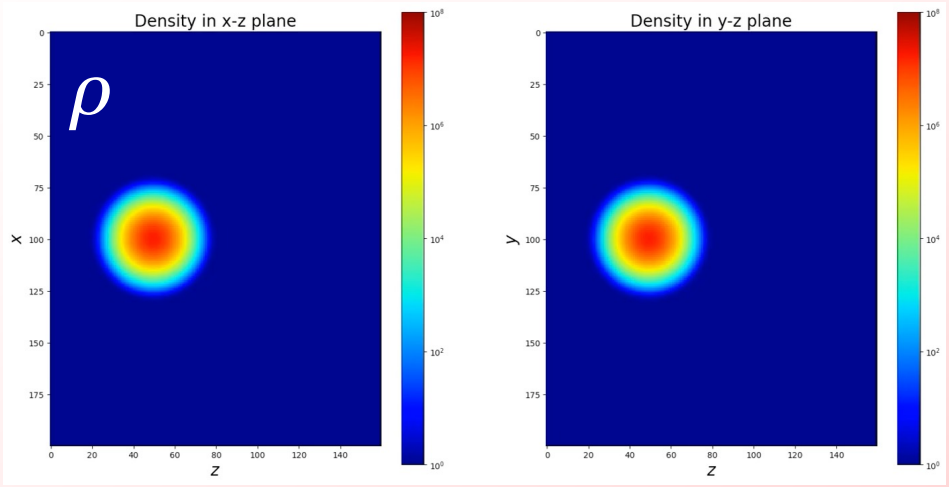


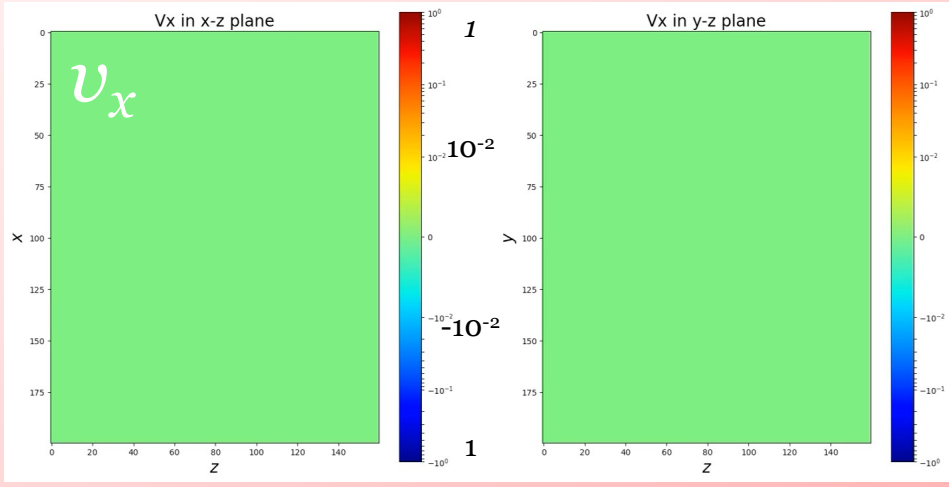


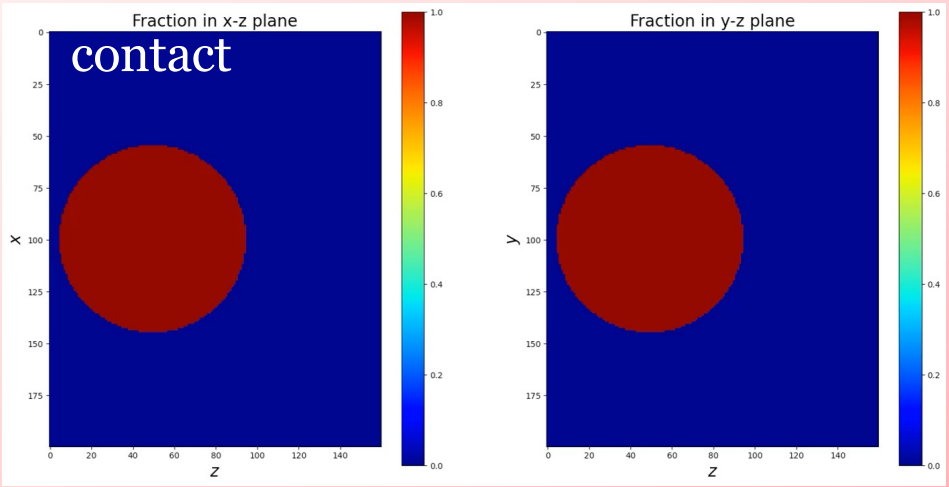


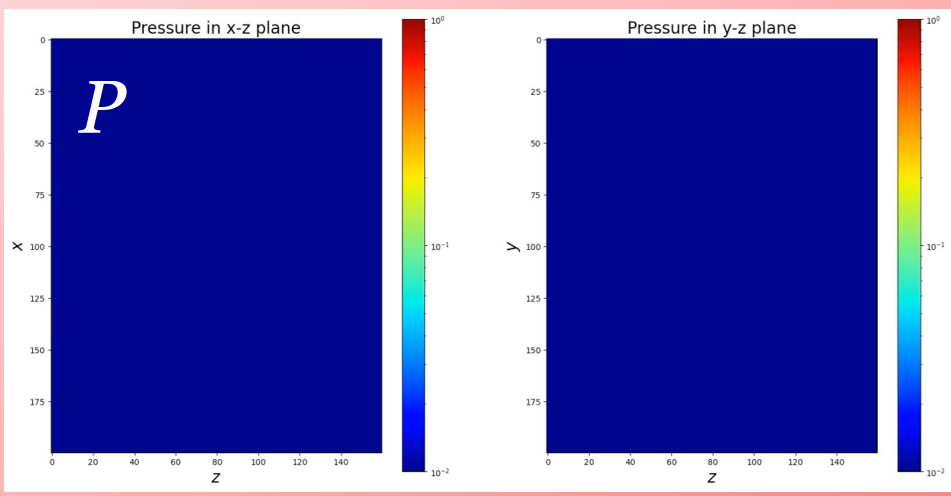
Hydrodynamic limit

$\sigma = 10^{-6}, \beta = 10^{2}, \Gamma = 2$





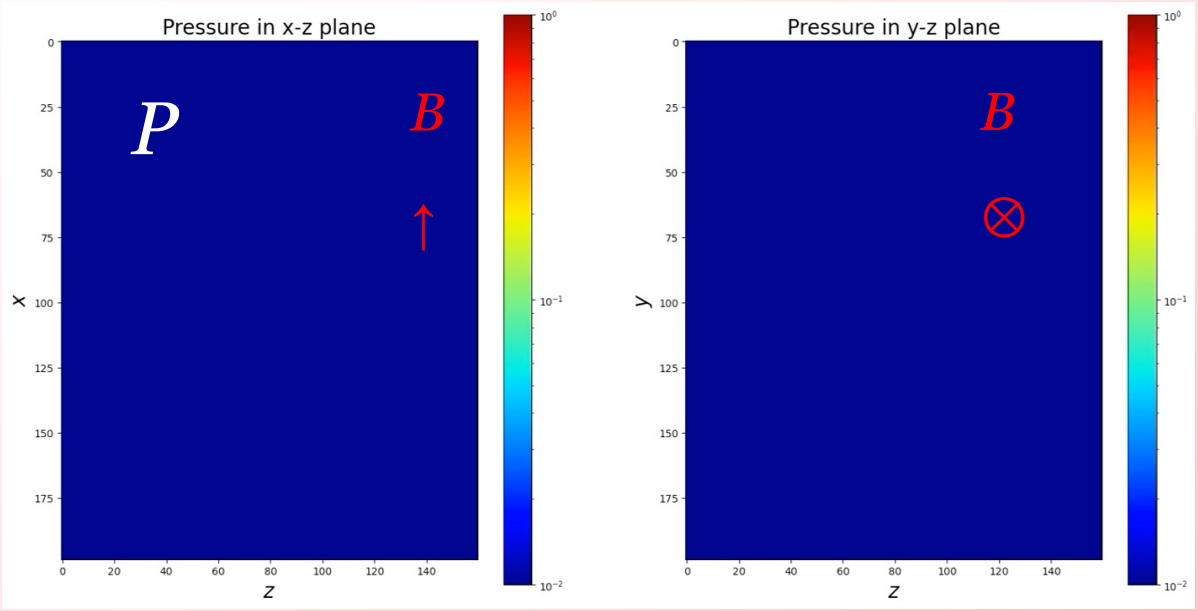




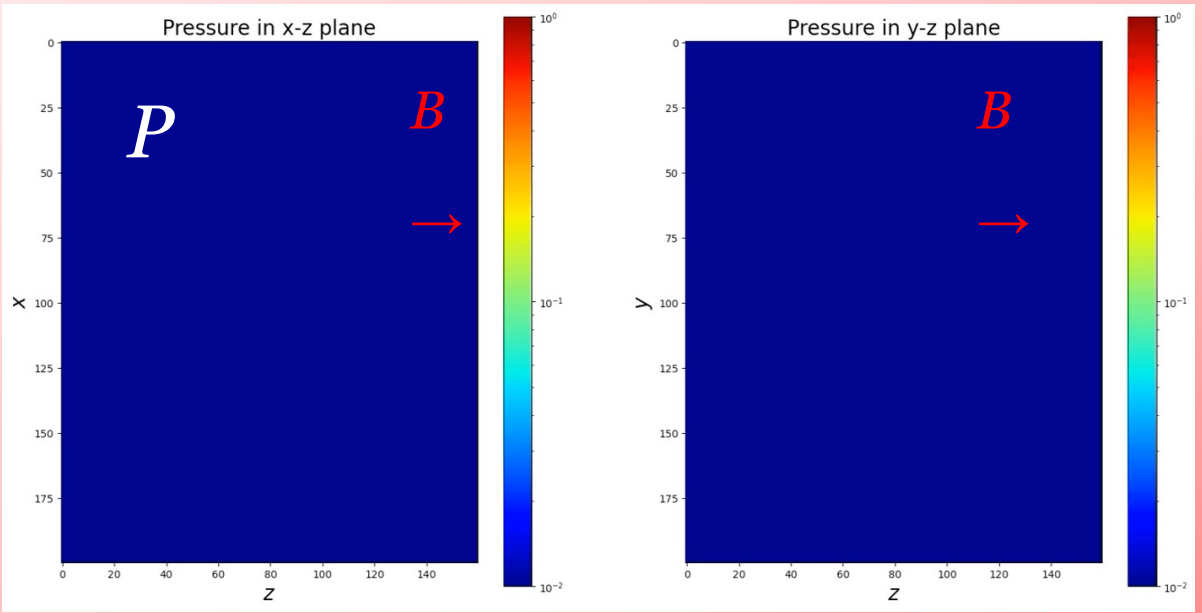
B-field Direction

$\sigma = 10^{-1}, \beta = 10^{-2}, \Gamma = 2$

$\Phi_B = \pi/2$



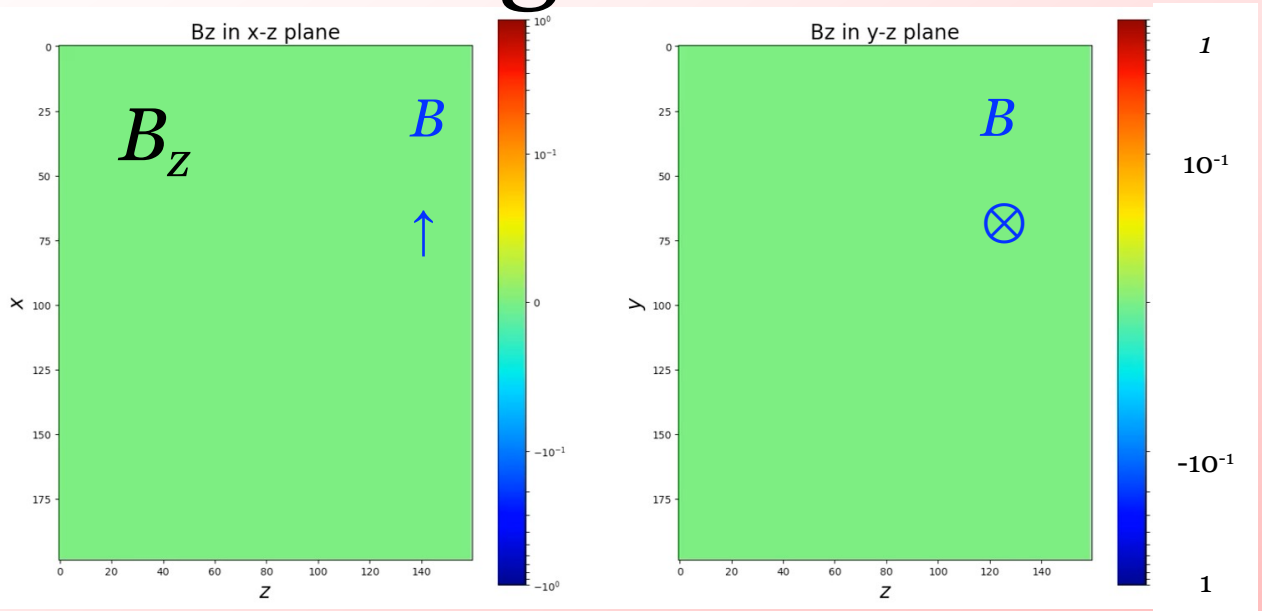
$\Phi_B = 0$



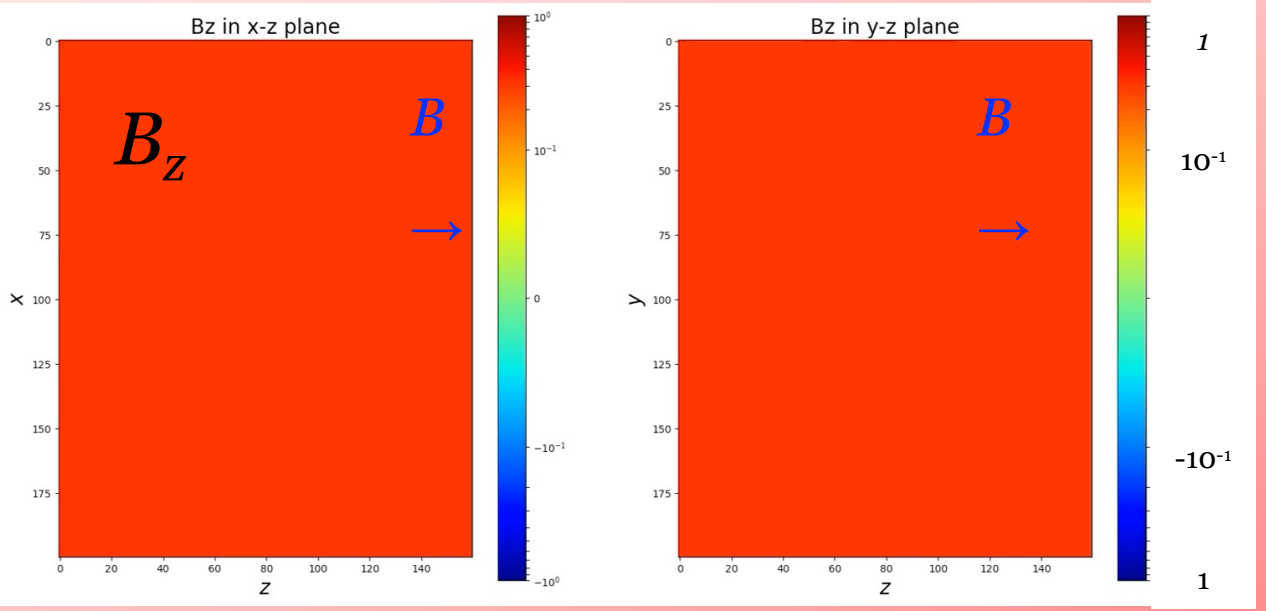
Reconnection Region

$\sigma = 10^{-1}, \beta = 10^{-2}, \Gamma = 2$

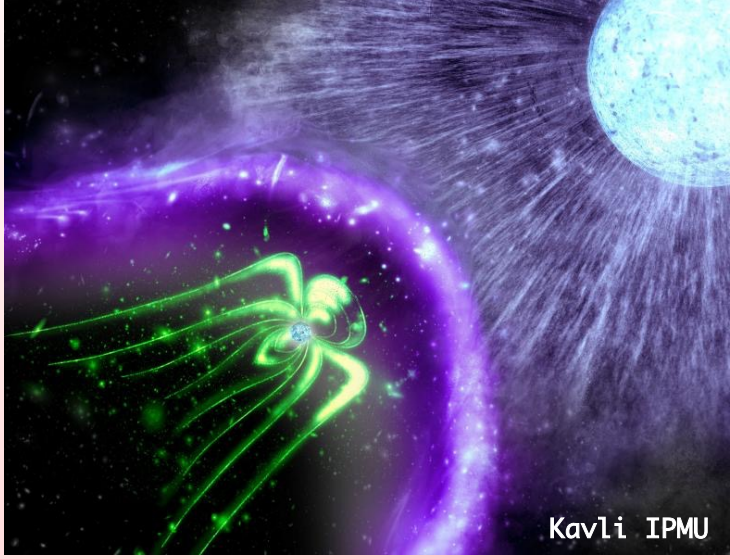
$\Phi_B = \pi/2$



$\Phi_B = 0$



Summary



- 超音速流に乱流を起こしたかった.
  - Numerical studyでBlobを置くのは最善ではないかも.
- 2D shock tube problem
- 磁場の方向とshock形状やReconnection領域
- Gamma-ray binaryやLaboratory Experiments?