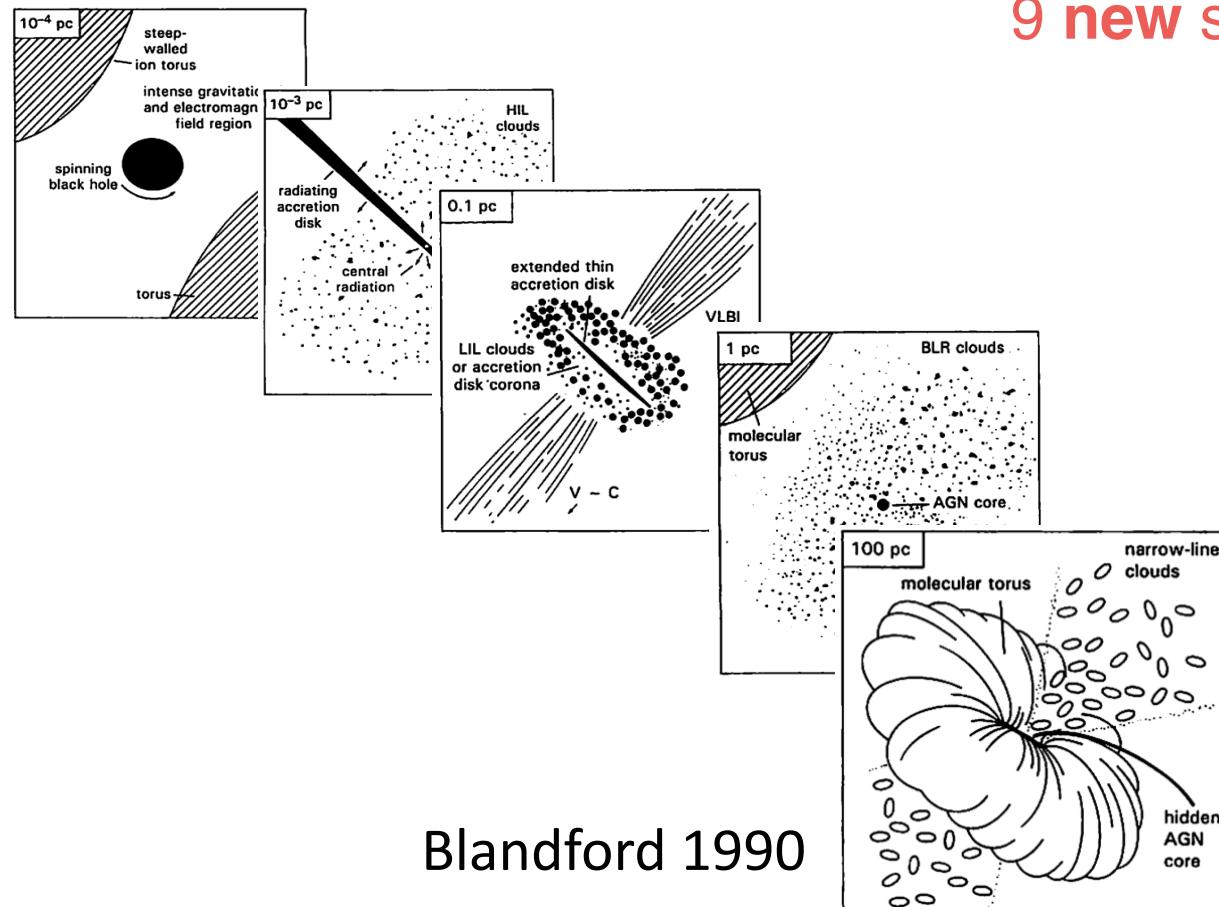


輻射フィードバックによる AGNの遮蔽構造



Blandford 1990

9 new slides out of 15

和田桂一

鹿児島大学

Collaborators:

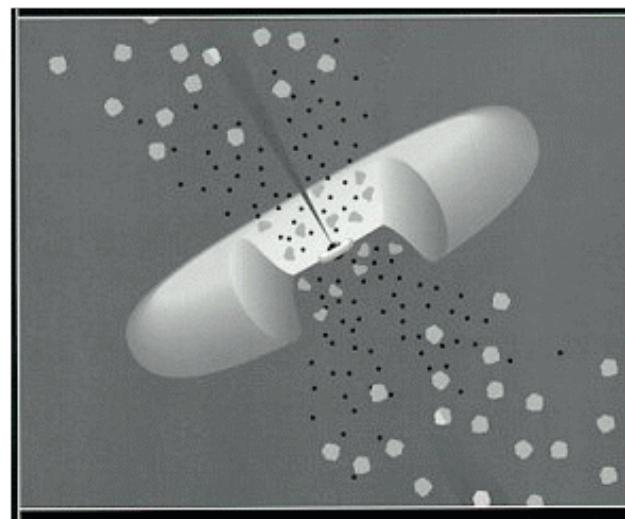
Marc Schartmann (MPE)
Rowin Meijerink (Leiden)

結論

“obscuration” or “AGN type-1/2” のために

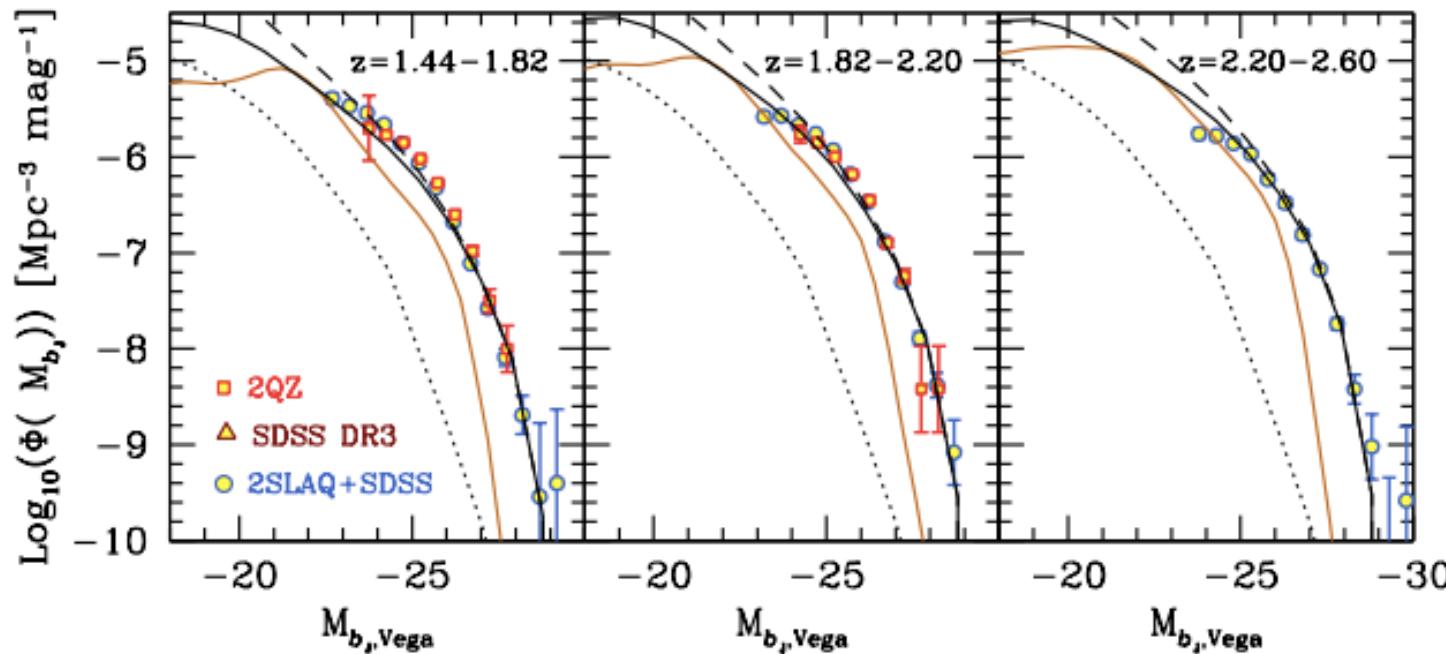
(clumpy) トーラスを”仮定”する必要はない。

(非等方) 辐射場とガスがあればよい



Introduction

巨大ブラックホールの進化史をさぐる ⇒ 例えば 光度関数

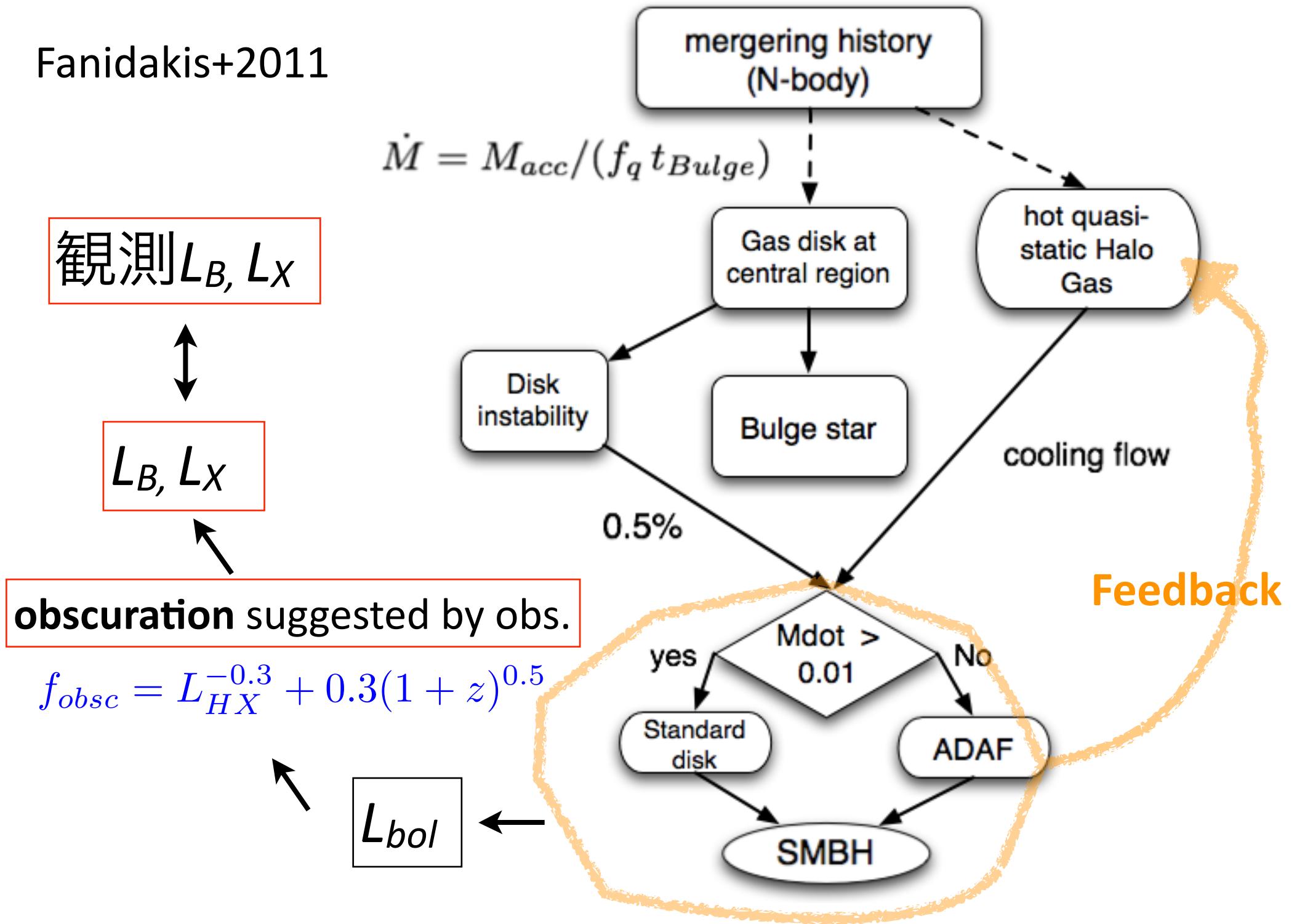


Fanidakis+2011

LF redshift evolution
≤ disk instability,
galaxy-merger
(reflecting SF
history)

セミアナ（準解析的モデル）で観測量と
比較するのはそう簡単ではない

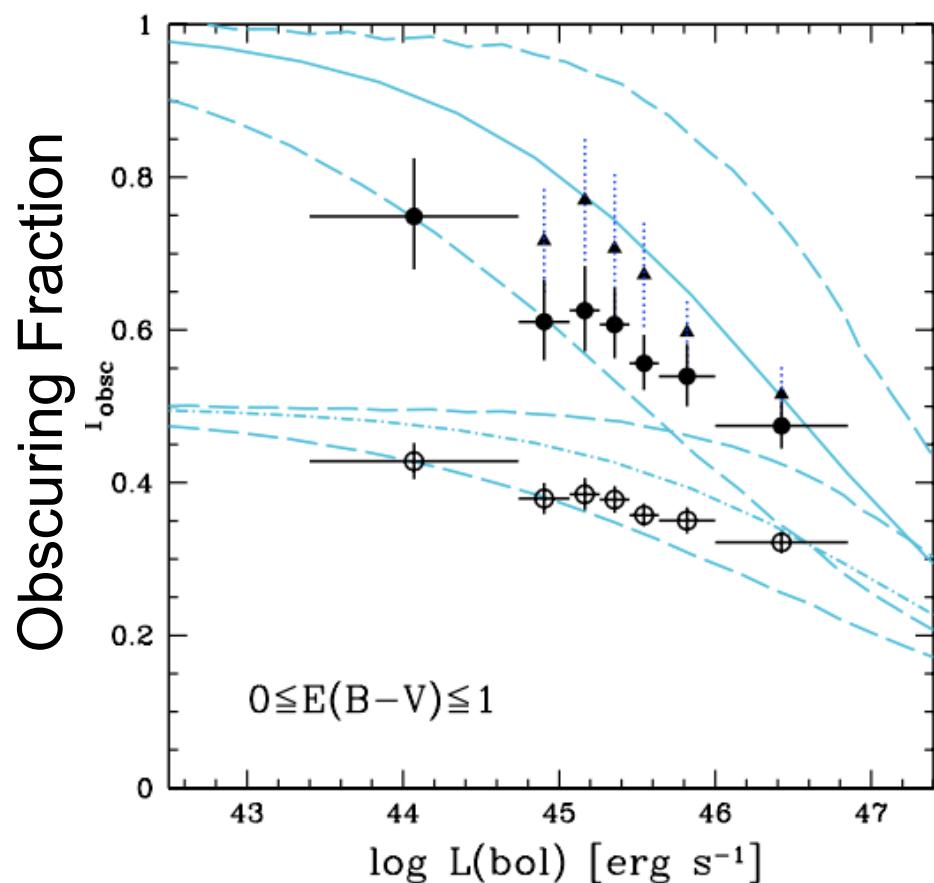
Fanidakis+2011



Obscured fraction vs. L_{AGN}

More luminous, more naked? “receding” torus?

Lusso+2013: 513 type-1 AGNs in XMM-COSMOS



AGN光度と遮蔽率の関係は、観測的には議論が多い。

減る: Lawrence & Elvis 1982, Ueda+ 2003,
Hasinger+2008,

減るけどXほど急ではない: Lusso+2013
依存性⇒トーラスからの輻射モデルに依存

増えて、減る?: Burlon+2011

ほぼ一定: Heckman他

Gas dynamics irradiated by a central source

Wada '12, '14

- **Non-spherical Central source:**

- $L_{AGN}(\theta) \propto \cos(\theta)$
- $L_{AGN} = \{0.01-0.5\} L_{Edd} = 10^{43-46} \text{ erg/s}$

- **3D Cartesian, uniform grid +Ray tracing with 256^3 rays**

- **No symmetry is assumed.**
- direct radiation only (e.g IR emission from dust).

- **Radiation pressure** for dusty gas (Schartmann+05)

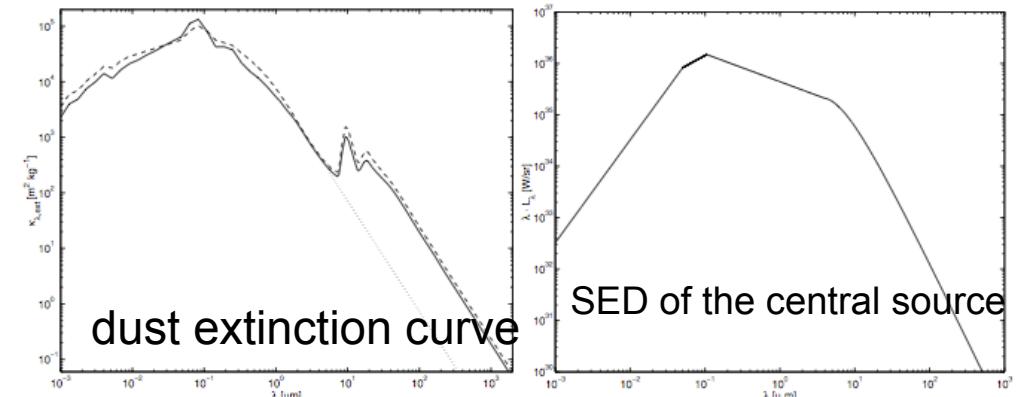
- Frequency dependent dust absorption and AGN SED (for $10^{-3} \sim 10^2 \mu\text{m}$)

- **X-ray heating** (Maloney+96, Meijerink & Spaans06, Blondin94)

- Coulomb heating
- photo-ionization for H and H₂
- Compton heating

- * **H₂ formation/dissociation**

- * [Non-equilibrium XDR chemistry w/ 25 species]

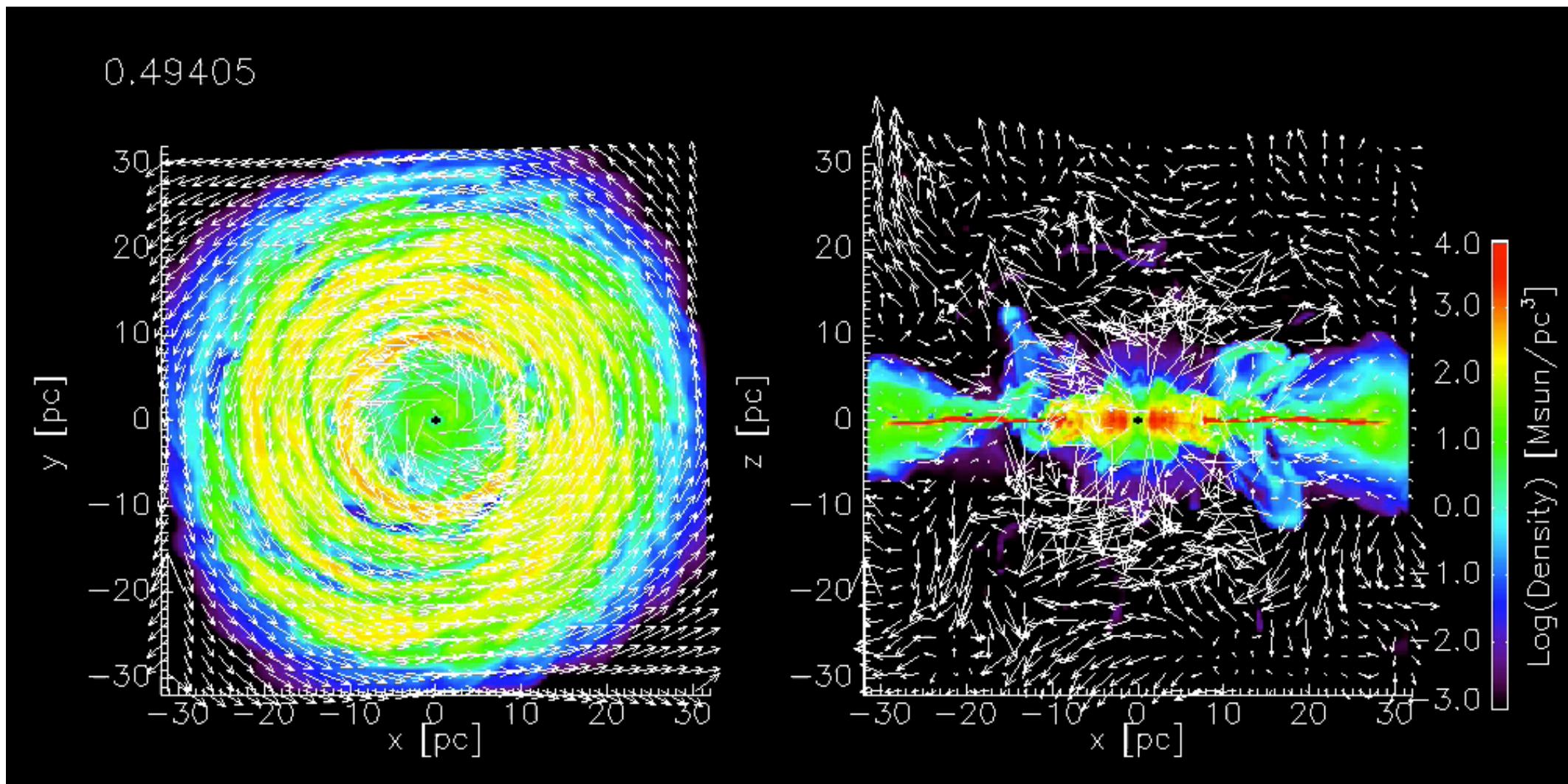


radiation-driven outflow+failed wind => thick disk形成

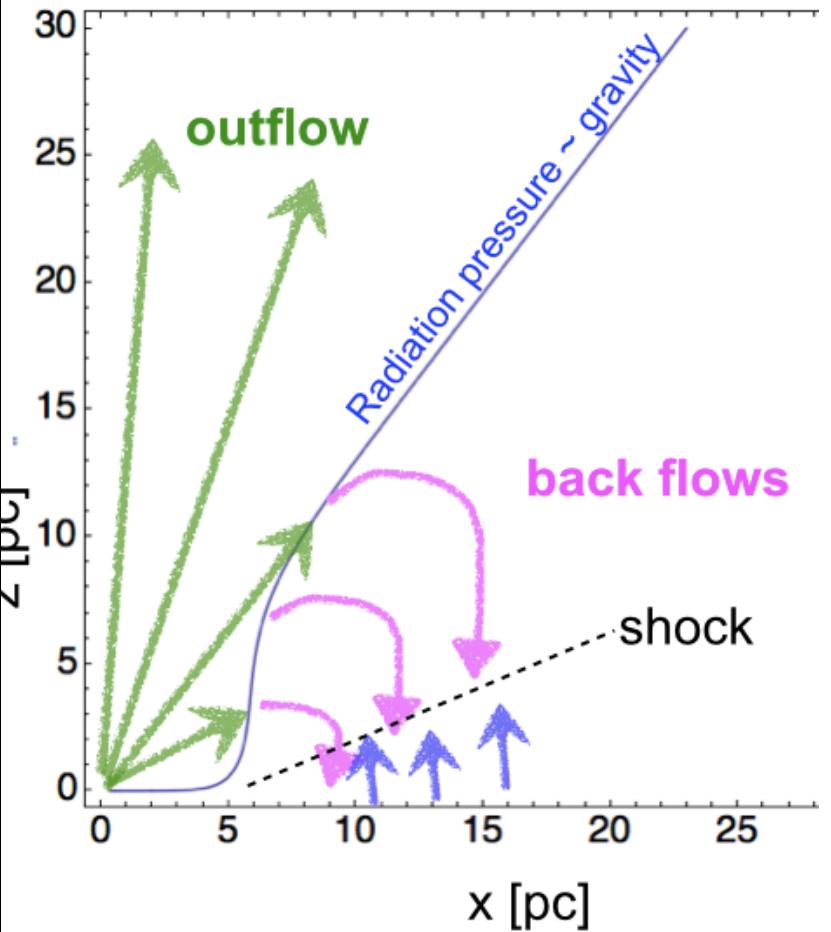
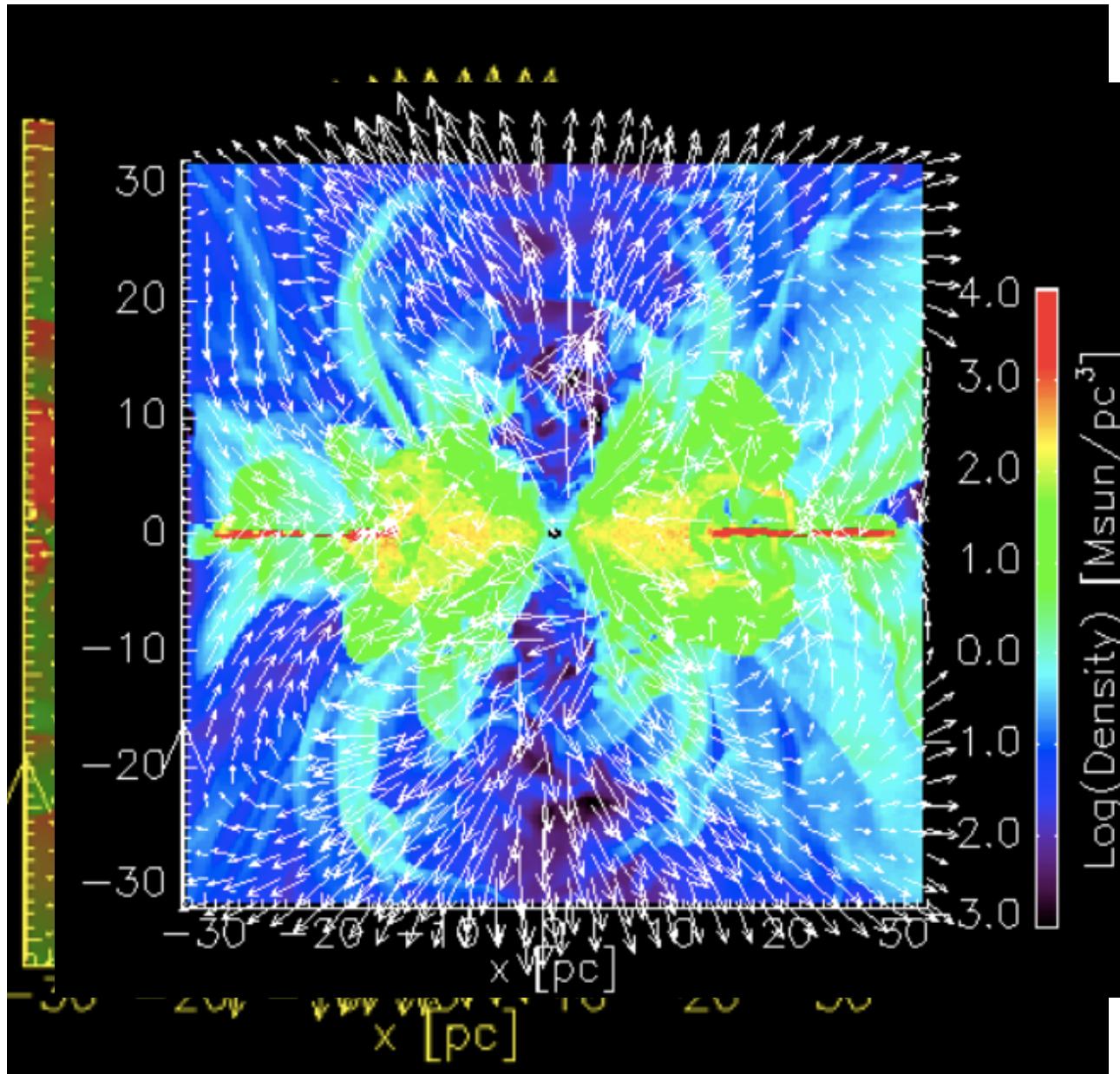
$M_{\text{BH}} = 1.3 \times 10^8 M_{\text{sun}}$

ER = 0.3

密度



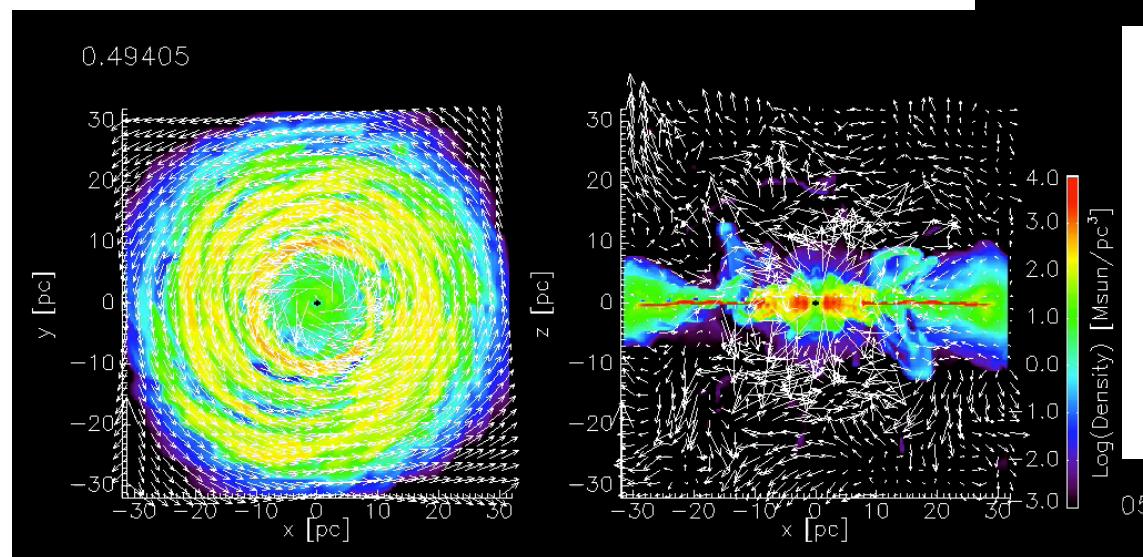
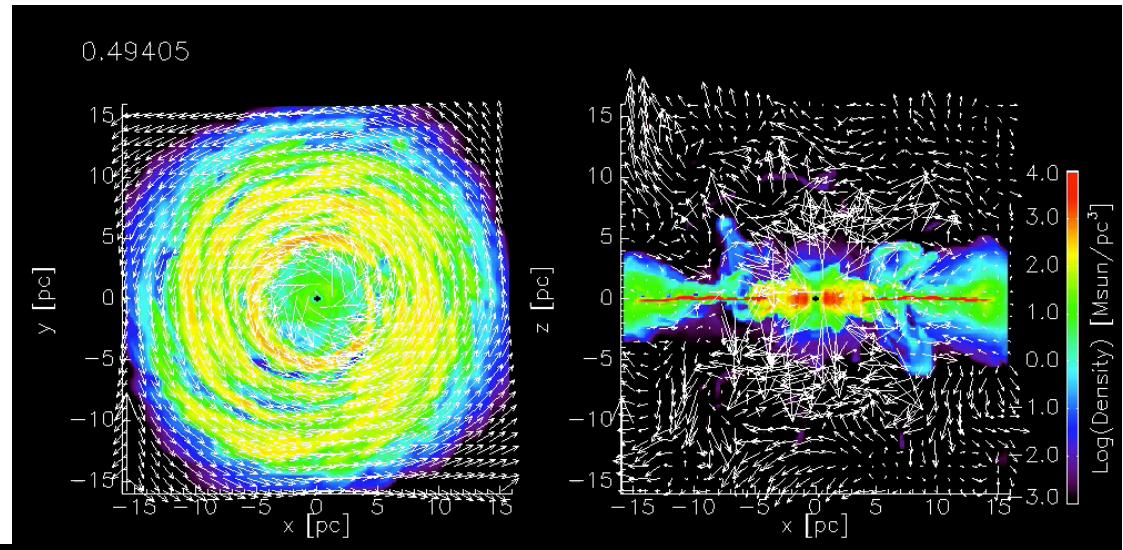
Radiation-driven “fountain” naturally forms a thick disk
Gravitational energy is used to generate turbulence.



$M_{\text{BH}} = 1.3 \times 10^8 M_{\text{sun}}$

ER = 0.5

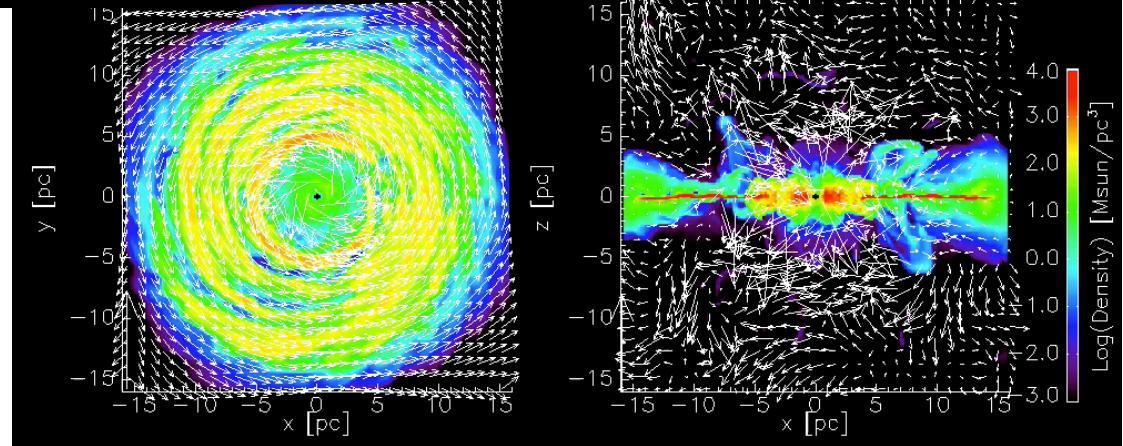
outflow => cavity



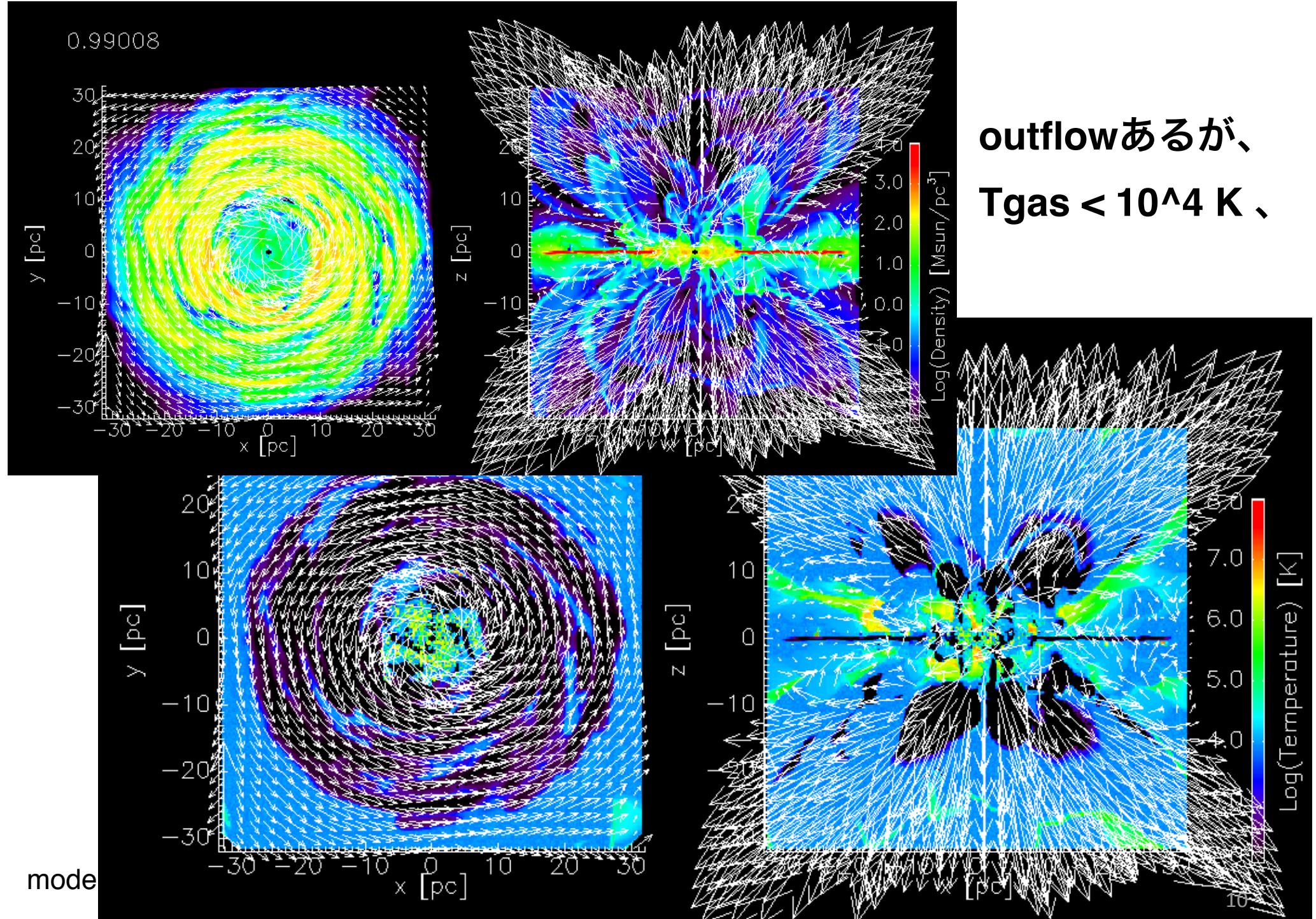
ER = 0.3

outflow => torus

ER = 0.2
stalled wind

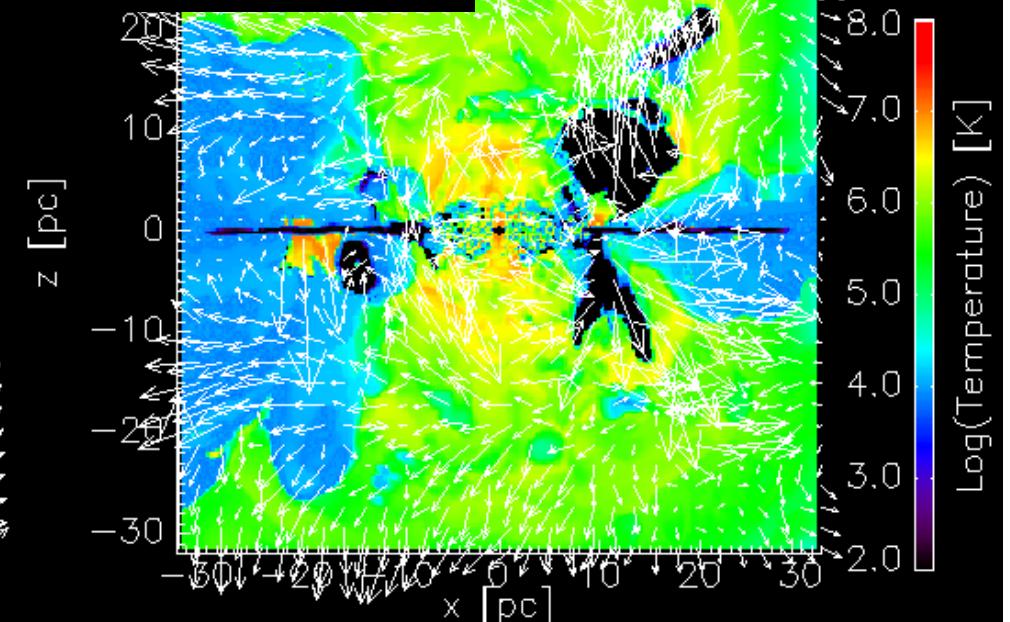
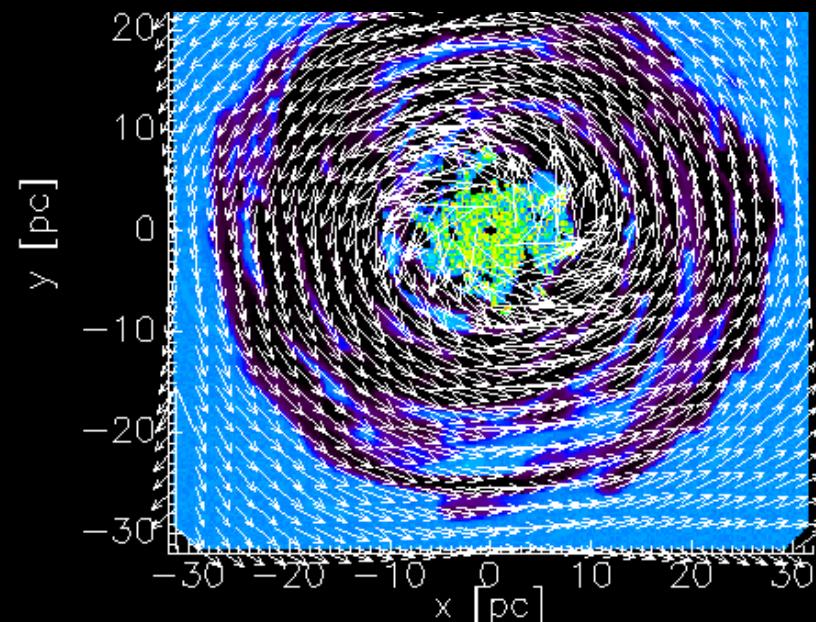
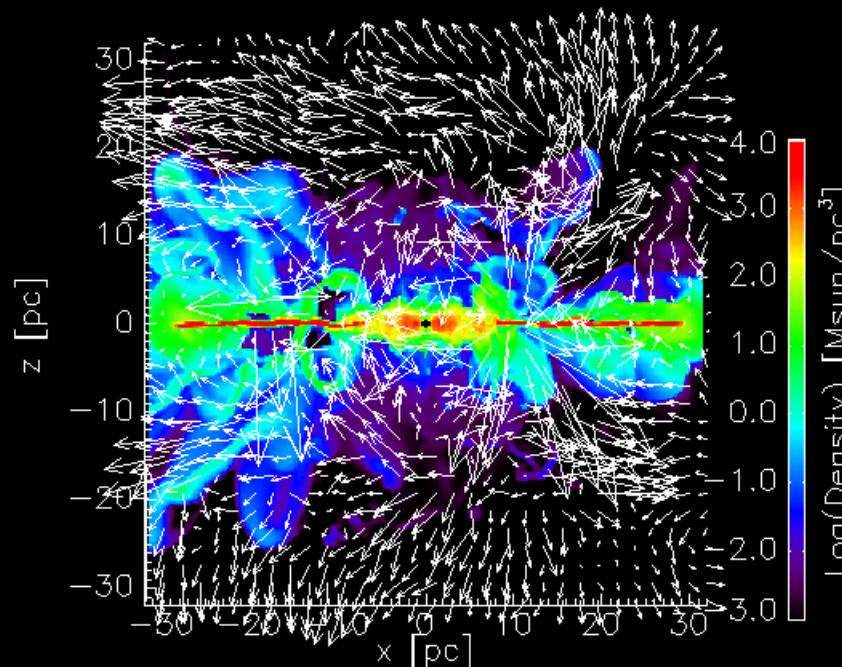
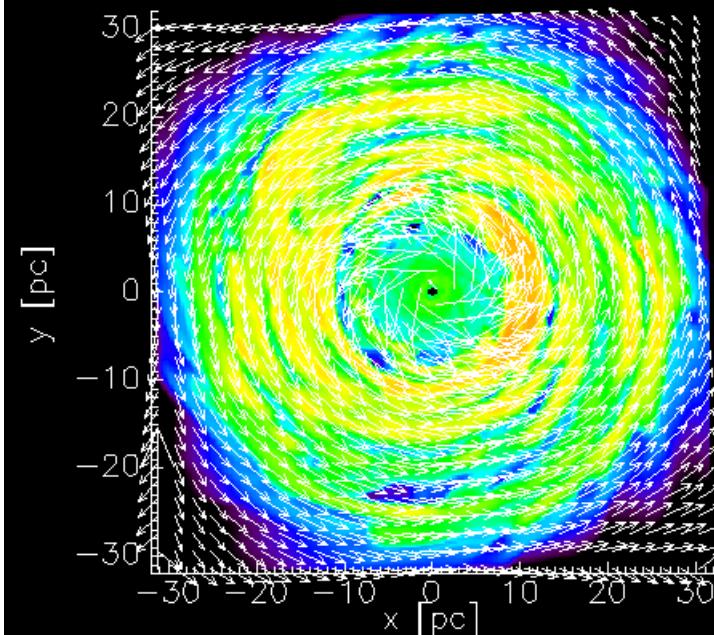


ER = 0.3, radiation pressureのみ



ER = 0.3, X-ray heatingのみ

0.98608

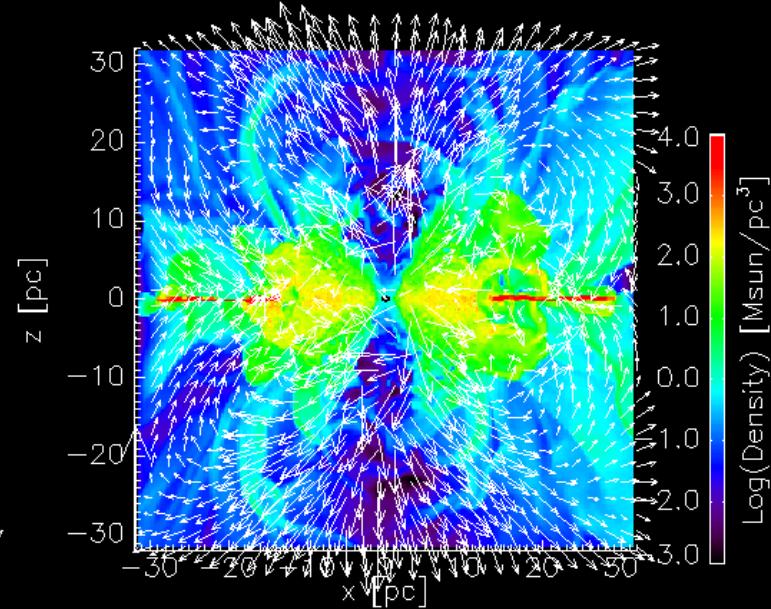
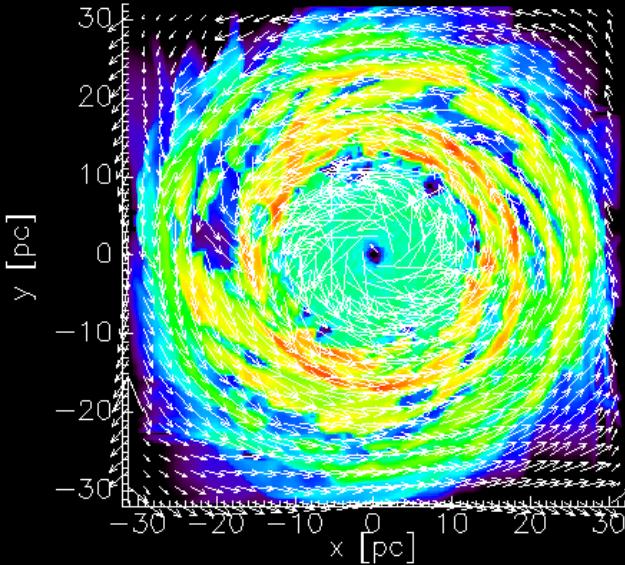


model vf:

Tgas $\sim 10^6$ K、
強いoutflowなし

Thick torus を作るには放射圧のみでは不十分

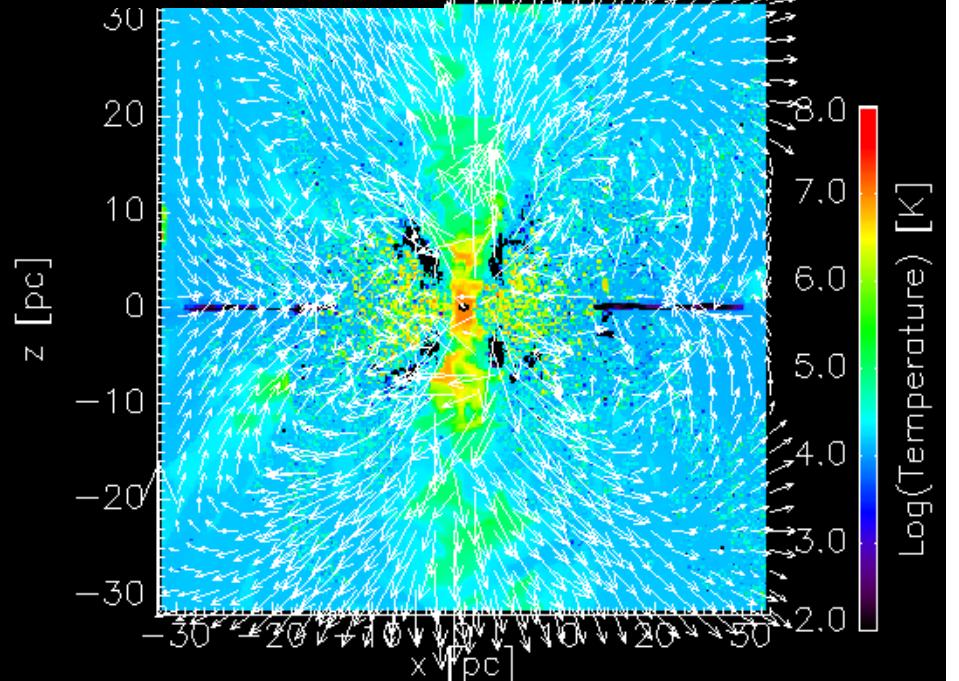
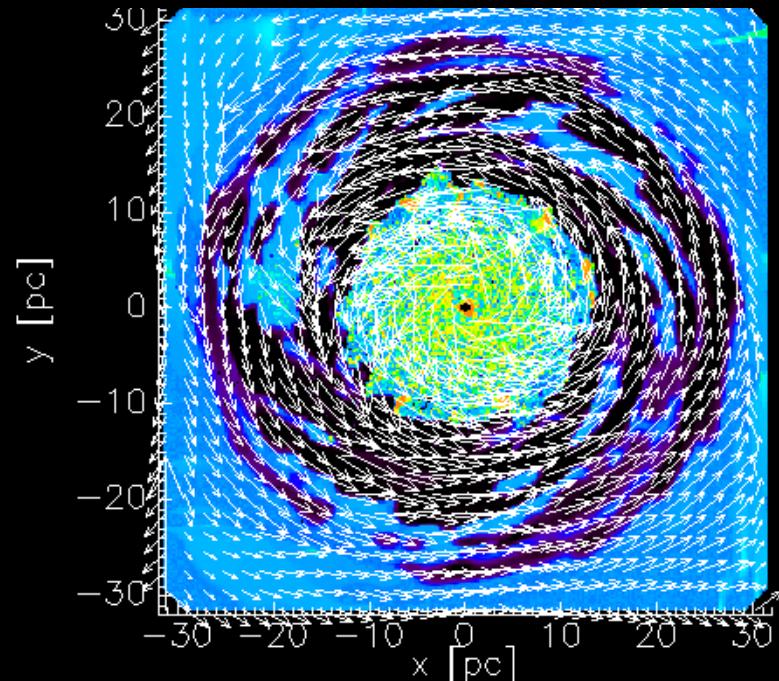
0.99008



ER = 0.3

温度

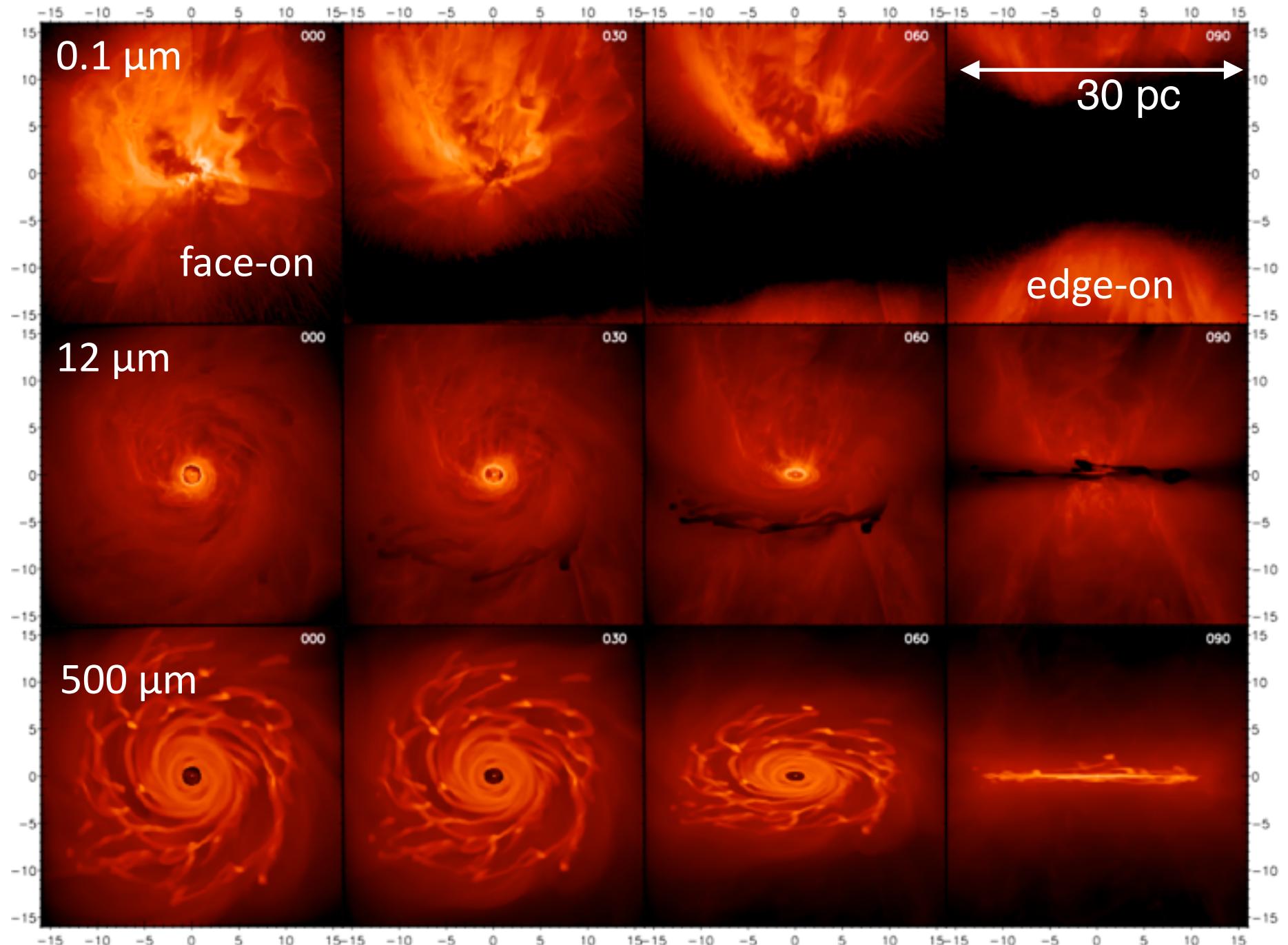
密度



model ve:

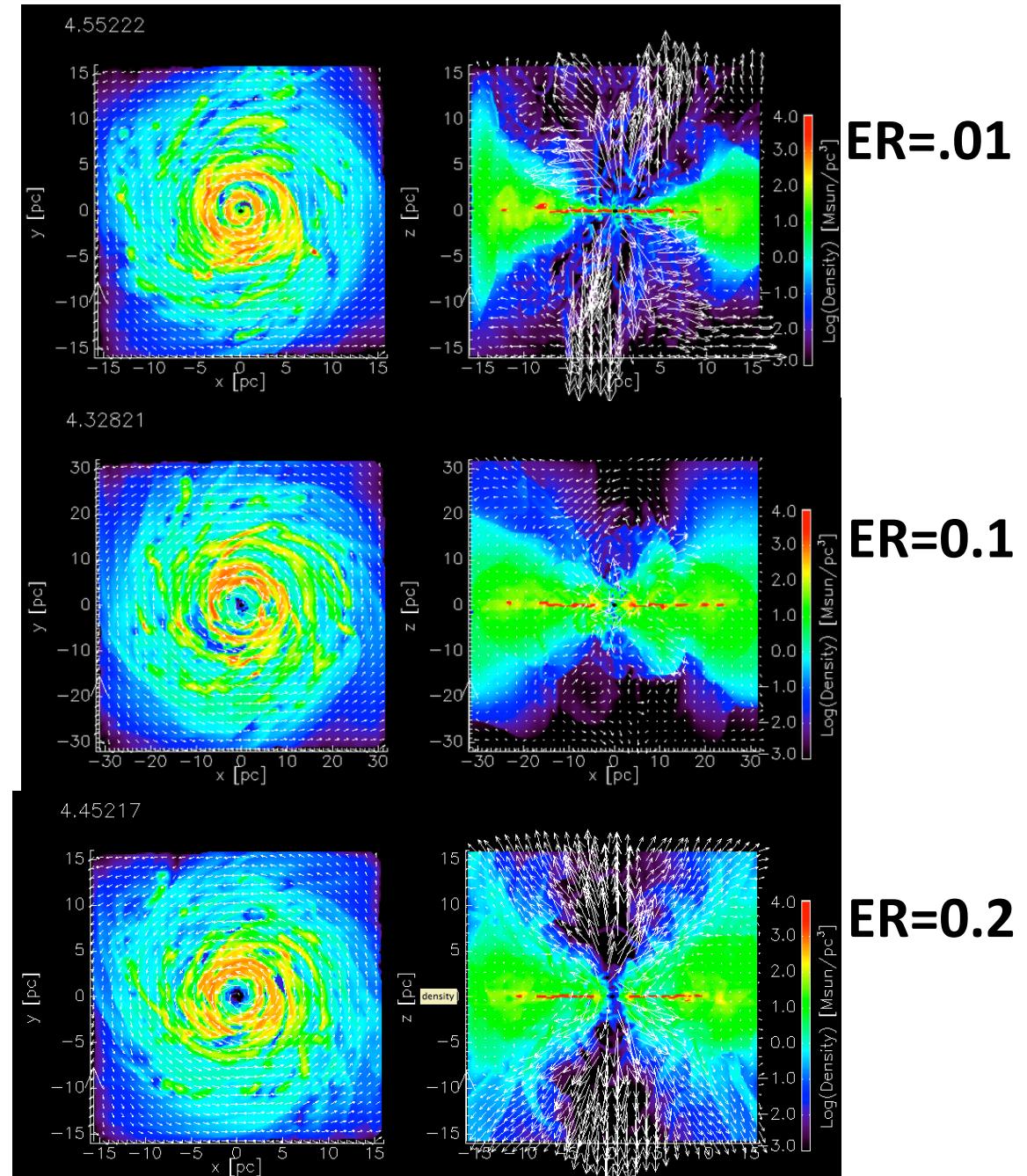
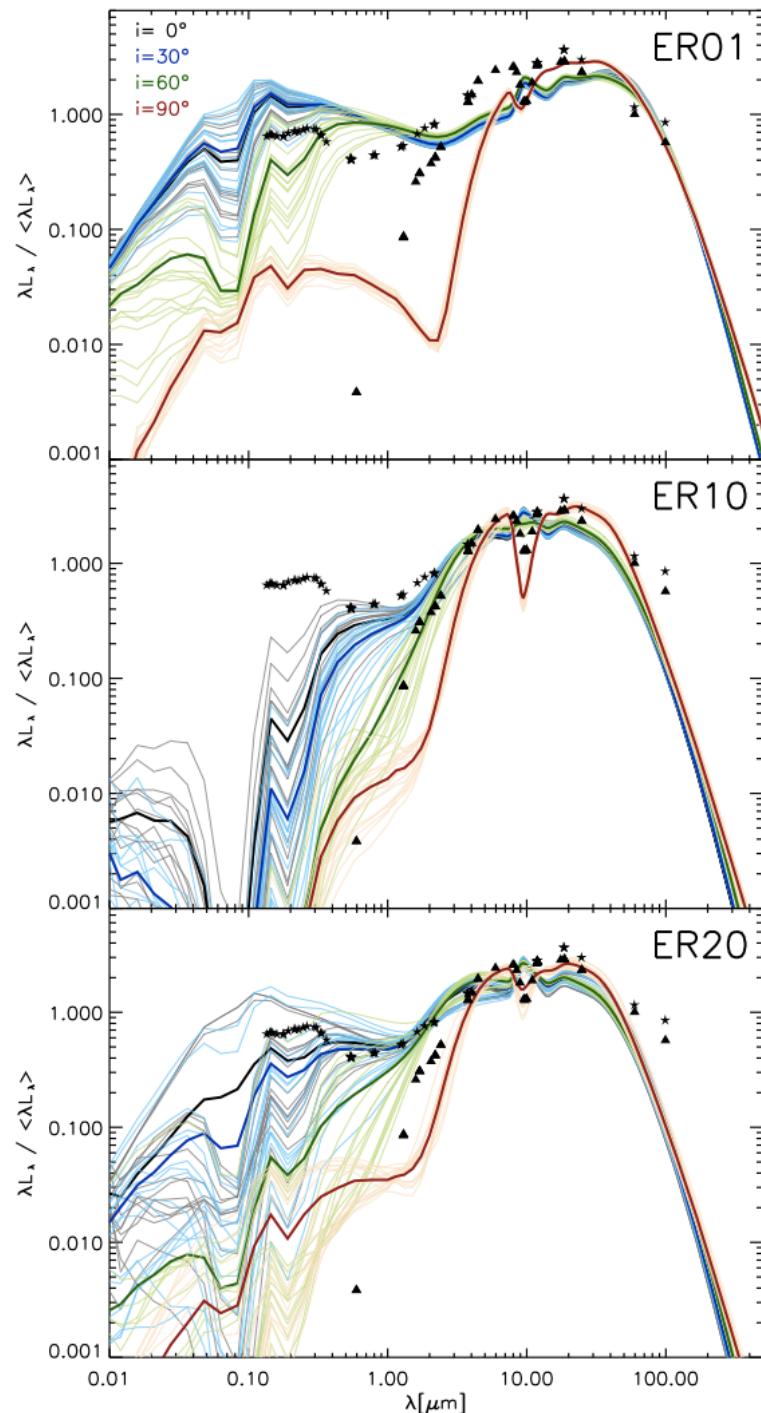
赤外放射でみるAGN (3D Monte Carlo計算)

Schartmann&Wada, in prep.



タイプ1,2 SEDを再現、 $10\mu\text{m}$ featureも。ER ~ 0.2 ($M_{\text{BH}} = 10^8 M_{\text{sun}}$)

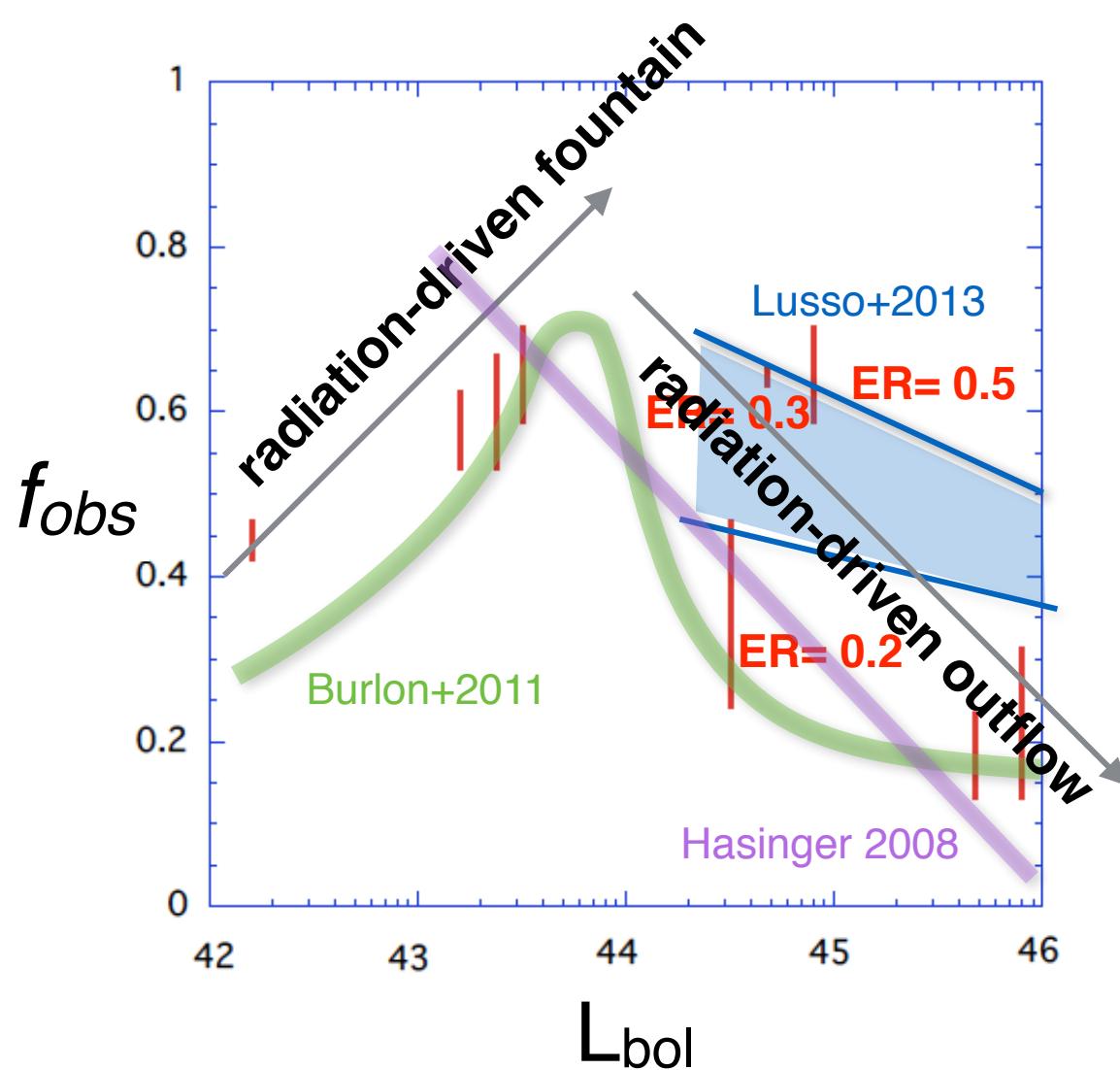
Comparison to Type1/2 template: Prieto+2010



Schartmann, Wada in prep.

obscuring fraction vs. L_{bol} , M_{BH}

$N_H > 10^{23} \text{ cm}^{-2}$ に対して



obscuring fraction :
 $L \sim 10^{44} \text{ erg/s}$ をピークに 高光度、低高度側で減少
⇒ 定性的には観測と
consistent

まとめと課題

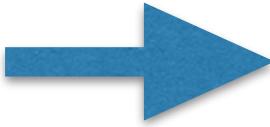
"obscuration" or type-1/2のために

(clumpy)トーラスを"仮定"する必要はない。

AD起源の非等方輻射場とガスがあればよい

- typical SEDをclumpy torusとか導入しなくても説明できる

利点

- 
- $f_{\text{obs}} (L_{\text{AGN}})$ を receding torus modelとか導入しなくても説明できる。

- bipolar outflow, 極方向からのdust emission など

- NLR, molecular out flowは再現されるのか？

- 
- accretion rateに応じた非定常な L_{AGN} の場合？

- z依存性？