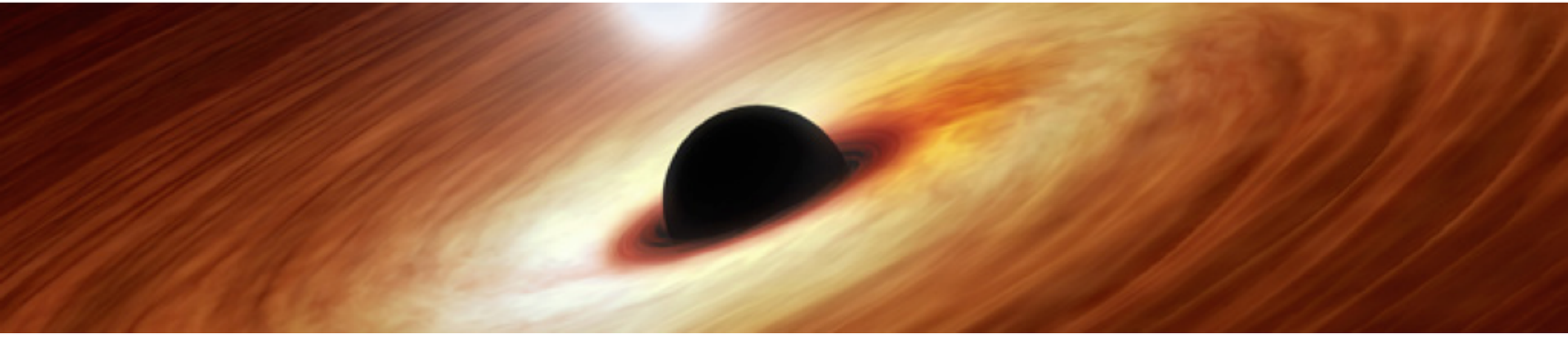
East-Asia AGN Workshop 2016

22-24 September 2016, Seoul National University, Seoul, Korea

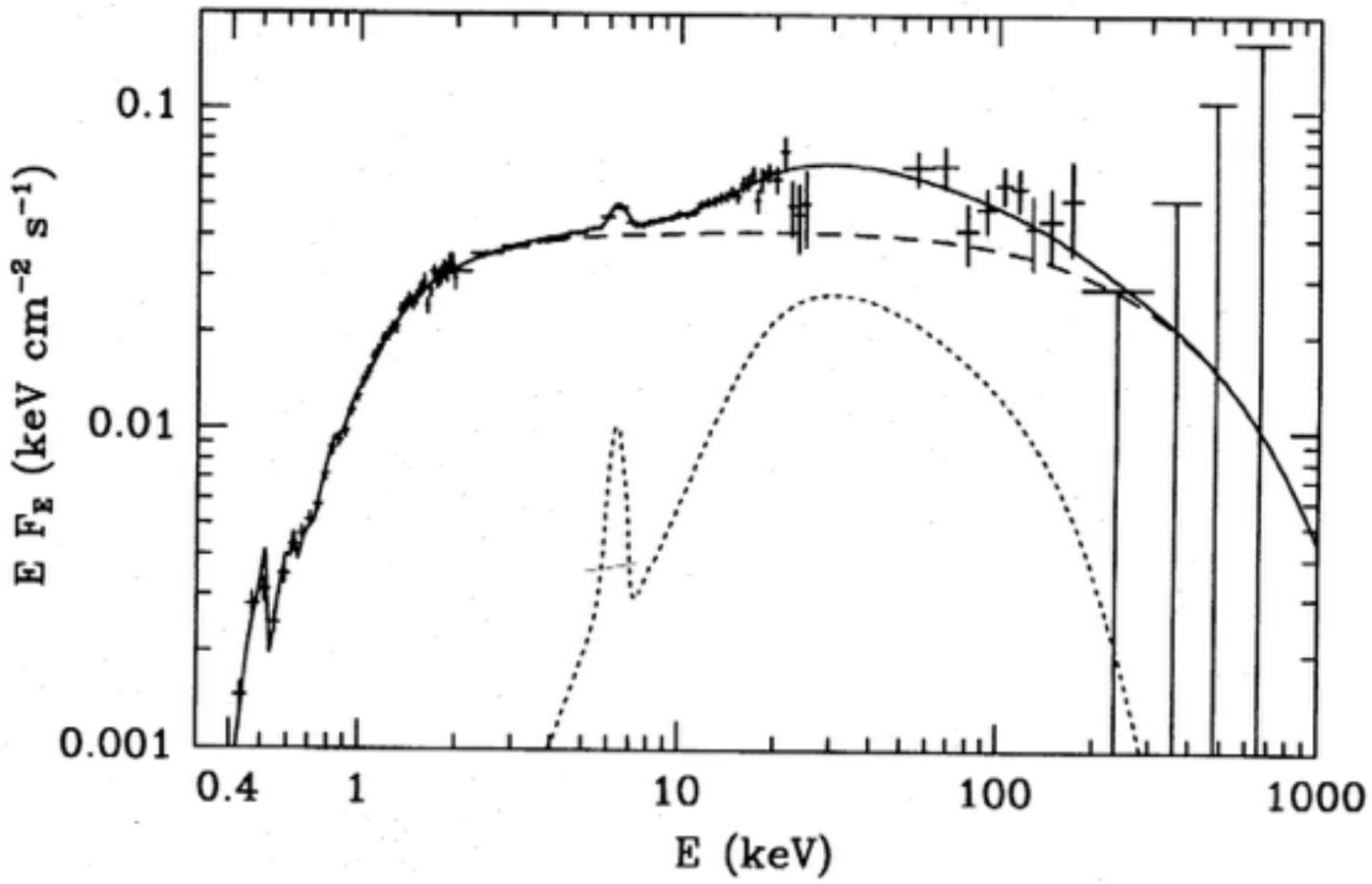
The condensation of the corona for the Γ-R correlation in active galactic nuclei



ErLin Qiao
NAOC

Seoul, Korea, Sep 22, 2016

X-ray spectrum of Seyfert I,
IC 4329A



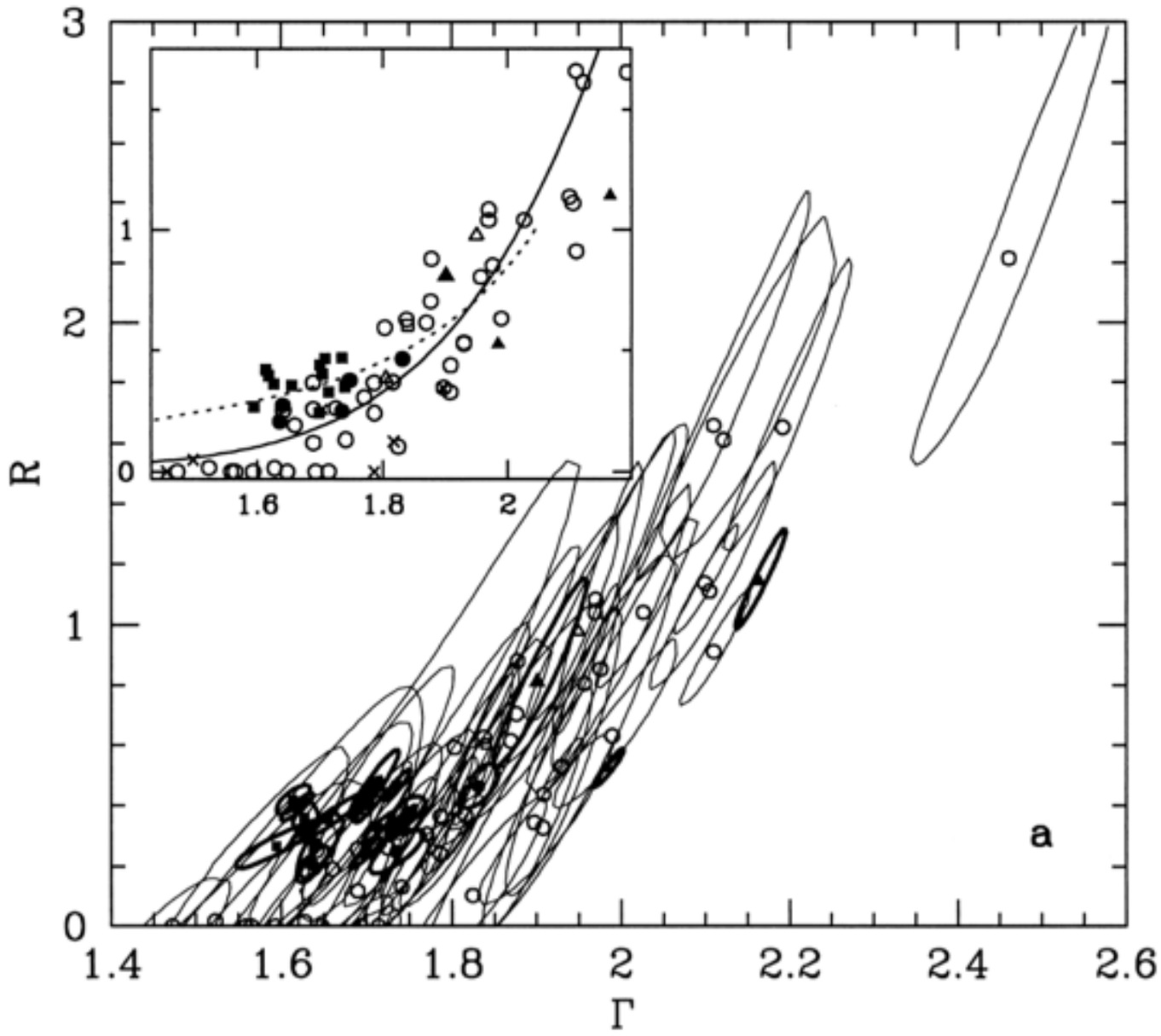
ROSAT, Ginga, OSSE

- **Hard X-ray photon index Γ**
- **R = Ω/2π**

θ=30° $R = 0.68^{+0.16}_{-0.14}$, $\alpha = 0.96^{+0.03}_{-0.03}$, and $E_c = 410^{+270}_{-120}$ keV.

Magdziarz & Zdziarski 1995

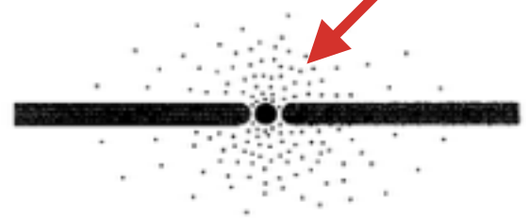
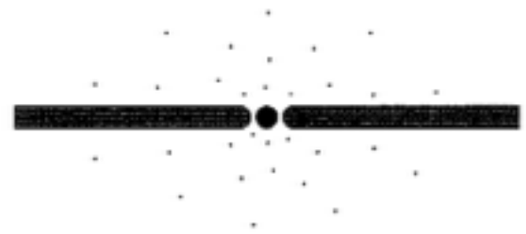
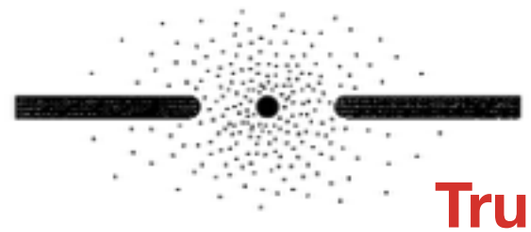
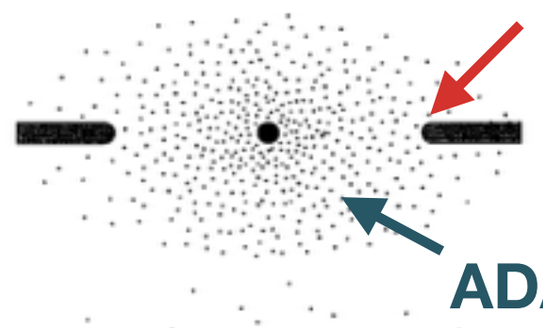
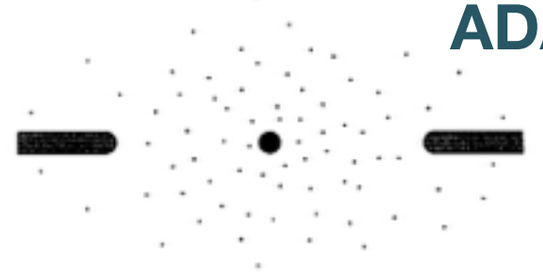
Γ-R correlation in AGNs



47 data sets for
23 RQ AGNs

Zdziarski et al. 1999

Where is the X-ray emission from for AGNs?

AGNs		BHXBs
NLS1s Radio-loud QSOs		very high state
Classical Seyferts Radio-quiet QSOs		high/soft state
Low-Luminosity Seyferts		Intermediate state
LINERs		low/hard state
Nearby galaxies, Sgr A* et al.		quiescent state

Esin et al. 1997
(Black hole X-ray binaries)

- **For the low-luminosity case, the X-ray emission is dominated by ADAF (see review by Yuan & Narayan 2014)**

- **For the high-luminosity case, the X-ray emission is dominated by the hot corona above the disk.**

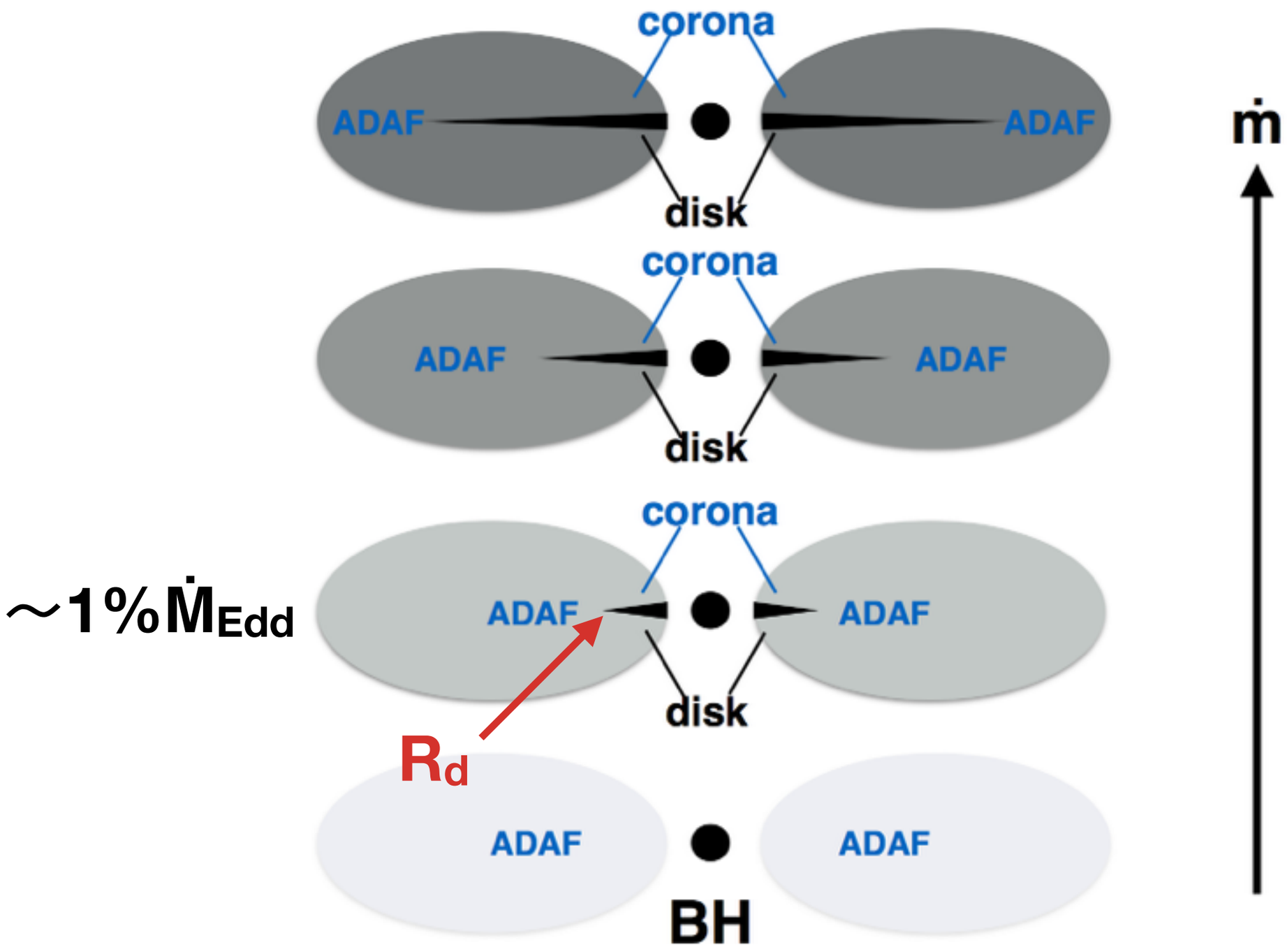
  - Assumed a fraction of the accretion energy dissipated in the hot corona (Haardt & Maraschi 1991, 1993; Svensson & Zdziarski 1994)

  - Due to Parker instability, Magnetic reconnection is invoked (e.g., Galeev et al. 1979; Liu et al. 2002, 2003; Goodman & Uzdensky 2008)

- **Some Numerical simulations have been done, However, It is still unclear for the formation of the corona, especially for radiation-pressure dominated case in AGNs (Uzdensky et al. 2013; Jiang et al. 2014 (less than 3.4%))**

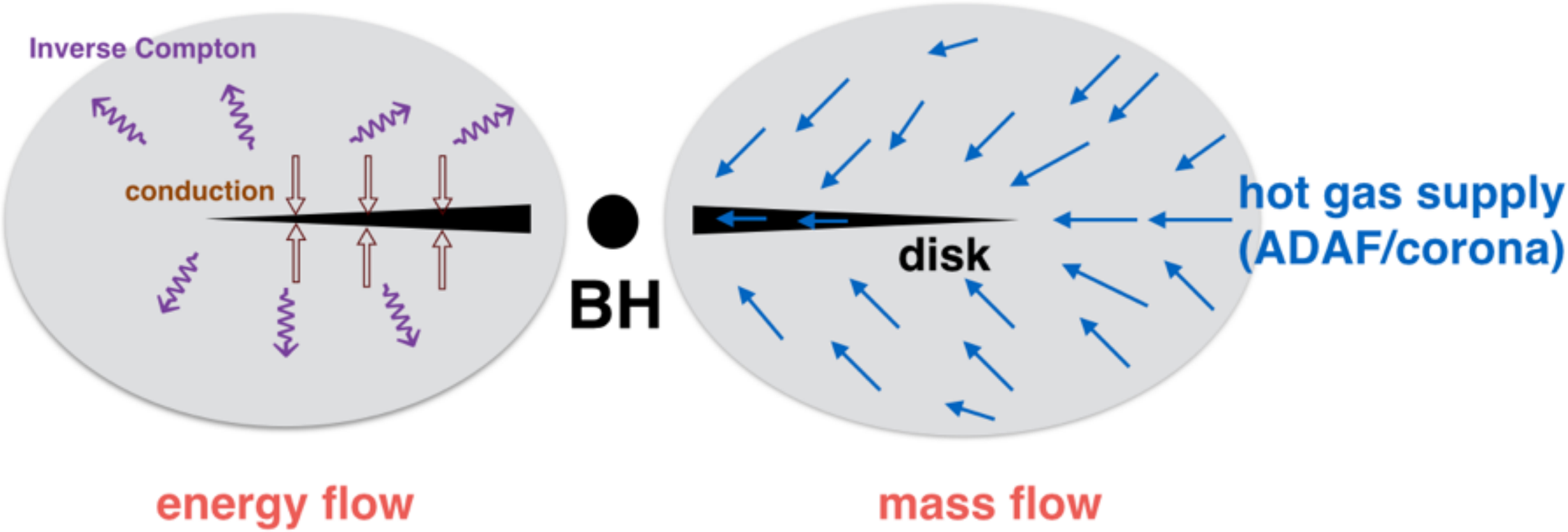
- **We suggested that the initial condition of the fuel gas is important for the X-ray emission for the luminous AGNs** (Liu, Taam, Qiao & Yuan 2015, ApJ, 806, 223).

- **So our picture is as follows,**



$\sim 1\% \dot{M}_{Edd}$

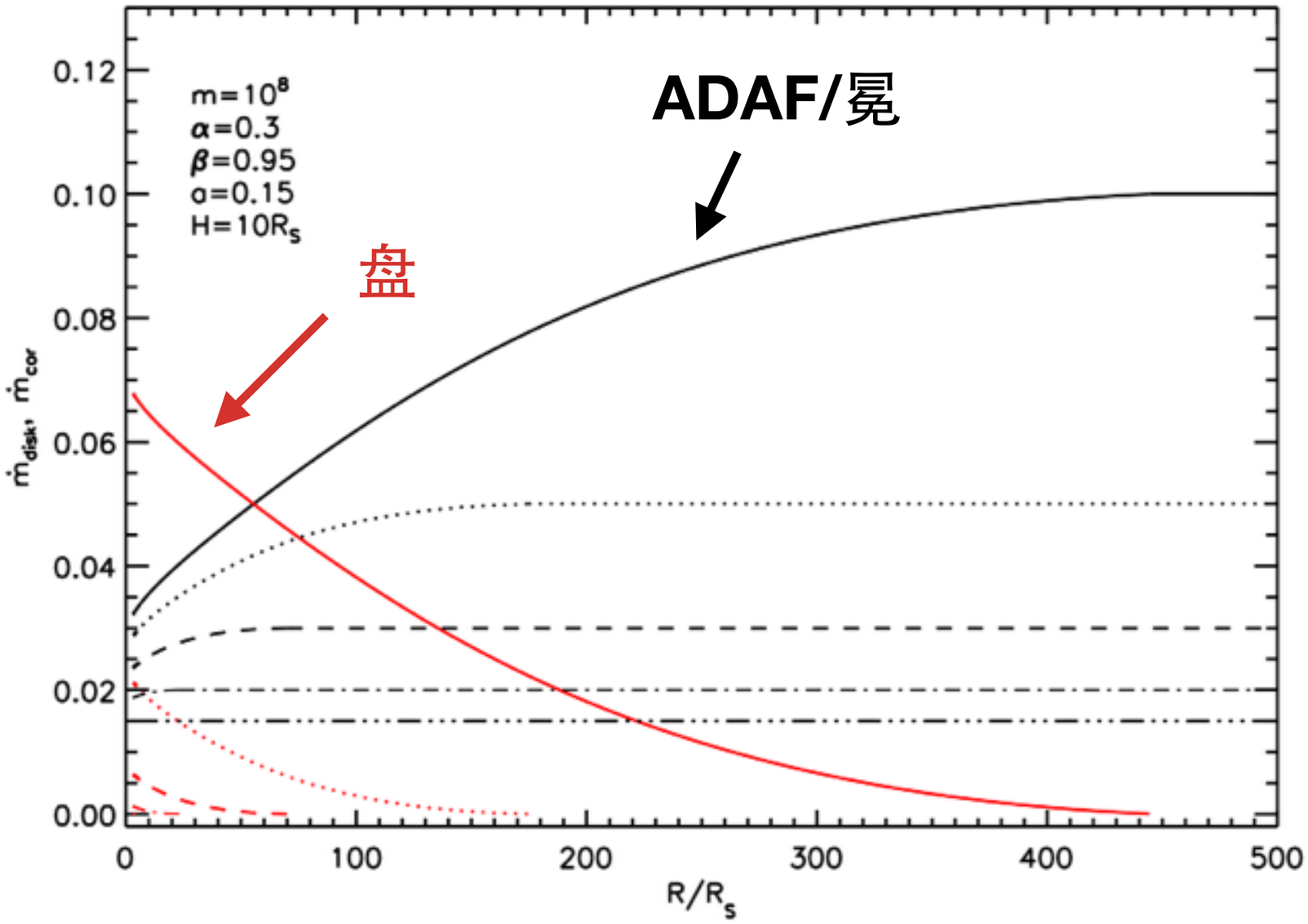
Condensation of ADAF/corona in AGNs



Qiao & Liu 2013, ApJ, 764, 2 (BHXBs)

Liu, Taam, Qiao & Yuan 2015, ApJ, 806, 223 (AGNs)

- **Theoretical Results:**
- 吸积物质分布图



输入参数:

$m=10^8$

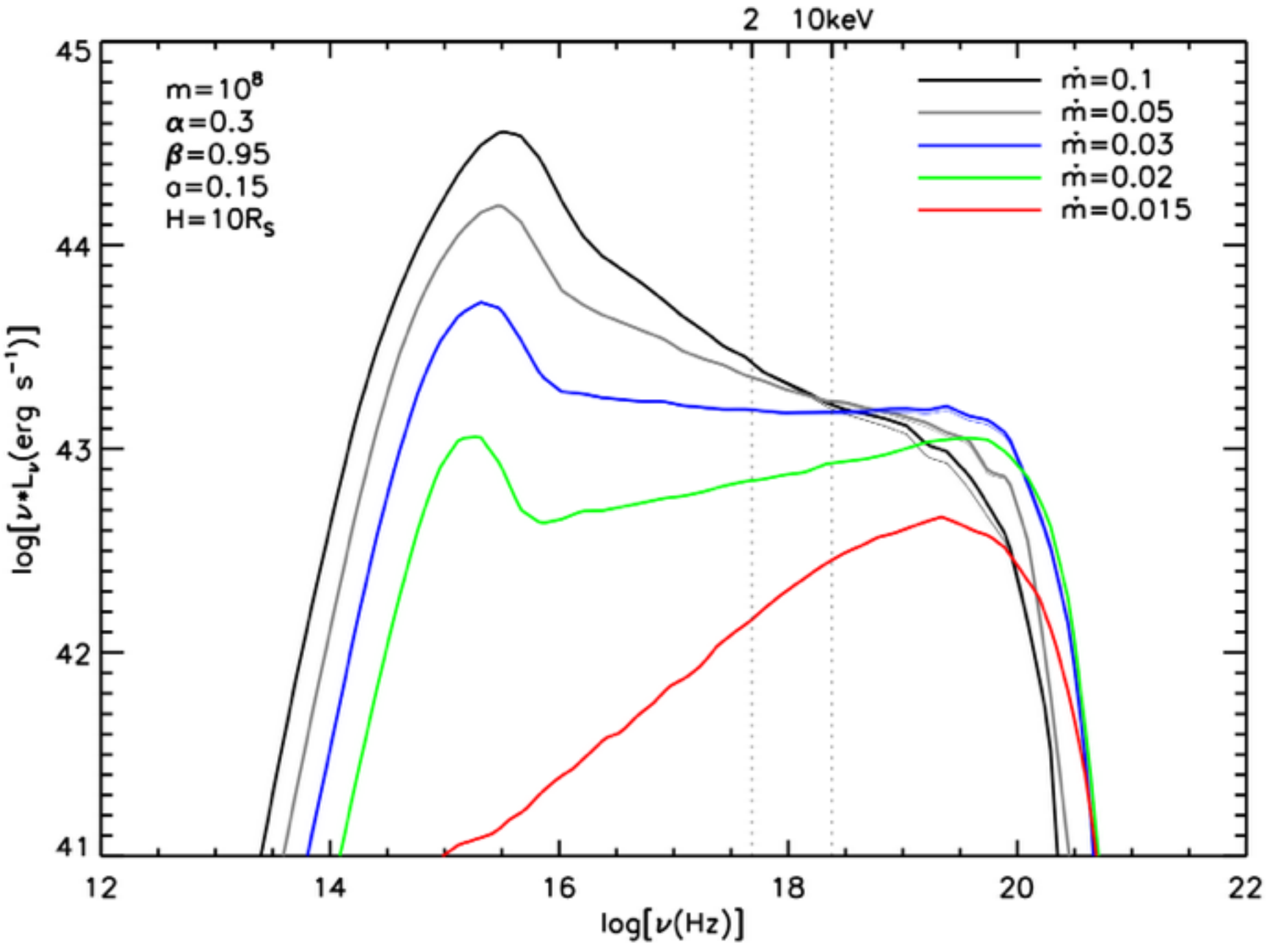
$\alpha=0.3$

$\beta=0.95$

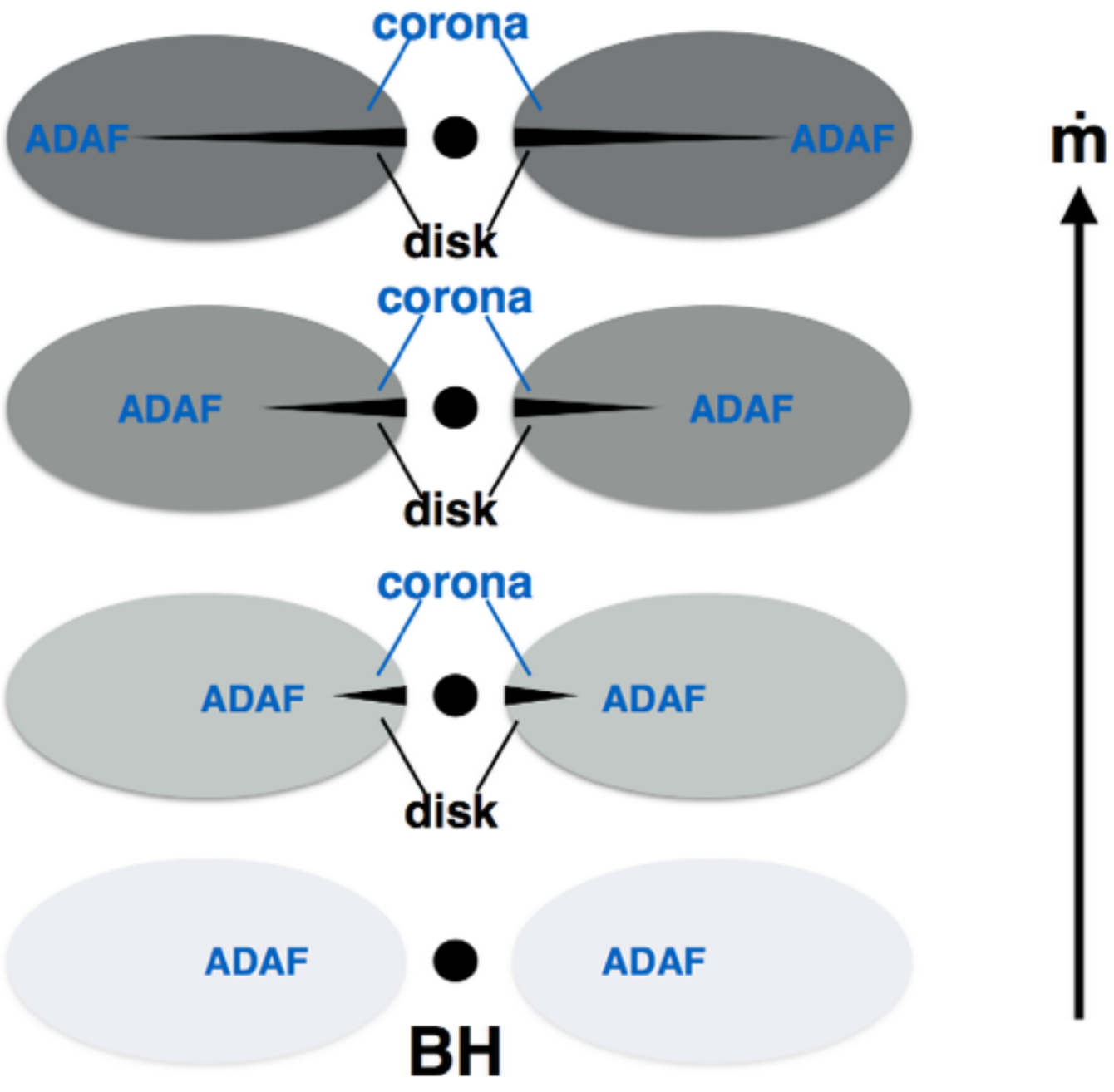
$a=0.15$

$H_s=10R_s$

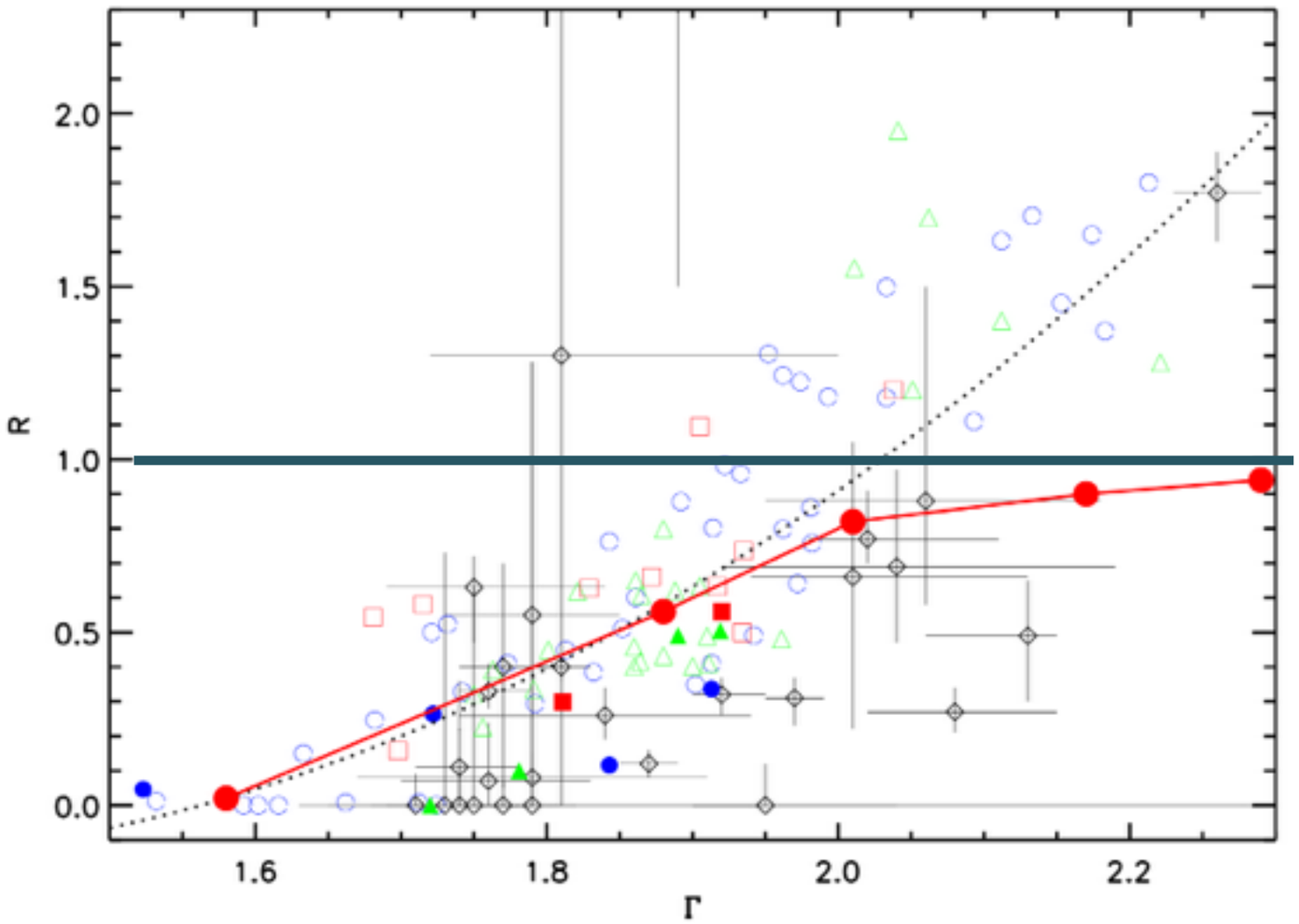
From the spectra, we can get Γ



From the geometry, we can get **R (R=Ω/2π)**



- **Comparing with observations:**



Qiao et al. 2016 Prep.

- Including Ginga, RXTE, BeppoSAX obaervations RQ 和 RL AGNs!
Zdziarski et al. 2003

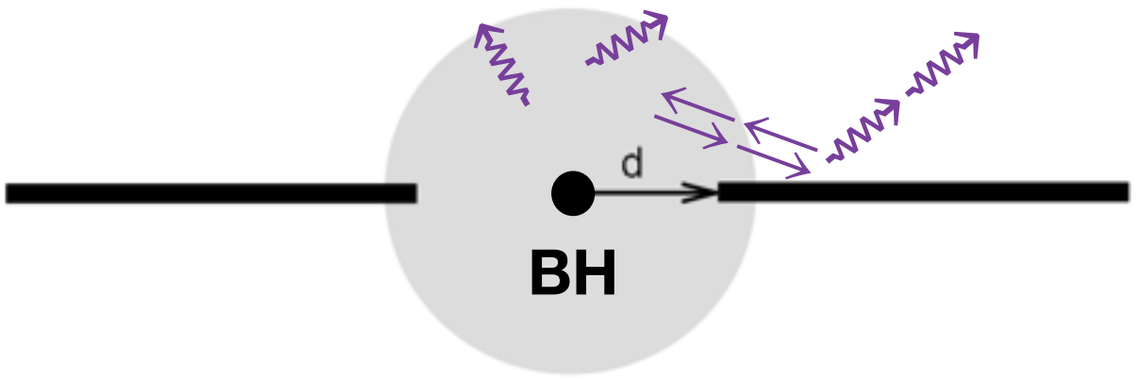
- Including 28 bright Seyfert galaxies (INTETRAL, XMM, Suzaku, RXTE)
Lubinski et al. 2016

- **Red dots are theoretical results**

Can explain R<1 ,
Can not explain R>1

- **Discussions**
  - **The disk-spheroid model**
  - **Plasma ejection model**
  - **… …**
  - **Applying our model to high mass X-ray binaries (wind accretion)**?
  - **We should collect further observational evidence to support our model**

The disk-spheroid model:



Zdziarski et al. 1999

R can be calculated directly from the geometry

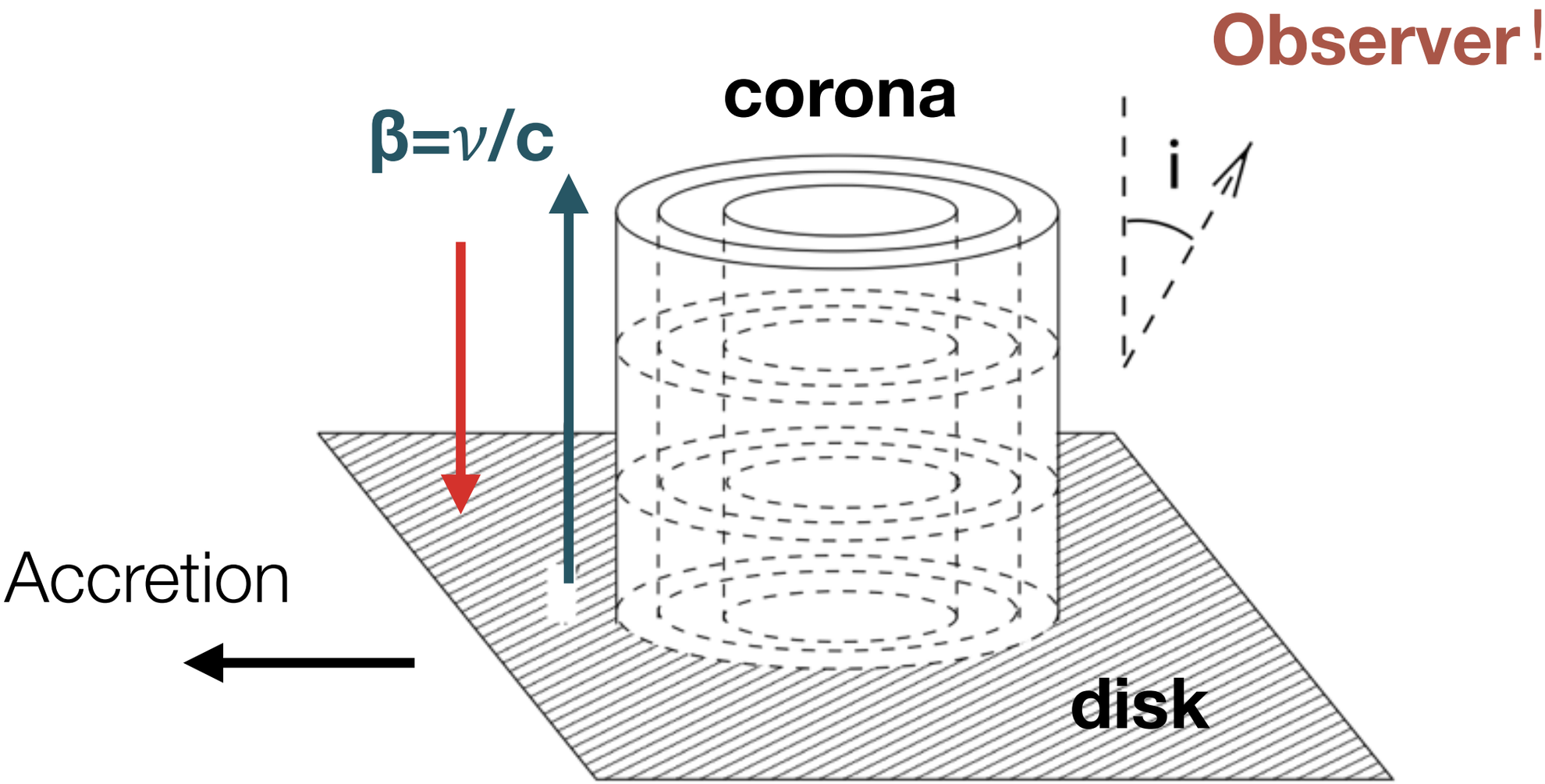
$$\Gamma \approx 2.33(A-1)^{-\delta}$$

$A=L_{cor}(d)/L_s(d)$

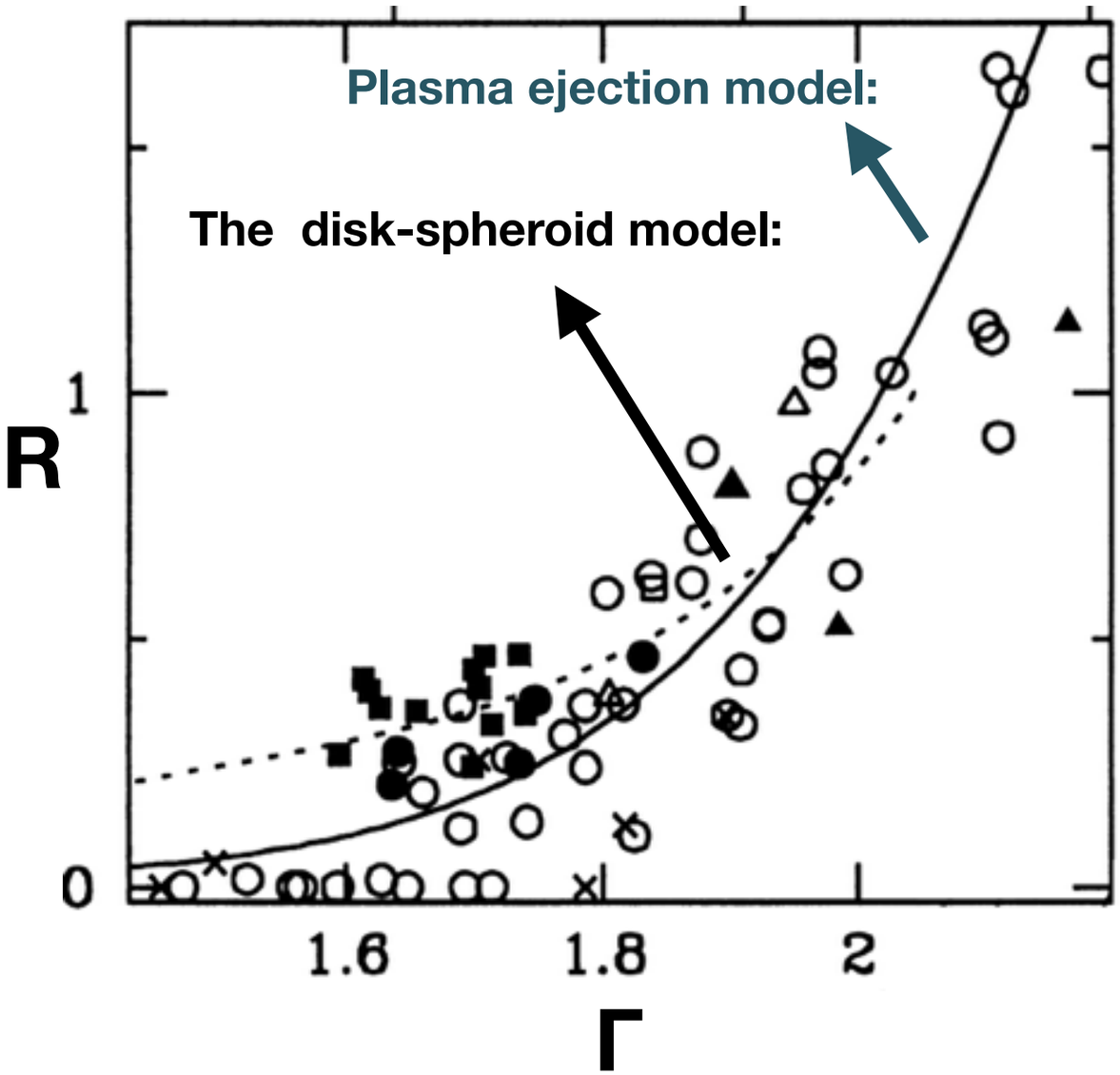
$\delta=1/6$ for BHXBs
$\delta=1/10$ for AGNs

Very simple model, do not consider the detailed physics!

Plasma ejection model:



Beloborodov 1999; Malzac et al. 2001



Although the two models can roughly explain the observations,
We need more physical models!

Thanks!