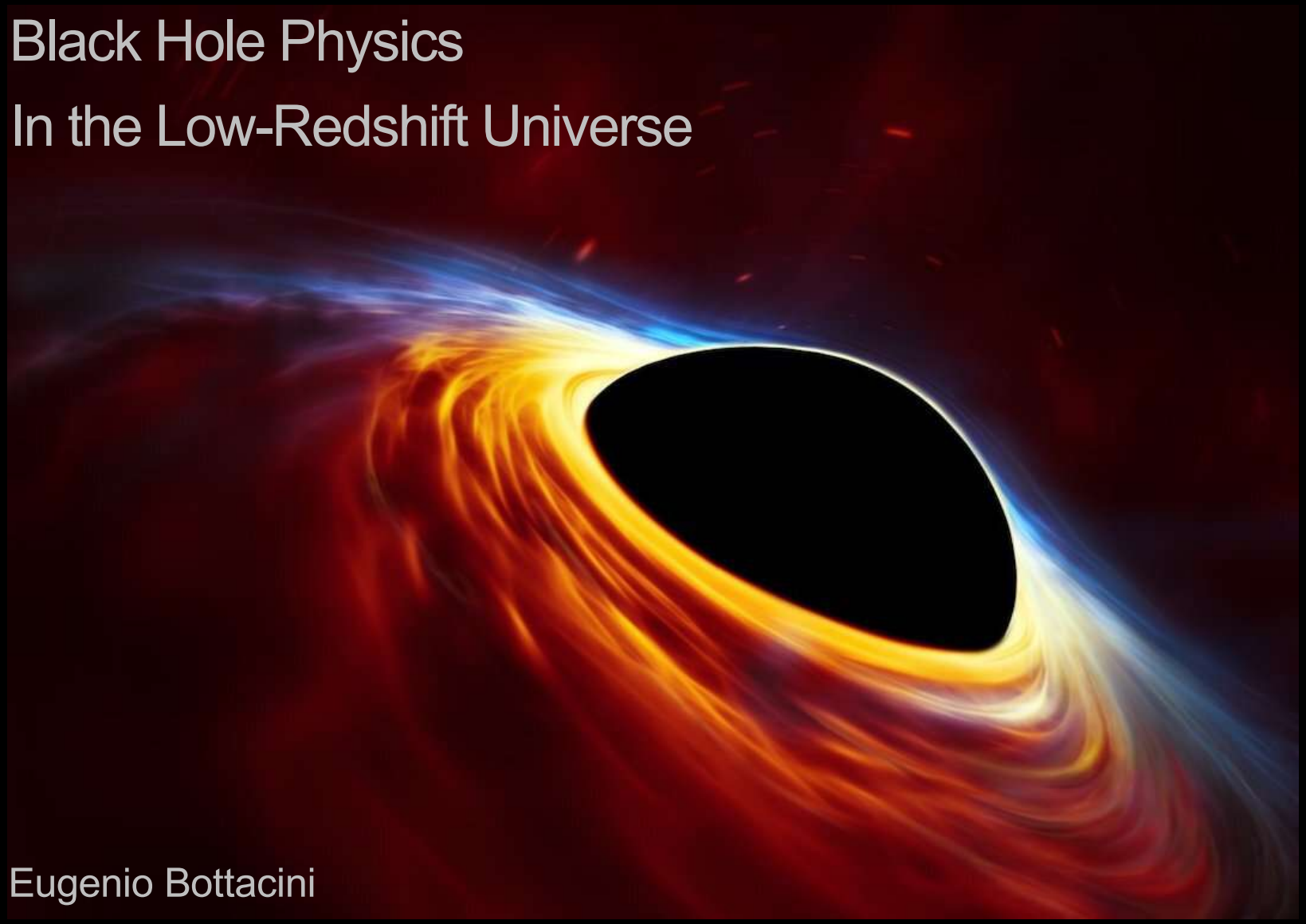
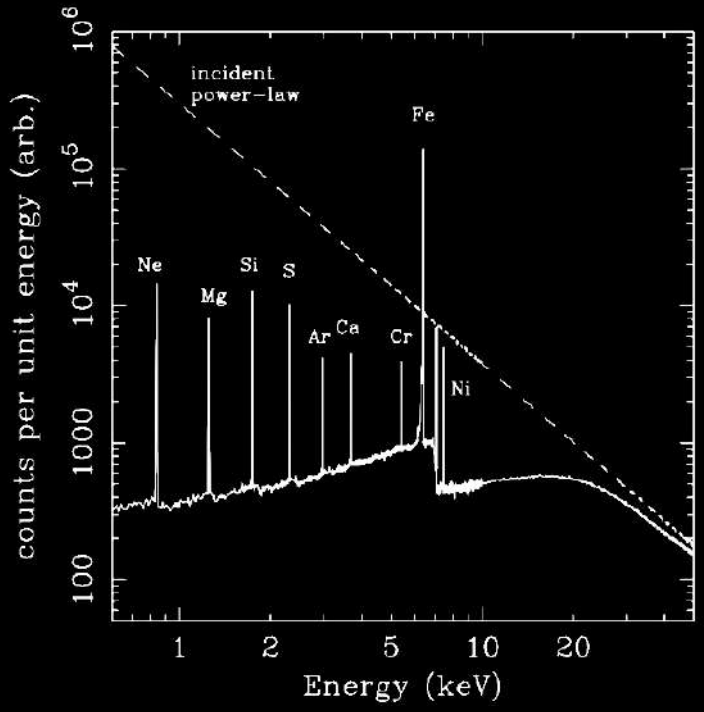
Black Hole Physics
In the Low-Redshift Universe

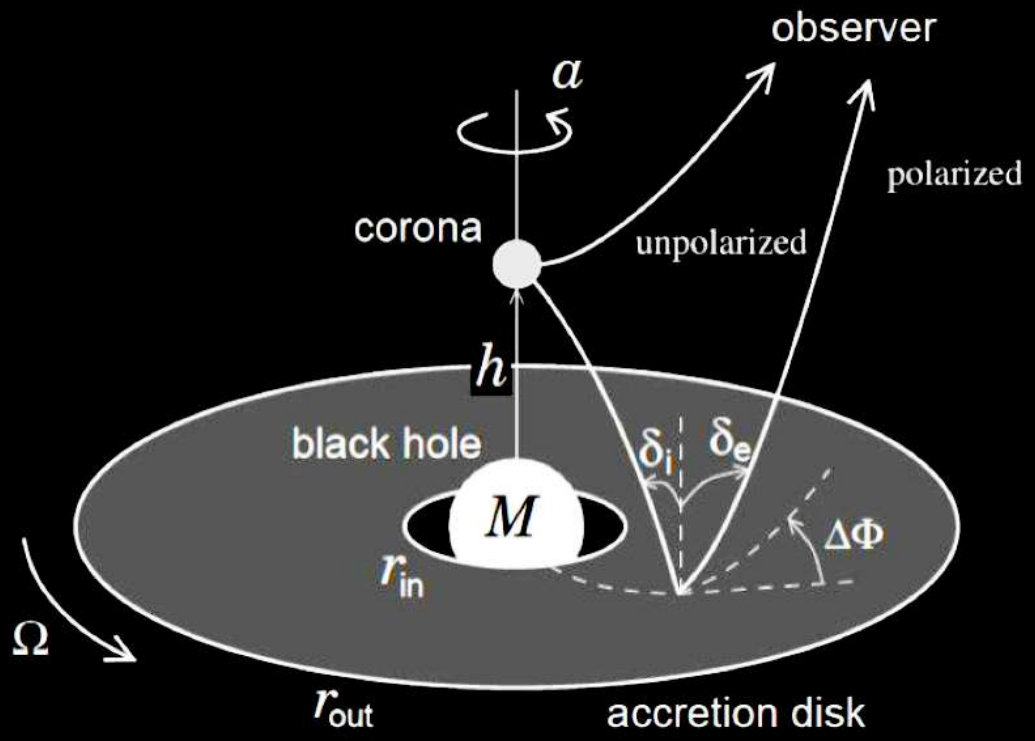


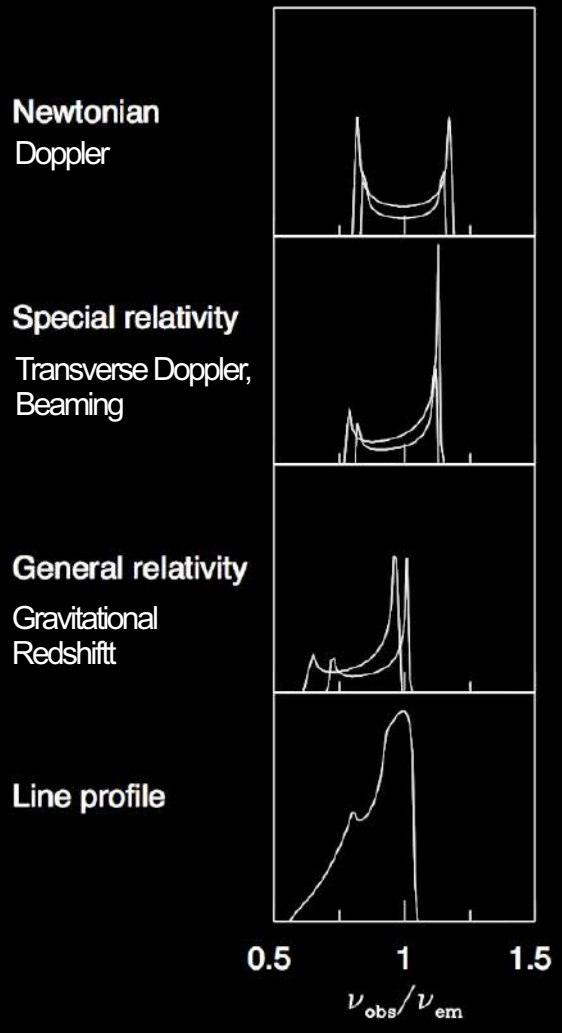
Eugenio Bottacini

Image Credit: ESO, ESA/Hubble, M. Kommesser

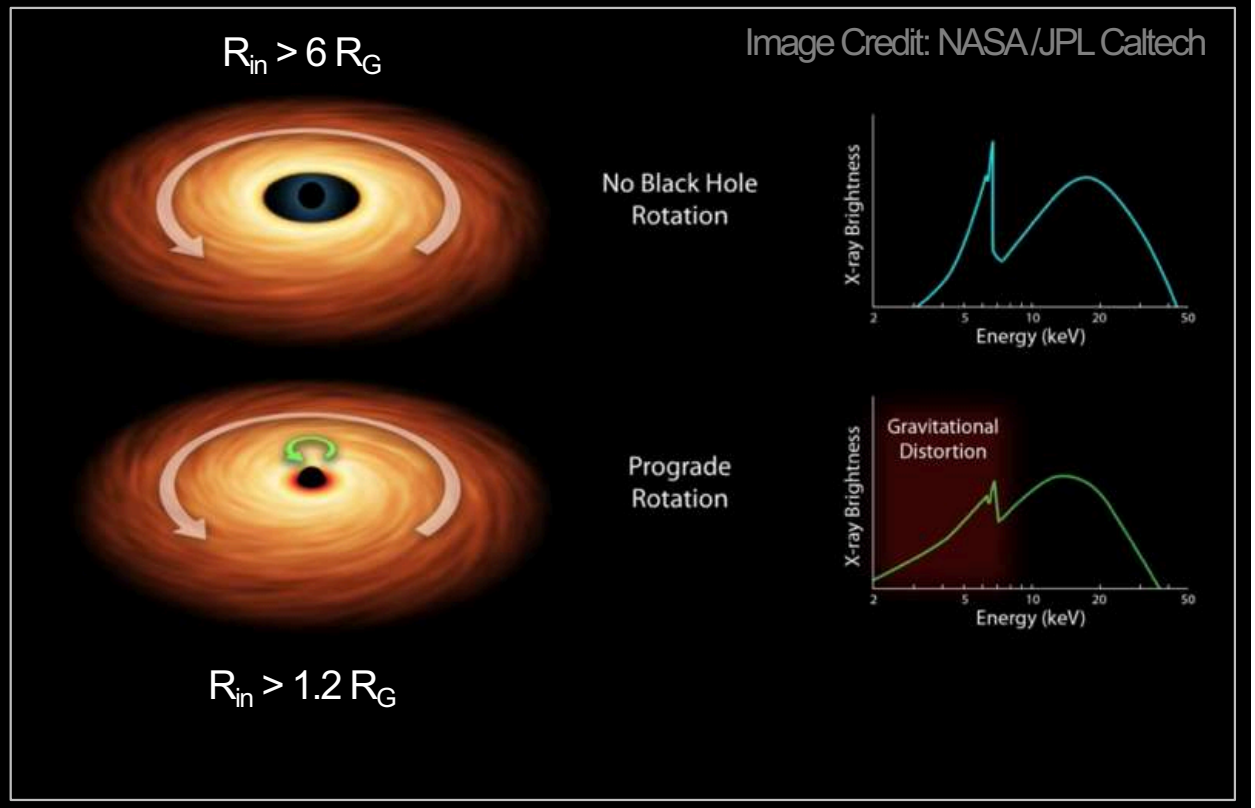

counts per unit energy (arb.)
incident
power-law
Fe
Ne
Mg
Si
S
Ar
Ca
Cr
Ni
Energy (keV)

Fabian (1998)


observer
a
polarized
corona
unpolarized
h
black hole
δi
δe
M
ΔΦ
rin
Ω
rout
accretion disk



Fabian (2000)

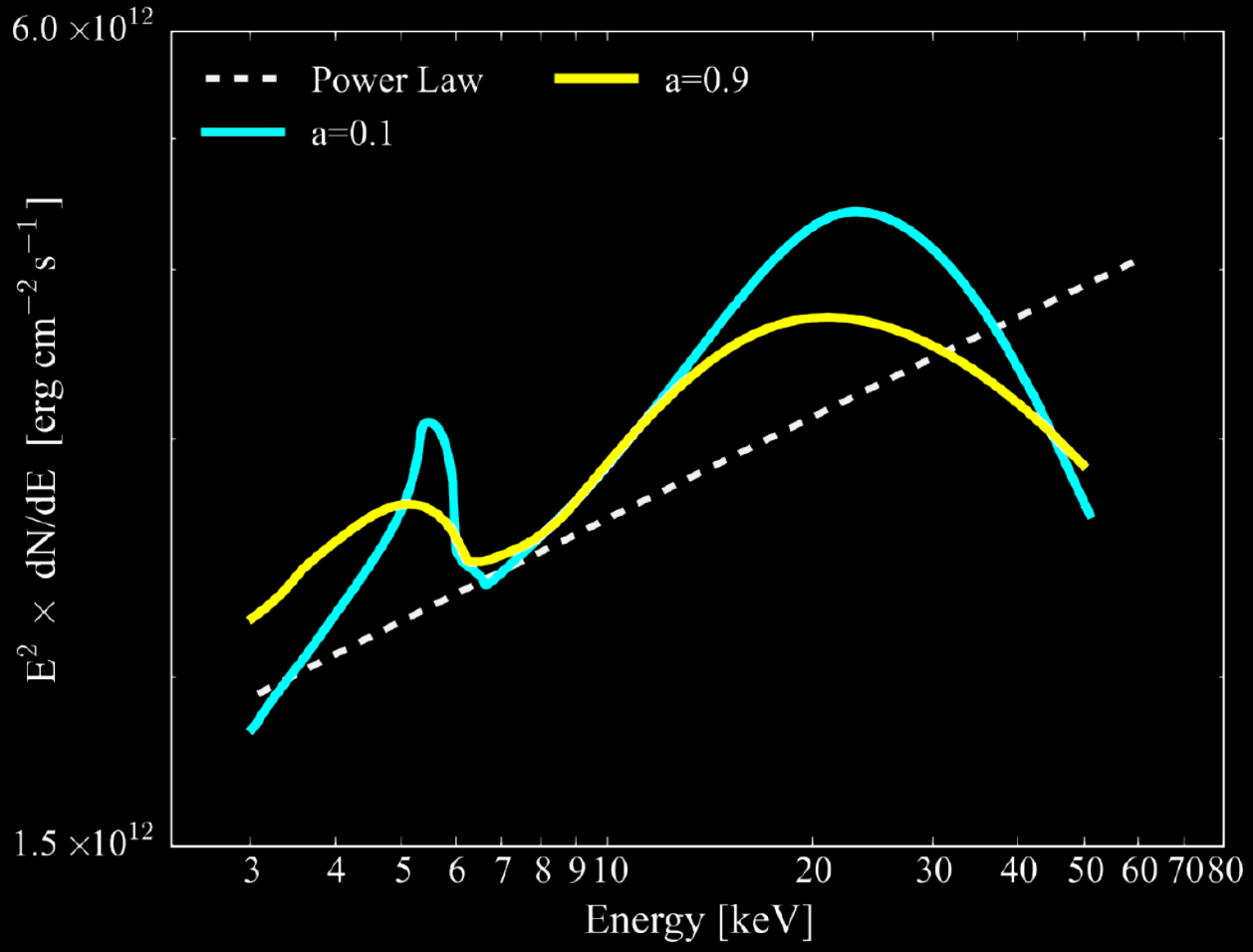


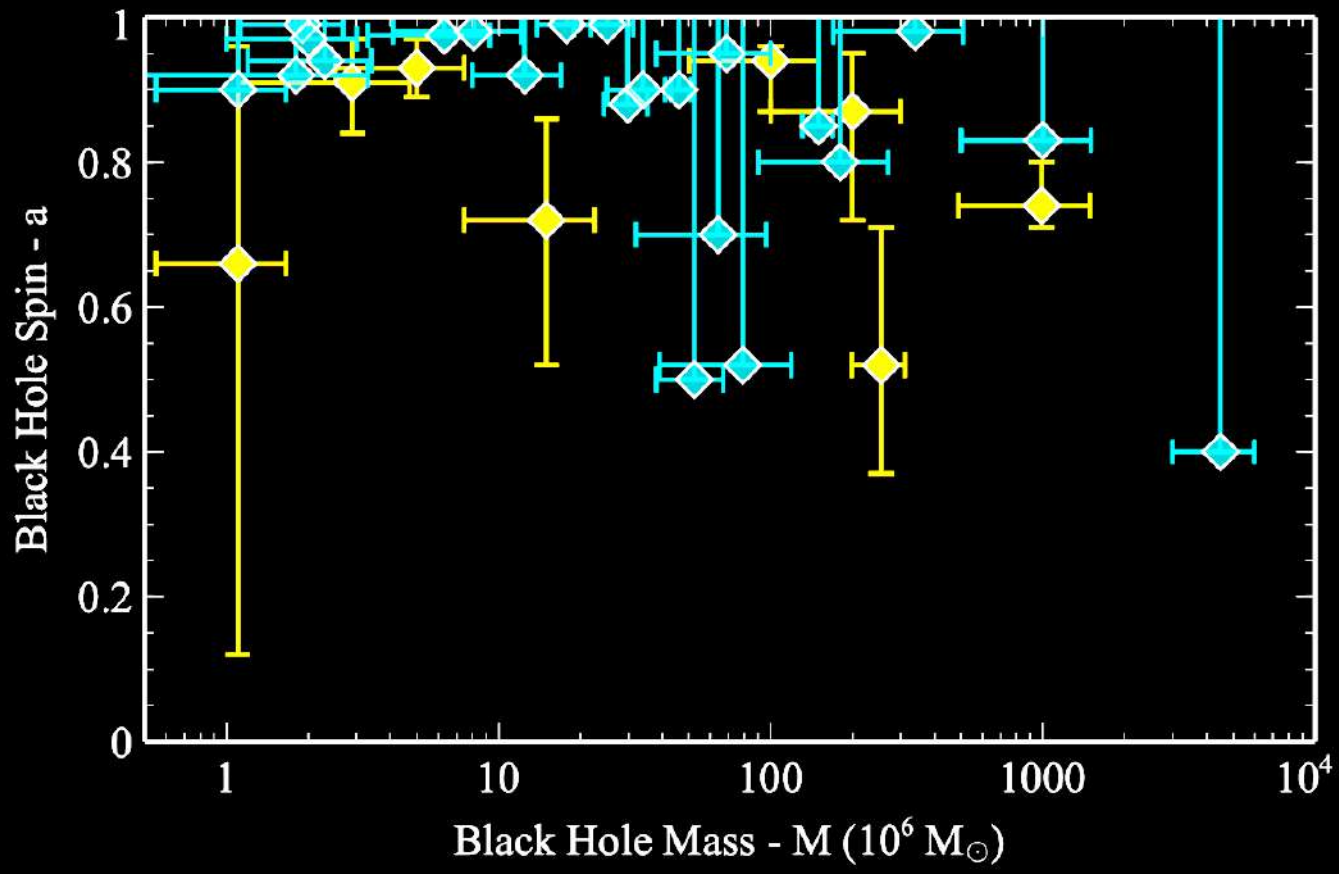
$$L_{acc} = \eta \dot{M} c^2$$

η ↑ a (spin) ↑

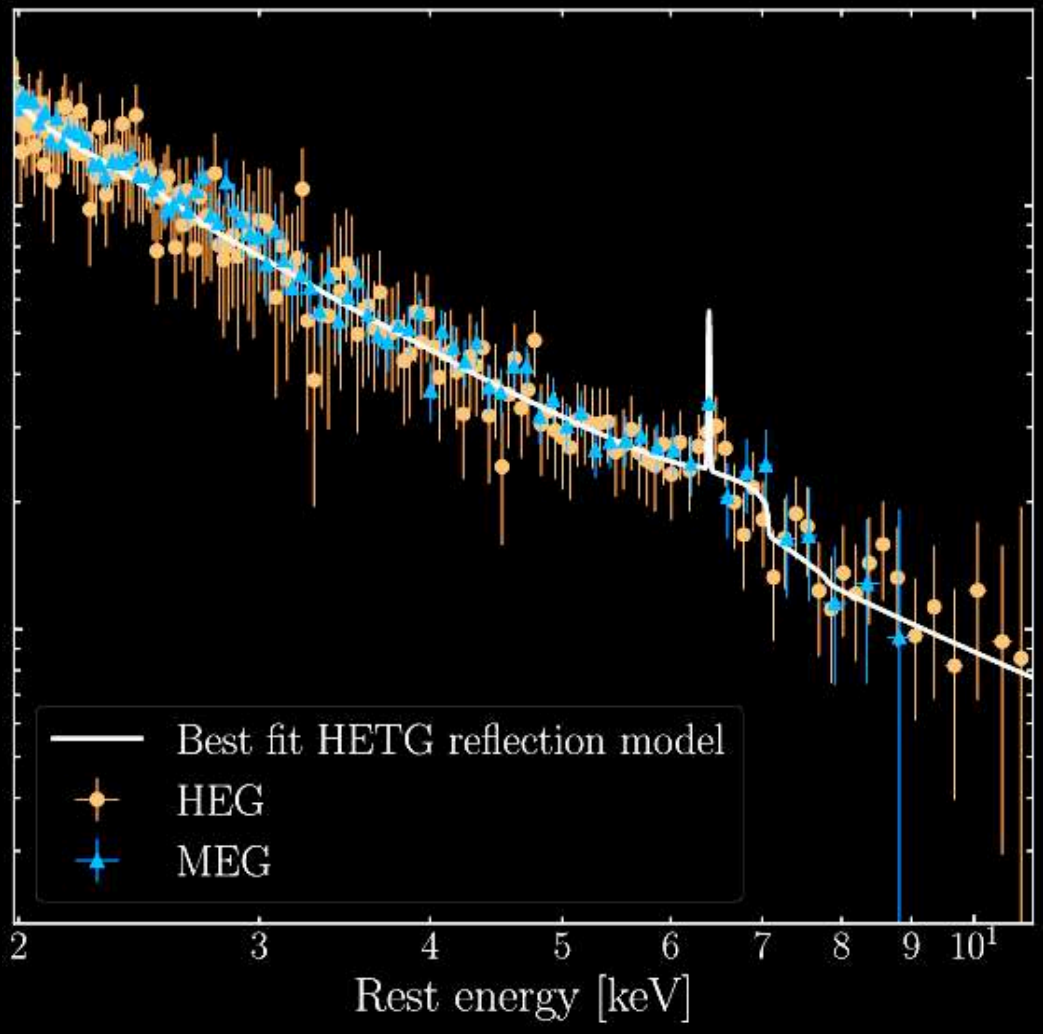
Thorne (1974)

Simulated X-ray Reflection Spectra





Reynolds (2020)

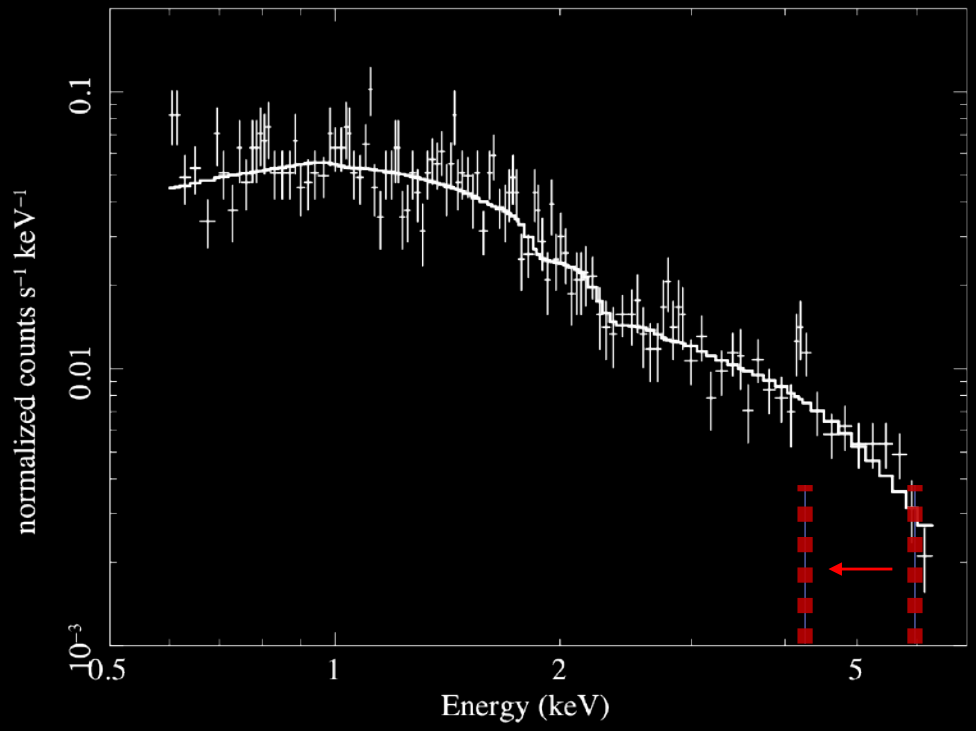


a = 0.6 (+0.2/-0.4)
@ 1.6 σ

Sisk-Reynés et al. (2022)

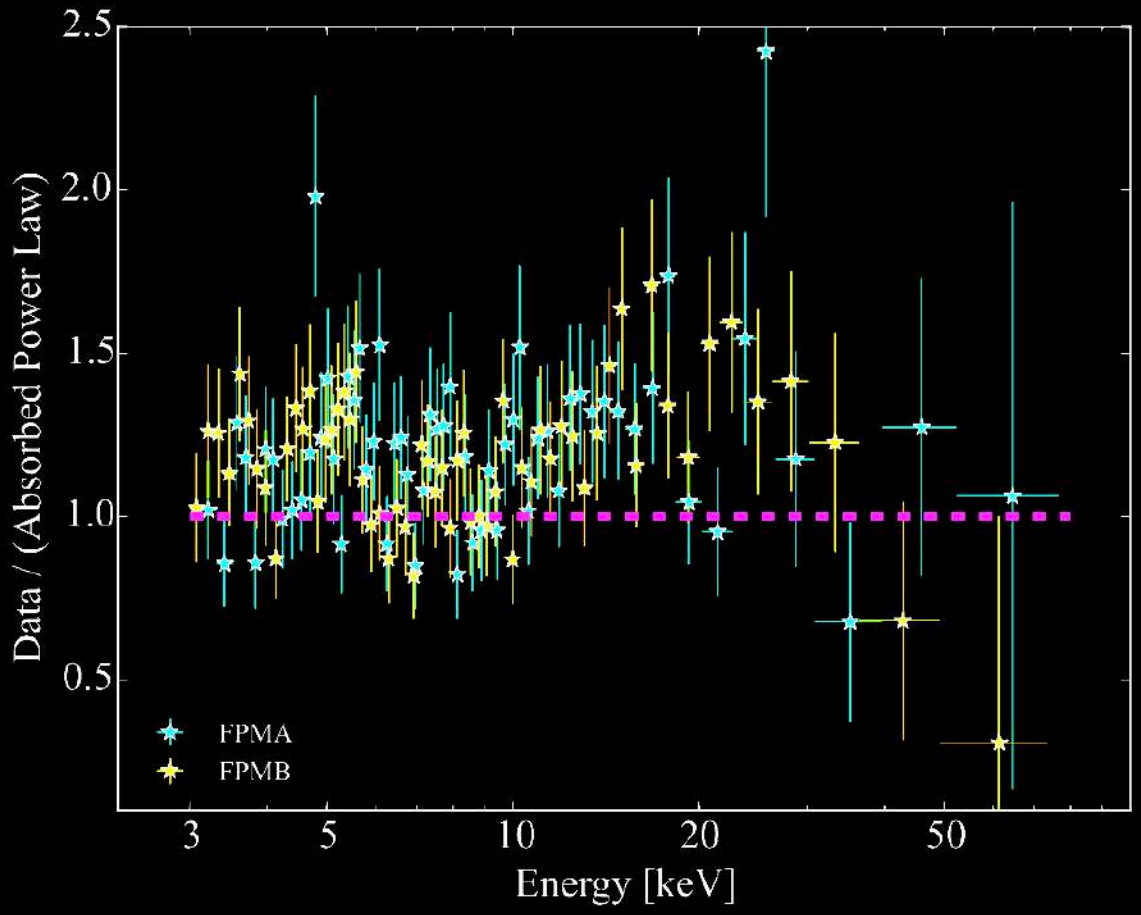
The Example of Mrk 876:

A gravitationally redshifted Iron line originated in a short-lived hot spot on the accretion disk constrains the spinning supermassive black hole



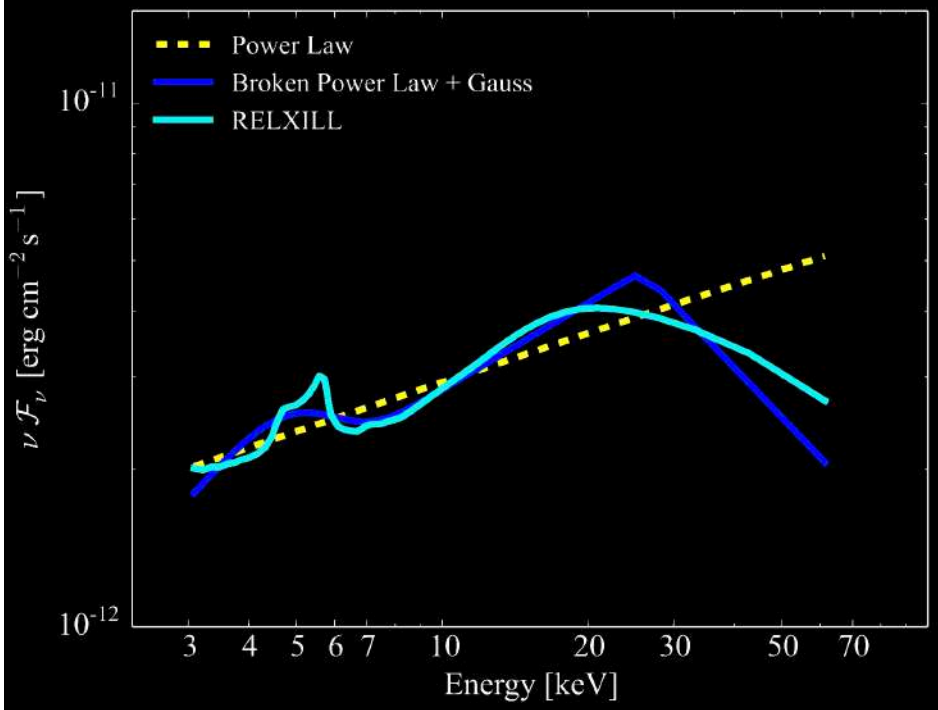
Bottacini et al. (2015)

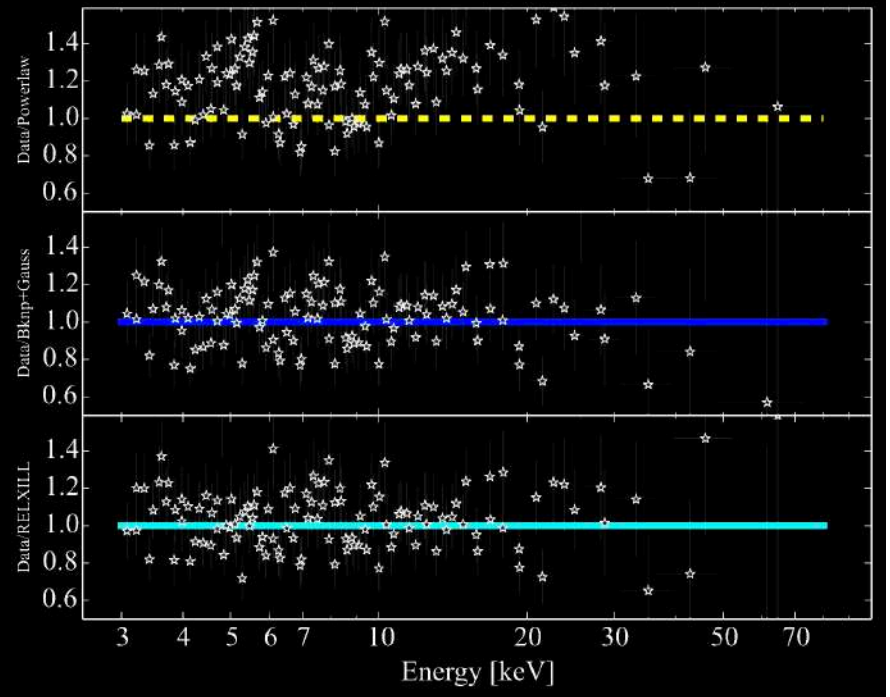
The Example of Mrk 876: *NuSTAR* Observation



Bottacini (2022)

The Example of Mrk 876: *NuSTAR* Observation



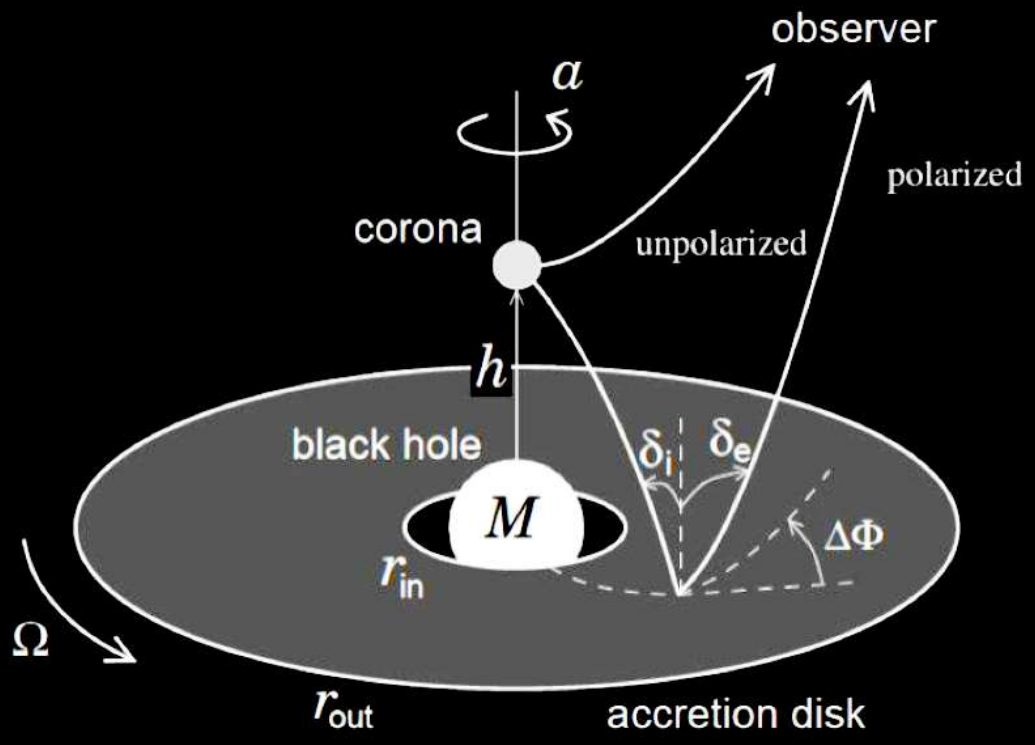


Bottacini (2022)

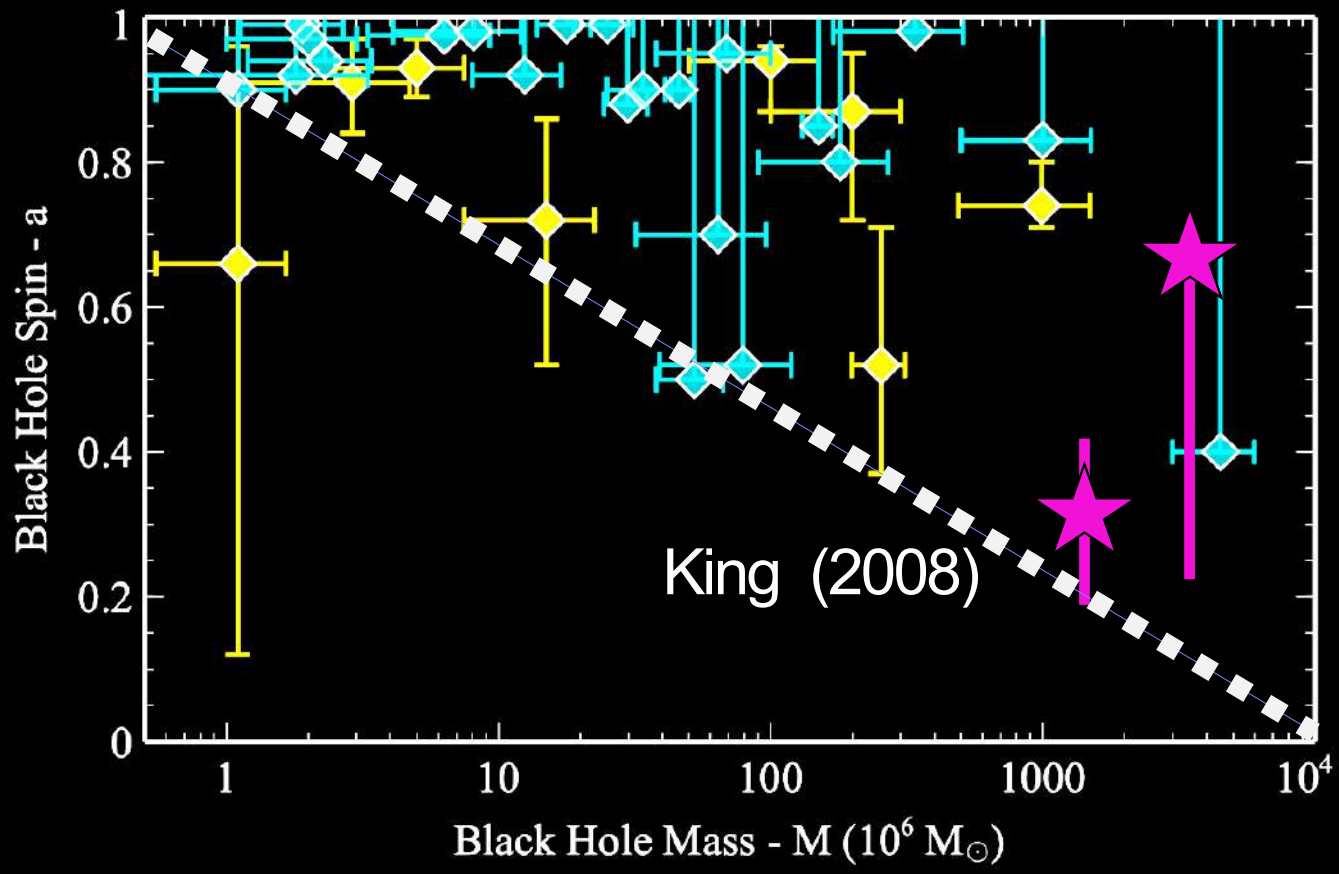
The Example of Mrk 876: *NuSTAR* Observation

- upper limit of spin: 0.85
- inclination angle of accretion disk in agreement with independent measurements: 32.84°

$$q = 4.56^{+0.70}_{-0.98}$$
$$a \leq 0.85$$
$$i = 32.84^{\circ}{}^{+12.22}_{-8.99}$$
$$\log(\xi) \leq 3.17$$
$$A_{Fe} = 1.85^{+2.36}_{-1.24}$$
$$Ref_{frac} = 1.91^{+17.54}_{-1.13}$$
$$R_{out} = 400\ R_G$$

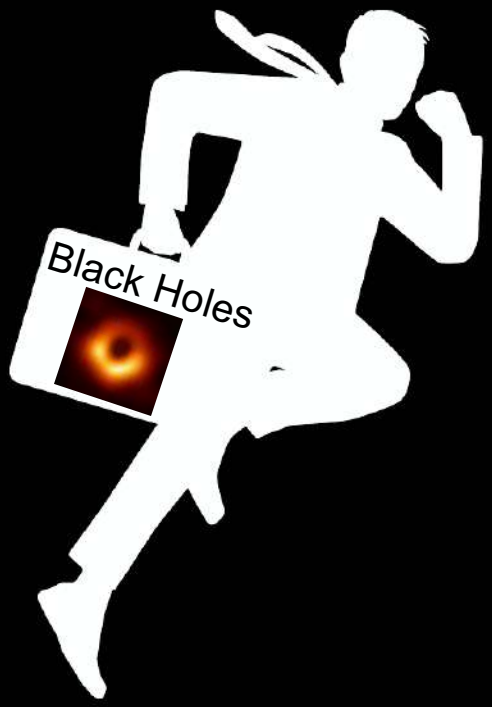


Bottacini (2022)



Reynolds (2020)

Take-Home Message



Theory & models little corroborated by data

More sophisticated theory difficult to explore

Good news:
- Room for more theory or models
- Room for new missions