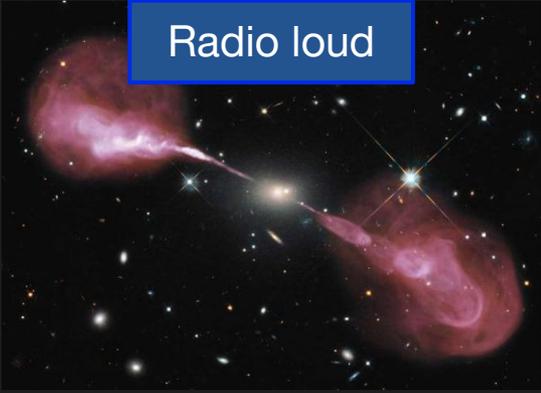


# Coronal emission from radio-quiet AGNs at high redshift

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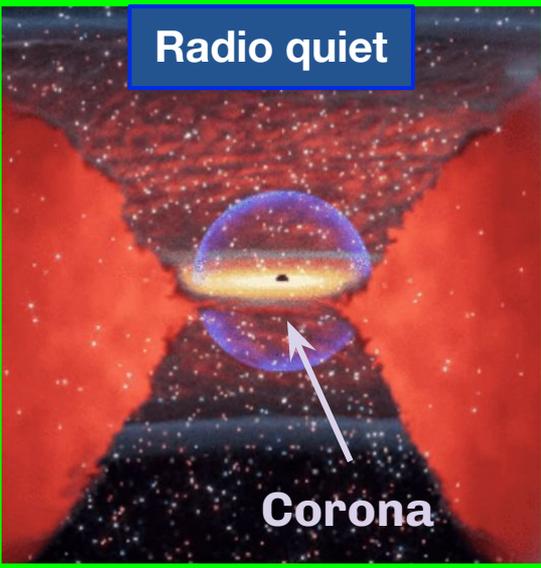
A radio-loud active galactic nucleus (AGN) is depicted as two galaxies with prominent, glowing pinkish-purple jets extending from their centers towards each other. The jets are bright and diffuse, indicating significant radio emission. The background is a dark field of stars.

Radio loud

# AGNs

- ~90% of all AGN are radio-quiet

The **corona** is:

A radio-quiet active galactic nucleus (AGN) is shown in a cross-sectional view. It features a central black hole surrounded by a glowing accretion disk. Above and below the disk are large, red, funnel-shaped structures representing the accretion flow. A small, blue, spherical region labeled 'Corona' is situated just above the inner edge of the accretion disk. A white arrow points from the label 'Corona' at the bottom to this blue region.

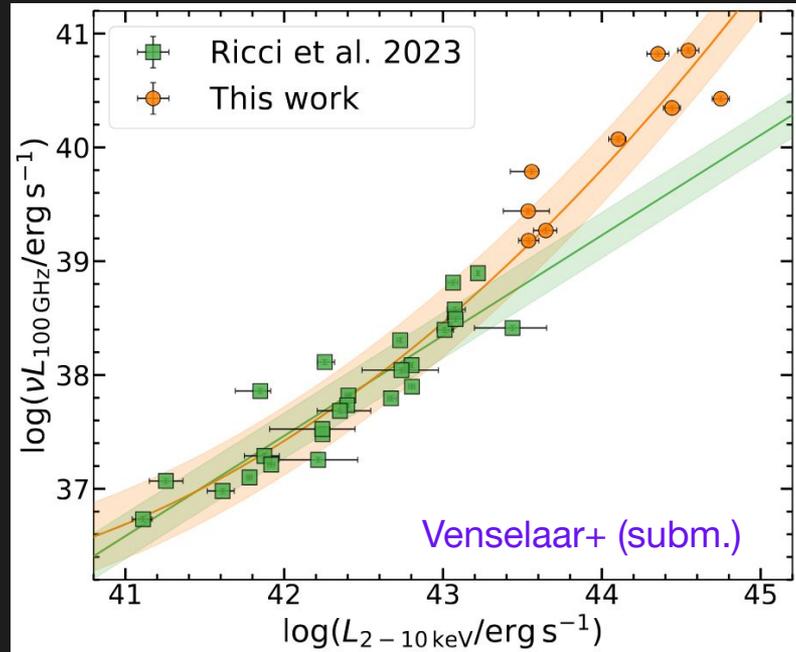
Radio quiet

- A very compact ( $5-100 r_g$ ) and extremely hot ( $\sim 10^9$  K) plasma close to the supermassive black hole.
- Responsible for the hard X-ray emission observed.
- Likely heated by magnetic reconnection → Also leads to relativistic (non-thermal) particle acceleration

Corona

# Key results in local galaxies ( $z < 0.1$ )

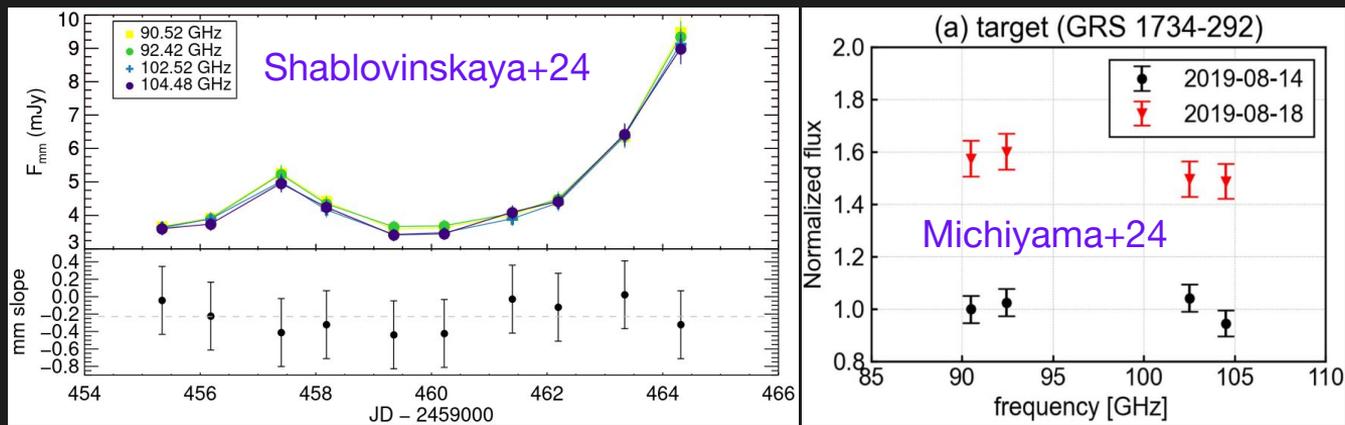
1. Correlations found between  $L_{\text{mm}}$  and  $L_{\text{X}}$  in local galaxies ( $z < 0.1$ )



Important application  
to obscured galaxies  
in which X-rays  
cannot escape!

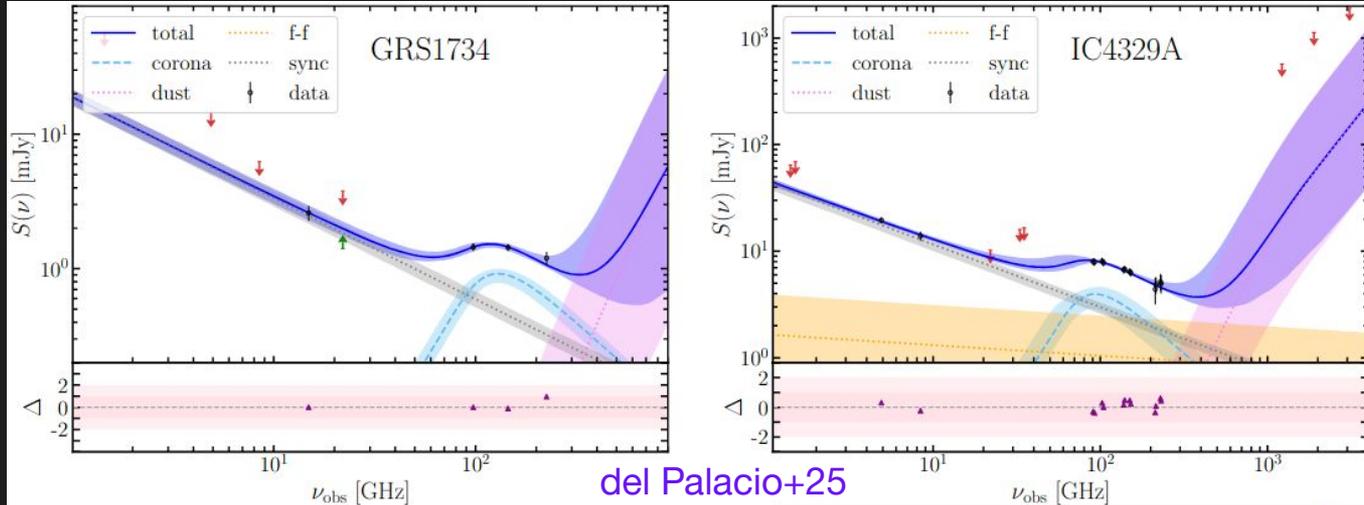
# Key results in local galaxies ( $z < 0.1$ )

1. Correlations found between  $L_{\text{mm}}$  and  $L_{\text{X}}$
2. Variability of the mm emission on ~daily timescales



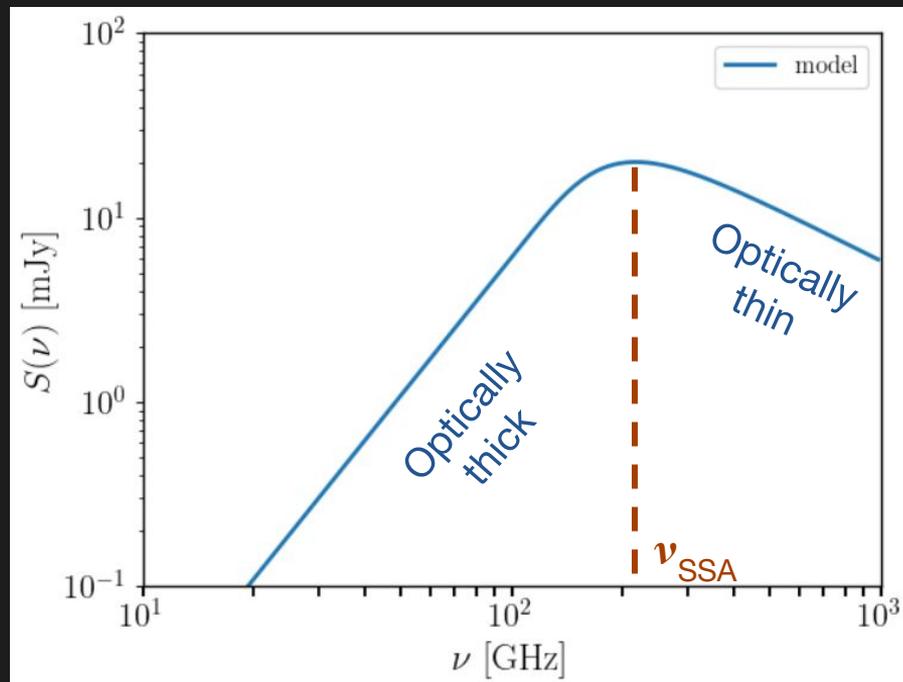
# Key results in local galaxies ( $z < 0.1$ )

1. Correlations found between  $L_{\text{mm}}$  and  $L_{\text{X}}$
2. Variability of the mm emission on  $\sim$ daily timescales
3. A *bump* in the SED at  $\sim 100$  GHz



# Corona emission model

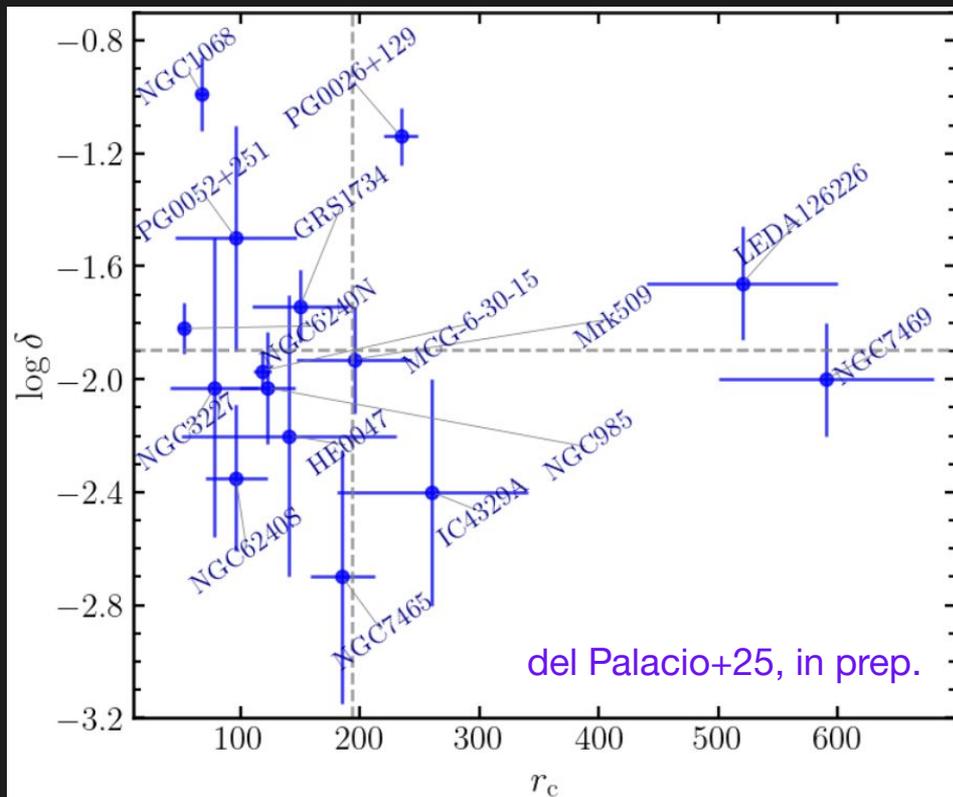
- Homogeneous spherical corona of radius  $R_c = r_c R_g$
- A fraction  $\delta$  of the energy goes into non-thermal (ultrarelativistic) electrons
- Energy condition for the magnetic field intensity:  $u_B = \eta_B u_{nt}$



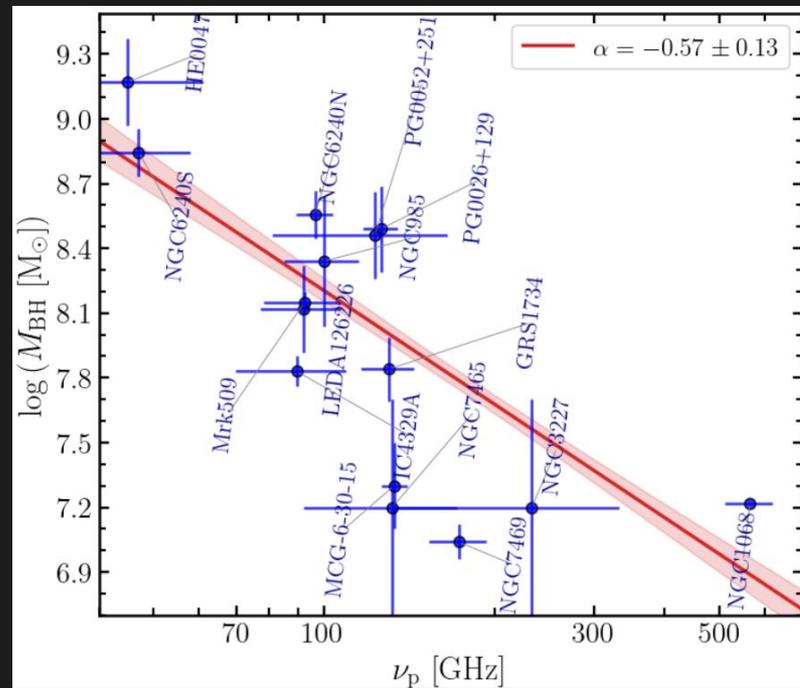
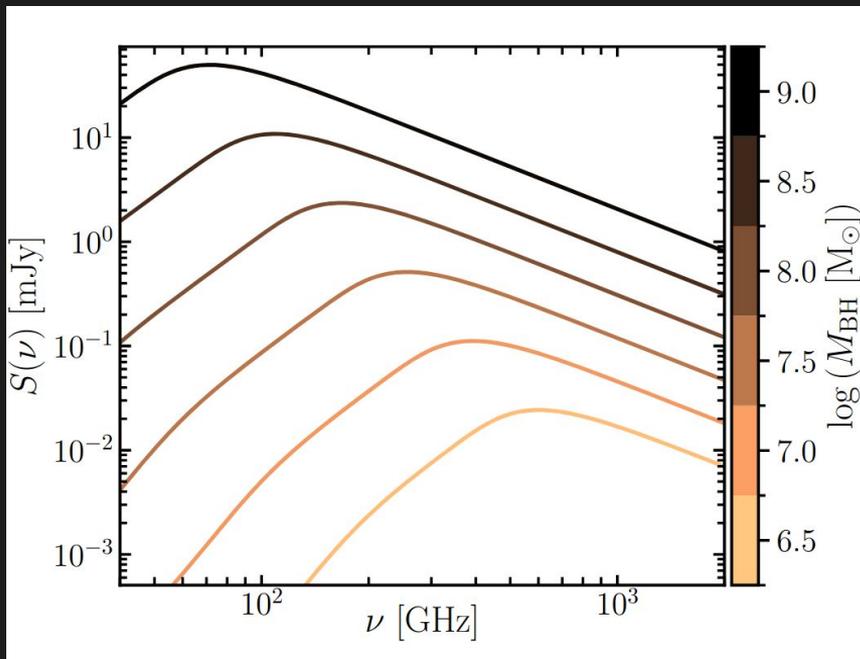
# Corona emission model

## Typical parameters:

- $r_c \sim 200$
- $U_{nt}/U_{th} \sim 1\%$
- $B \sim 25$  G



# SED dependence on $M_{\text{BH}}$

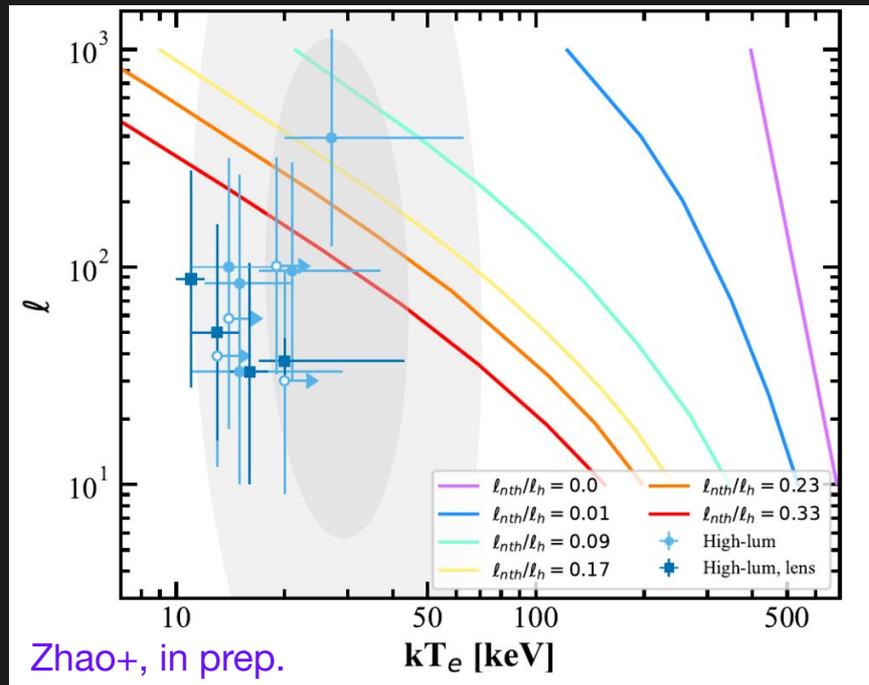


A possible way to estimate  $M_{\text{BH}}$  ?

del Palacio+25, in prep.

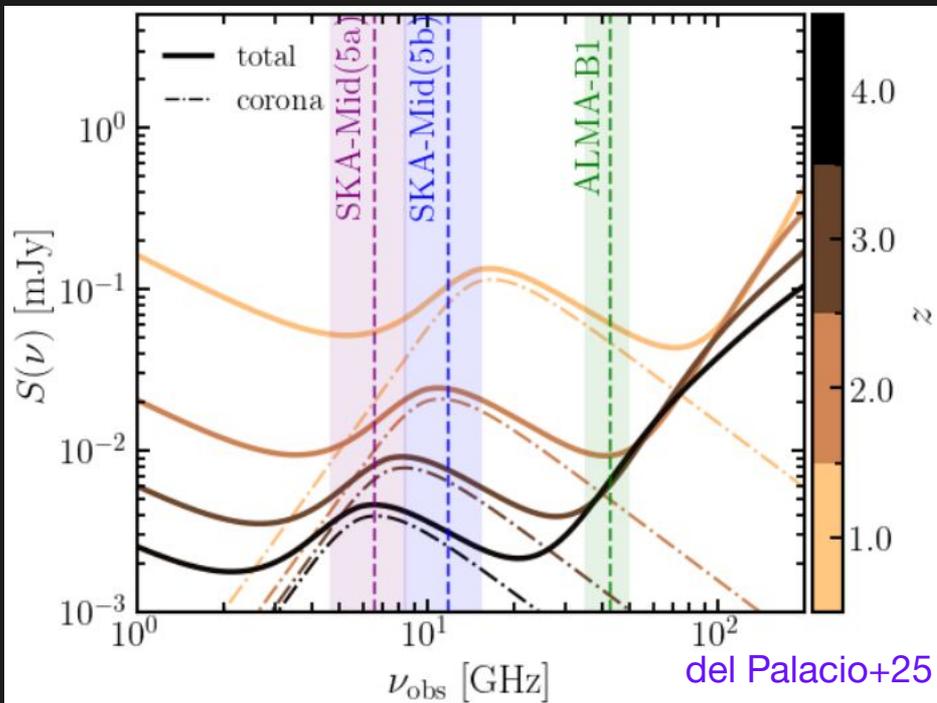
# Extra Motivation

- Predicted dependence on corona compactness, temperature and non-thermal fraction
- $kT$  can be measured in some high- $z$  AGN



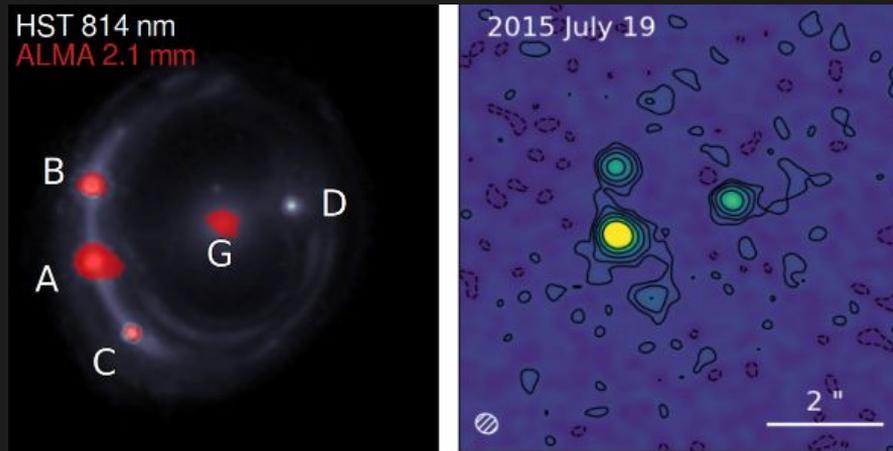
# Studies at high redshift

$$M_{\text{BH}} = 10^9 M_{\odot}$$



Possibility to detect lensed sources at high  $z$

Microlensing event revealed the corona in a lensed quasar at  $z=0.66$



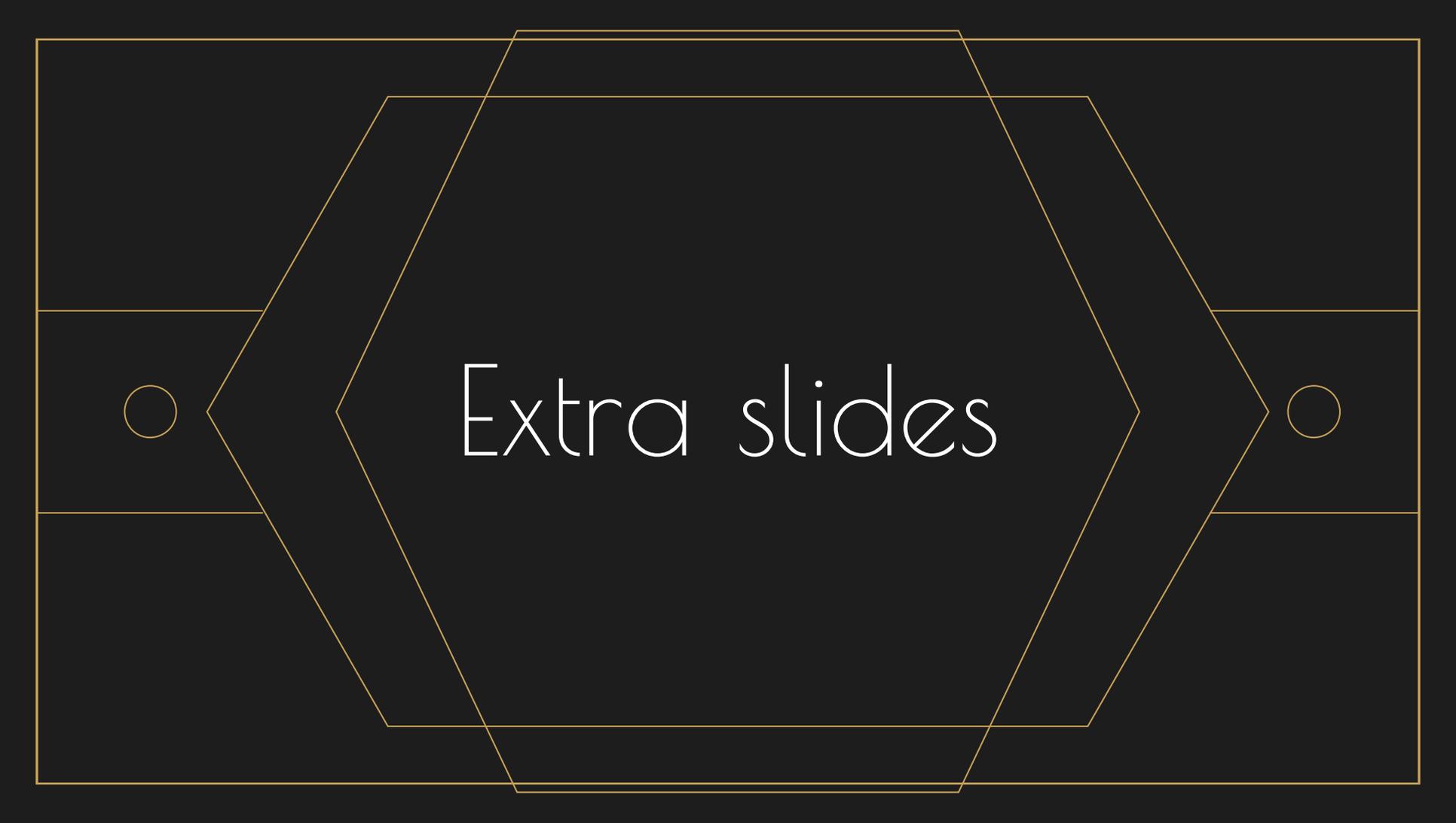
Rybak+25

# Conclusions

SKA can be key in the study of radio-quiet AGNs to determine:

- Properties of the corona (size and non-thermal fraction)
- Intrinsic AGN luminosity (important for obscured sources!)

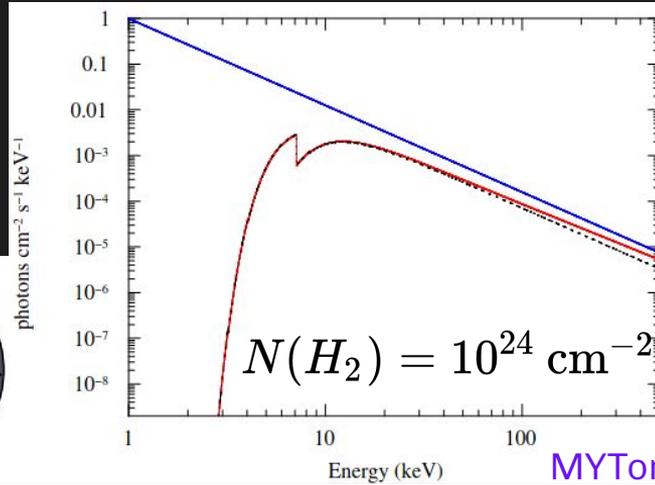
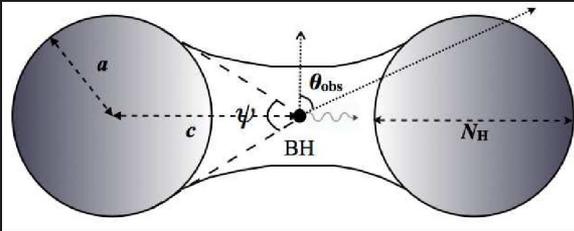
Ideal targets are lensed sources with very massive SMBHs



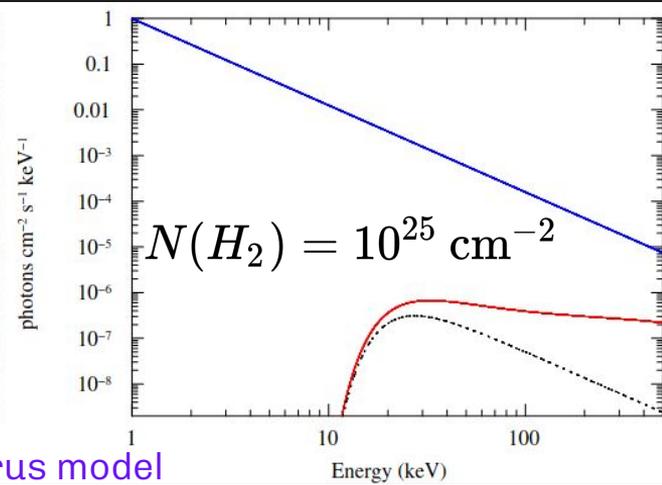
Extra slides

# Obscured galaxies

- Extreme column densities:  $N(H_2) > 10^{25} \text{ cm}^{-2} \rightarrow$  X-rays cannot escape



MYTorus model



# Parameter exploration

We aim to minimize the number of free parameters and explore how they affect the SED

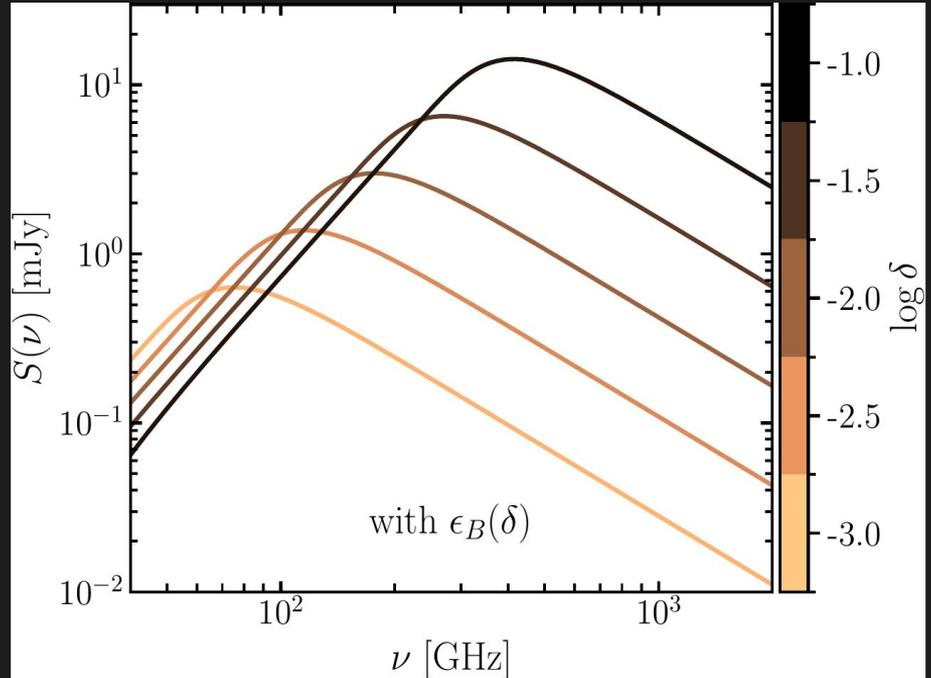
$$\delta = u_{\text{nt,e}}/u_e$$

$$\epsilon_B = u_B/u_e$$

Assume an energy condition

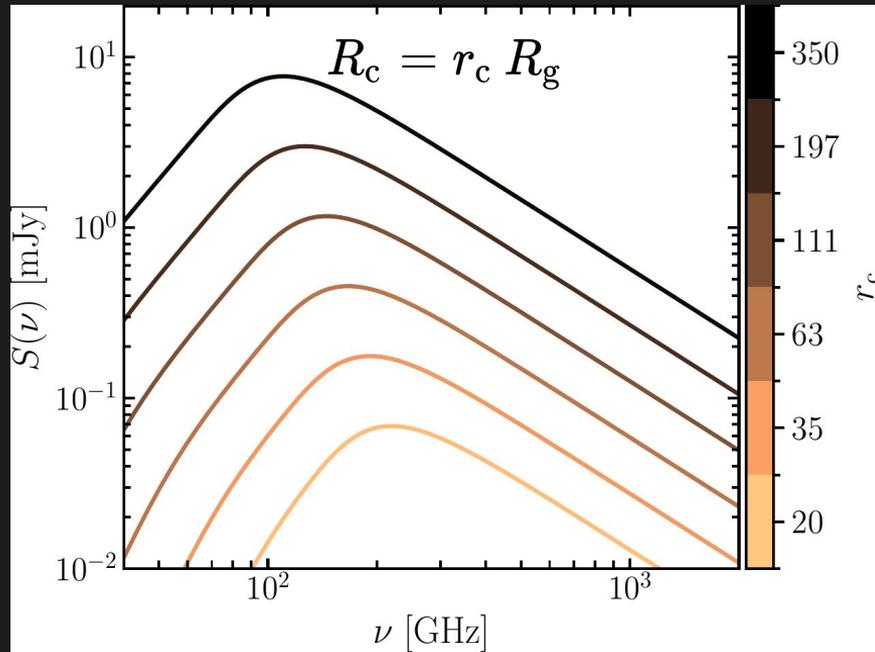
$$u_B = \eta_B u_{\text{nt}}$$

$$\epsilon_B(\delta) = \eta_B \delta (1 + \xi_{\text{e,p}}) \approx 30 \delta$$

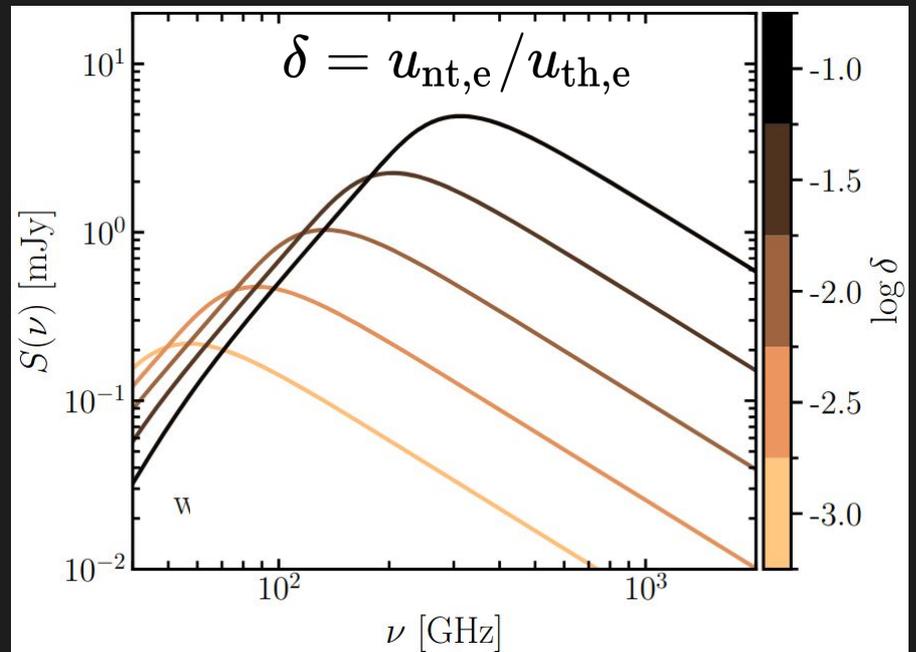


# Free parameters

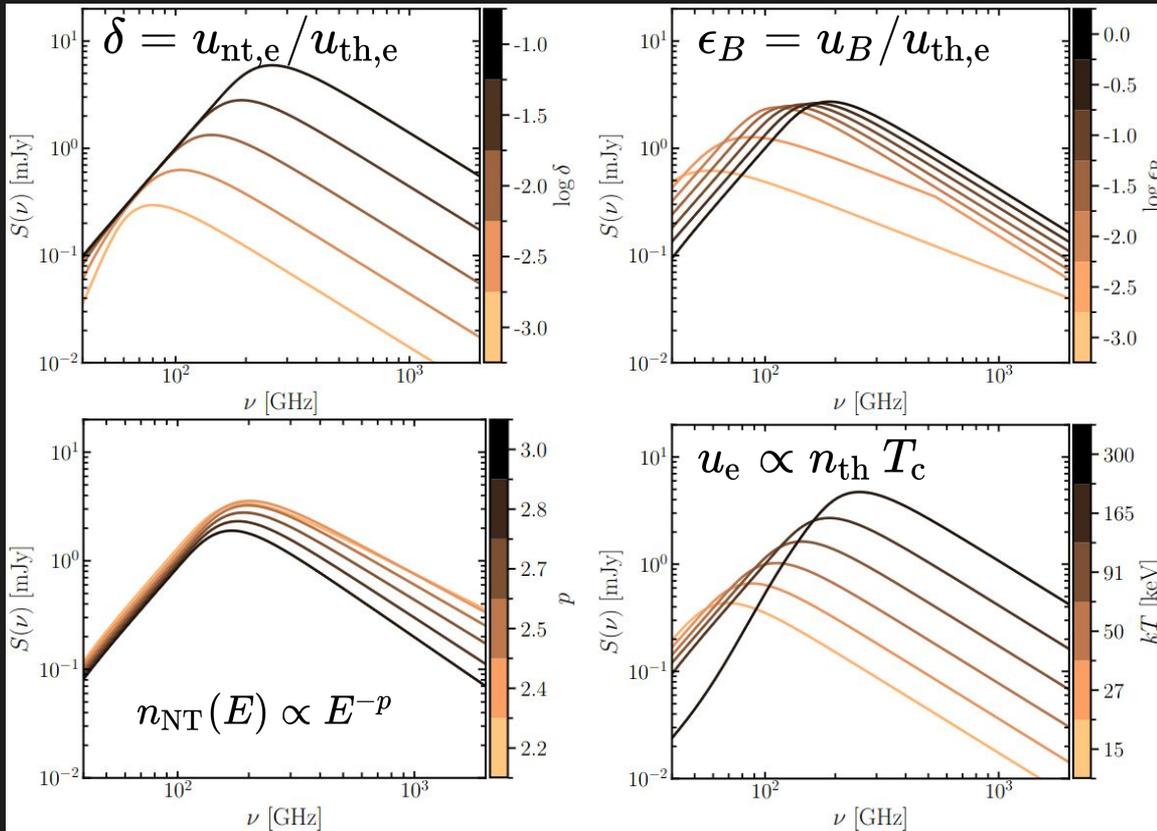
Corona size



Fraction of energy in non-thermal  $e^-$



# Parameter exploration



Higher flux,  
higher peak  
frequency. **Too  
many  
parameters!**

