

Probing the Sizes of AGN Coronae with ALMA-B2

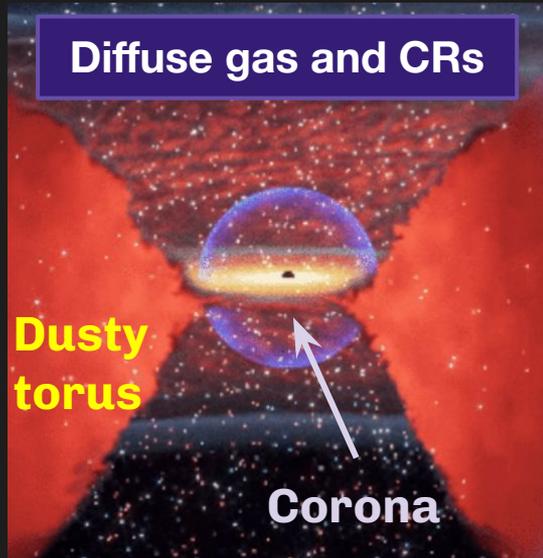
Santiago del Palacio

Chalmers University of Technology (Sweden)



CHALMERS
UNIVERSITY OF TECHNOLOGY

Radio-quiet AGNs



Diffuse gas and CRs

Dusty
torus

Corona

~90% of all AGN are
radio-quiet

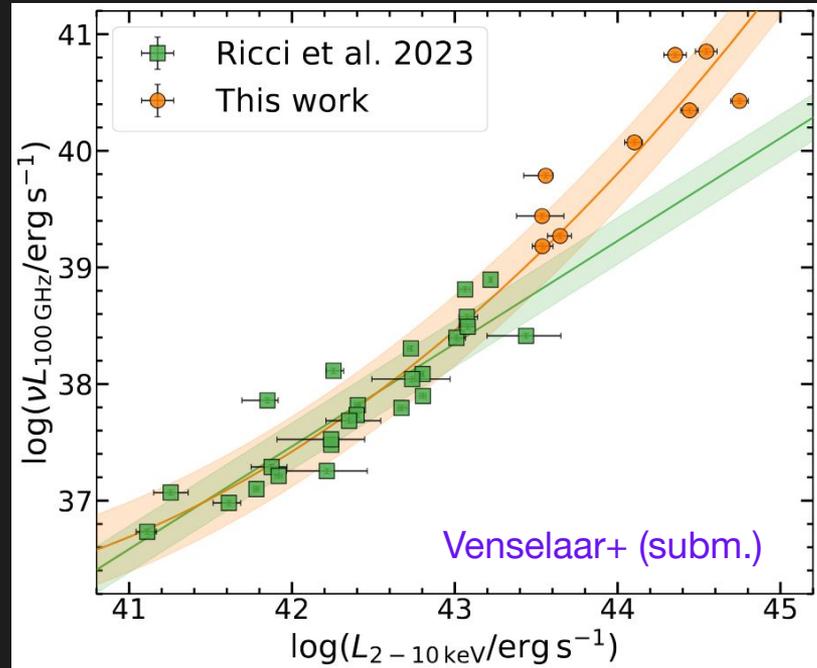
They lack powerful radio jets.

The **corona** is:

- A very compact region (\sim tens R_g) filled with 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 \rightarrow Also leads to relativistic (non-thermal) particle acceleration

Key results in local galaxies

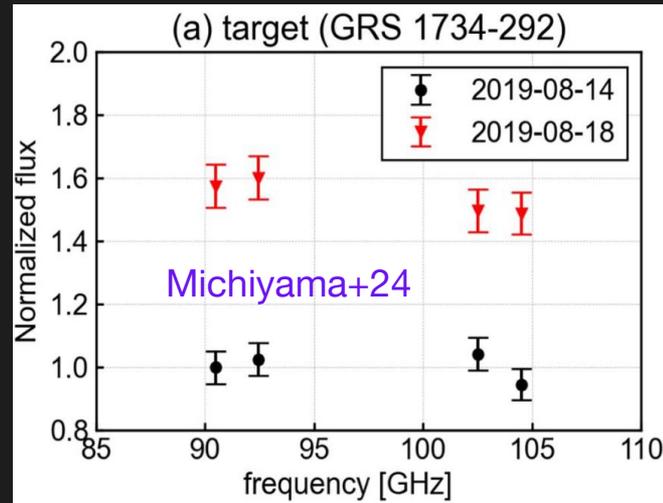
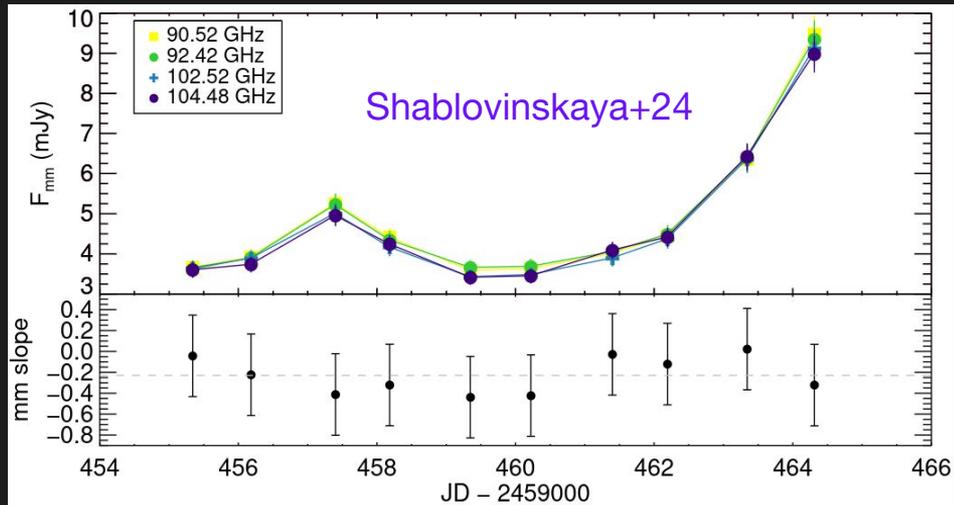
1. Correlations found between L_{mm} and L_{X} ($z < 0.1$)



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

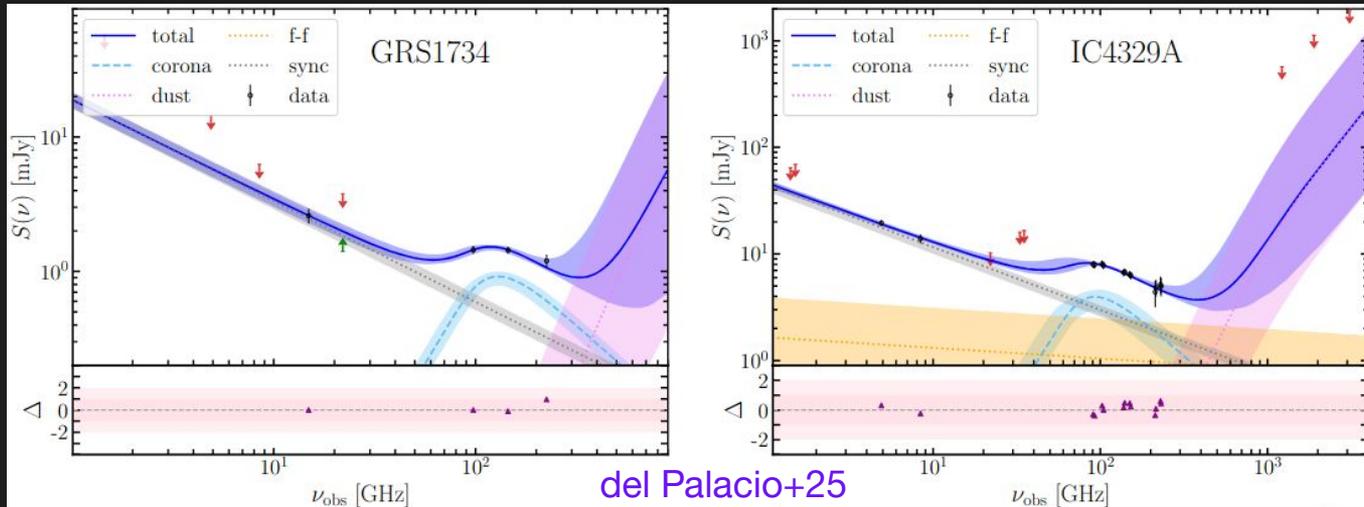
Key results in local galaxies

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



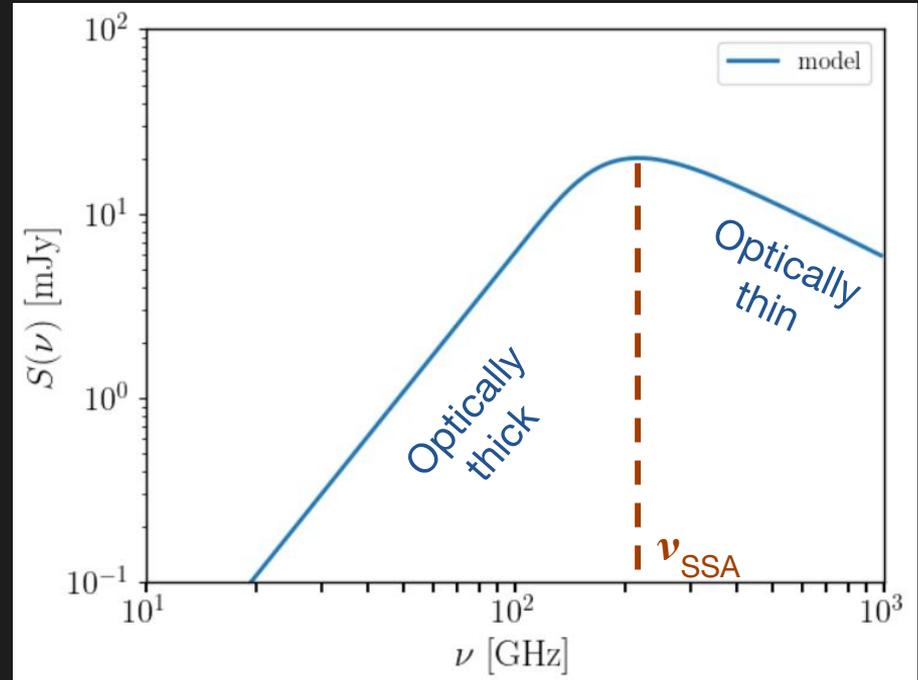
Key results in local galaxies

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



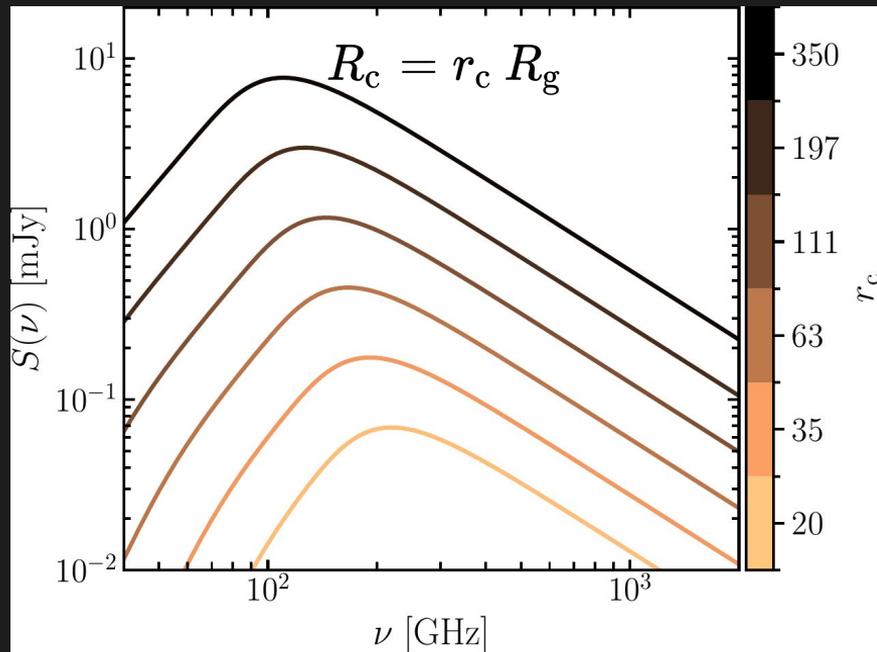
Corona emission model

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

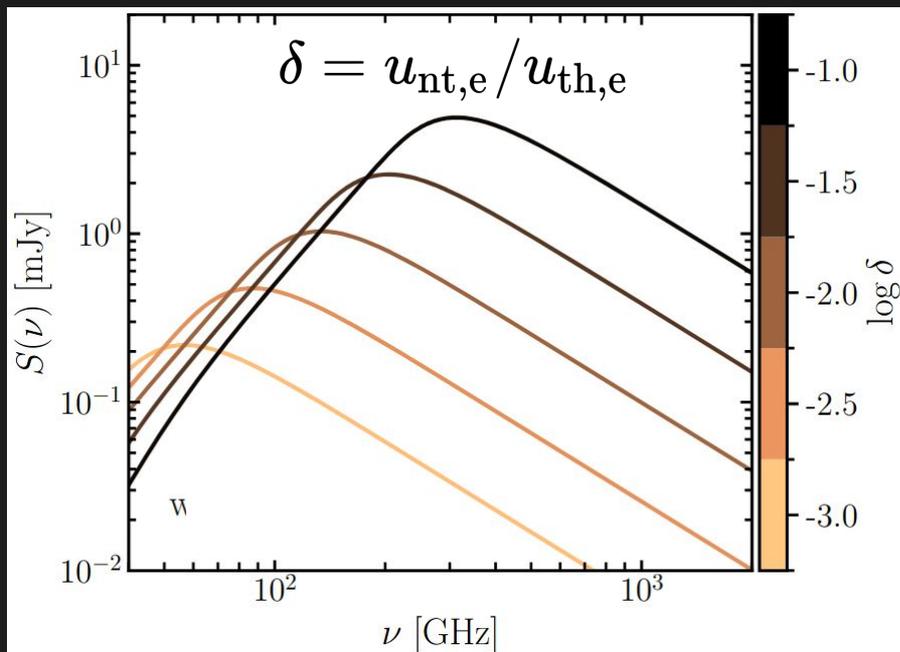


Free parameters

Corona size

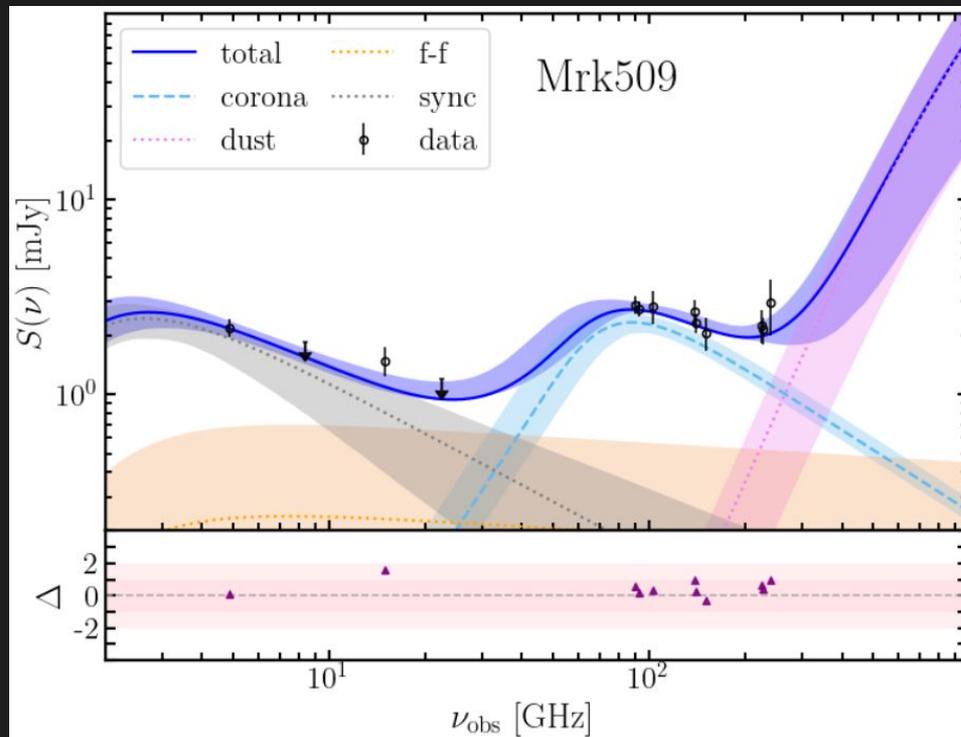
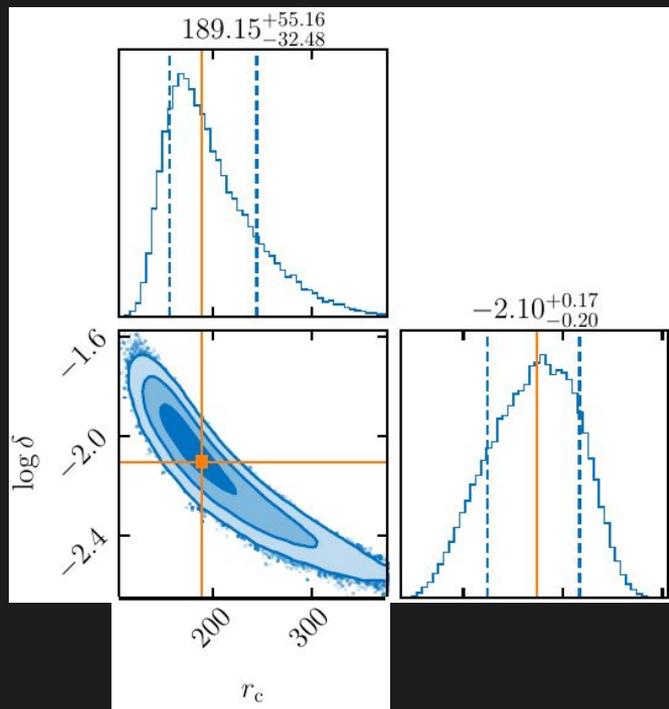


Fraction of energy in non-thermal e^-

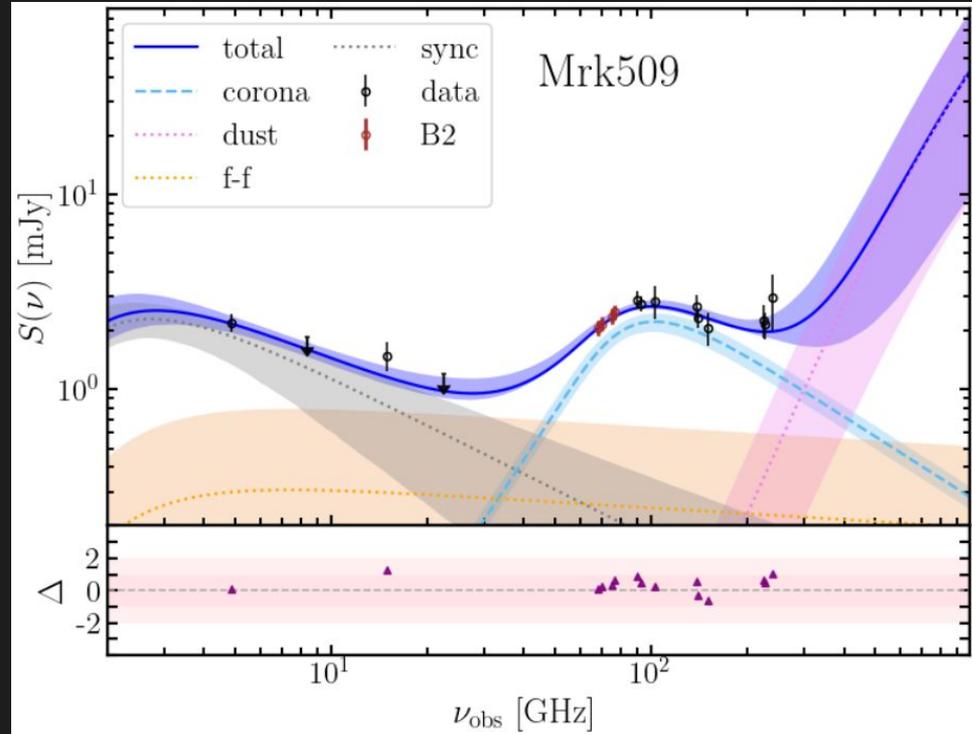
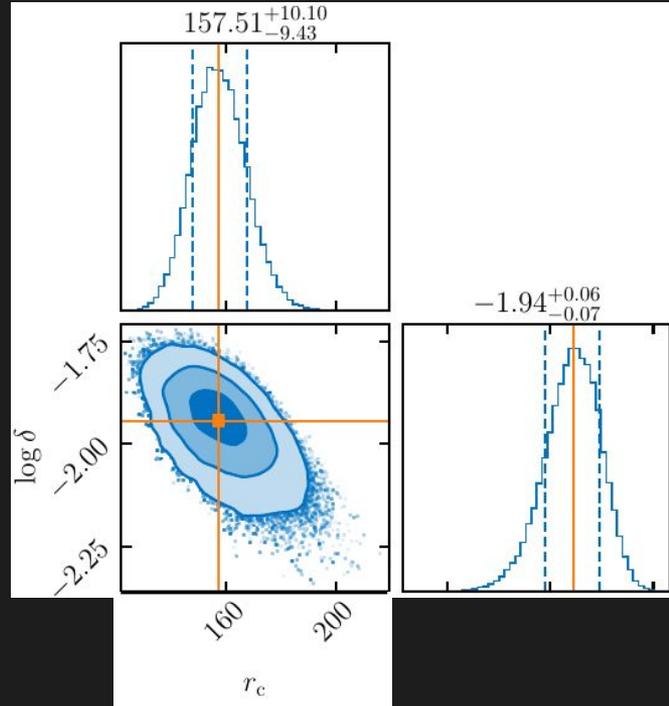


We need to measure the SED around the peak!

SED fitting



SED fitting with Band 2 data

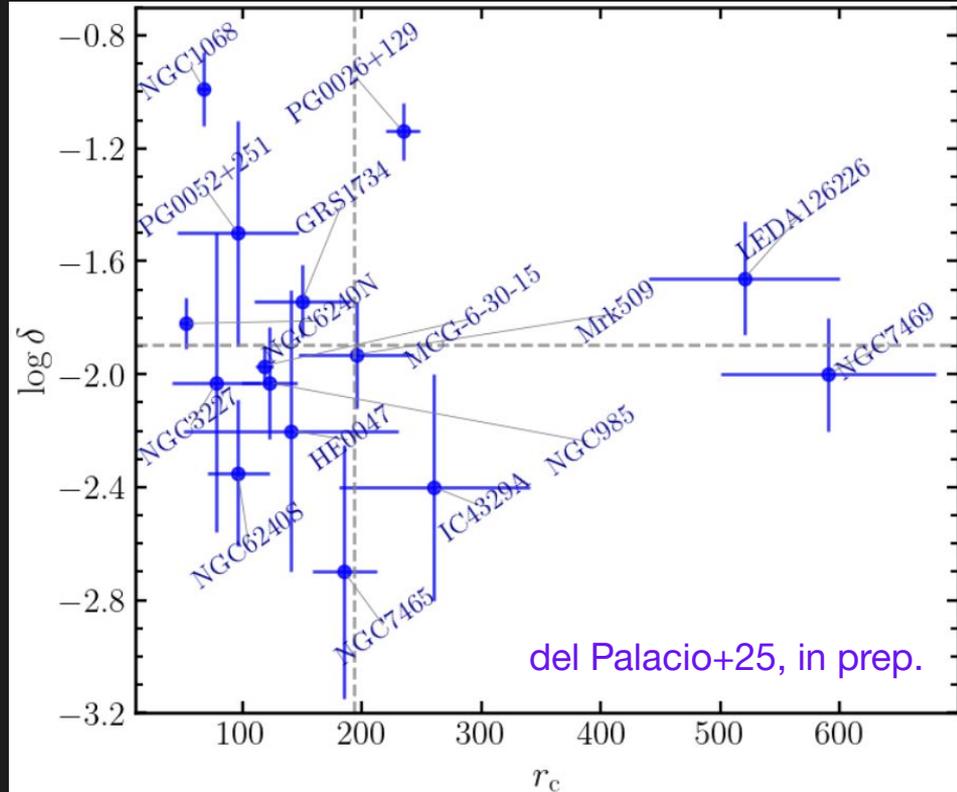


Corona emission model

Typical parameters:

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

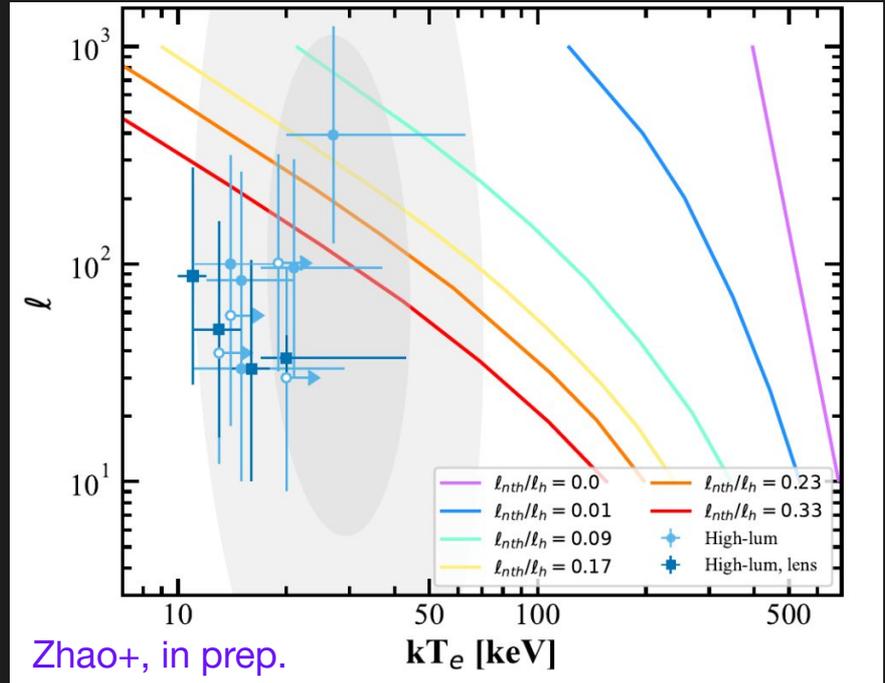
**Tension between
sizes inferred from
X-rays and mm?**



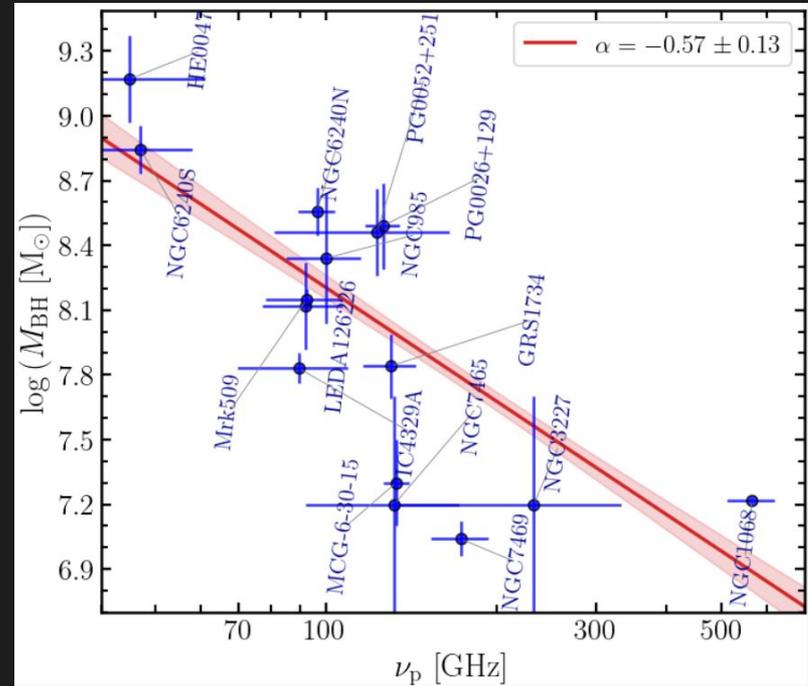
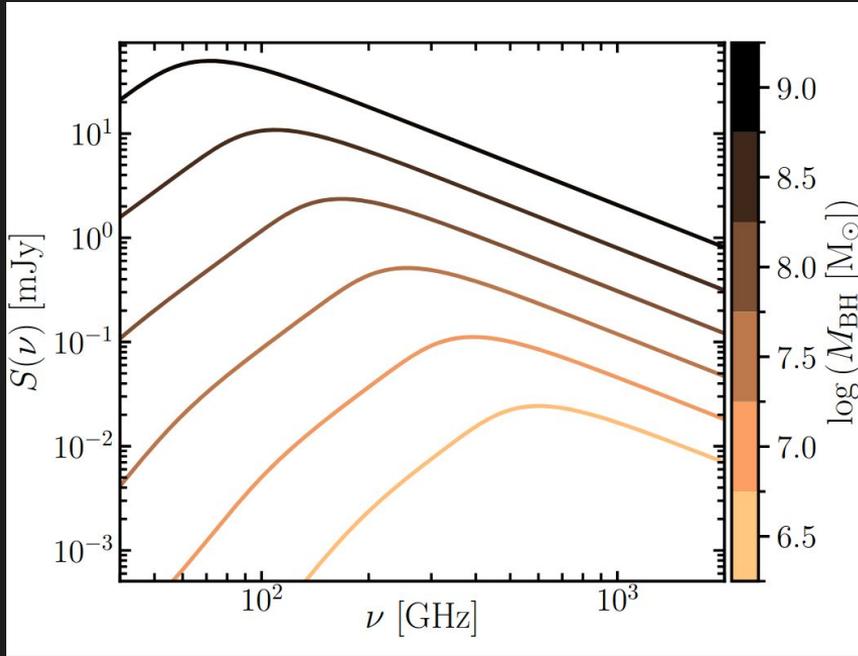
Extra Motivation

Predicted dependence on corona compactness, temperature and non-thermal fraction

Higher non-thermal fractions in X-rays?



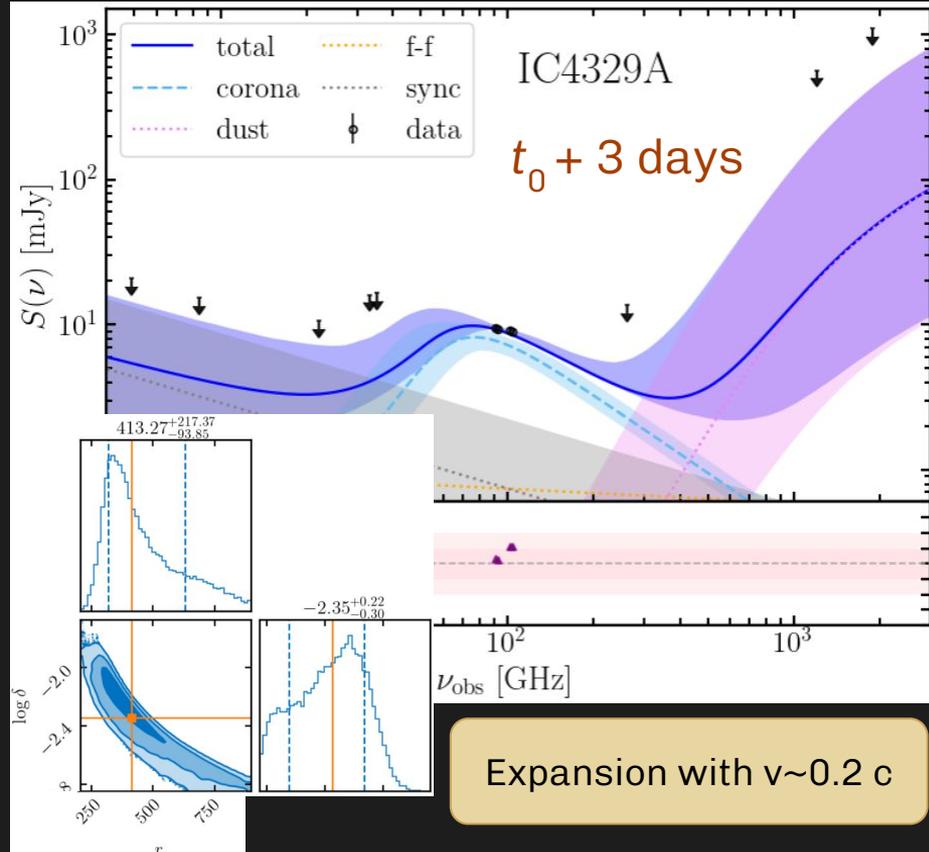
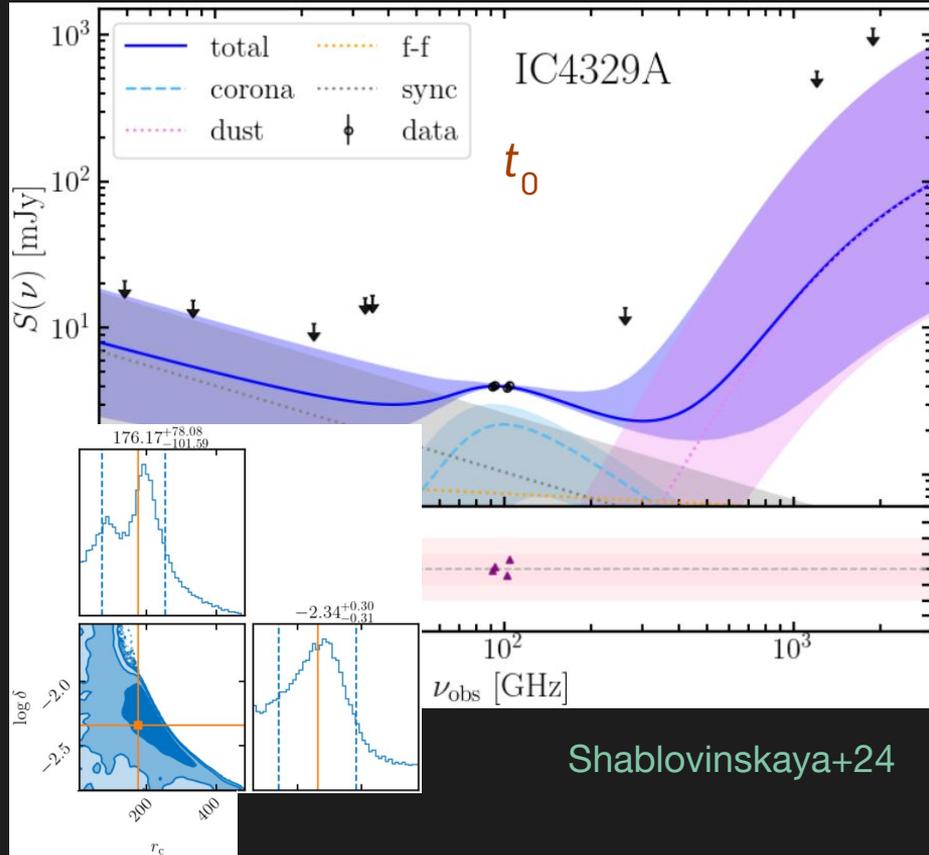
SED dependence on M_{BH}



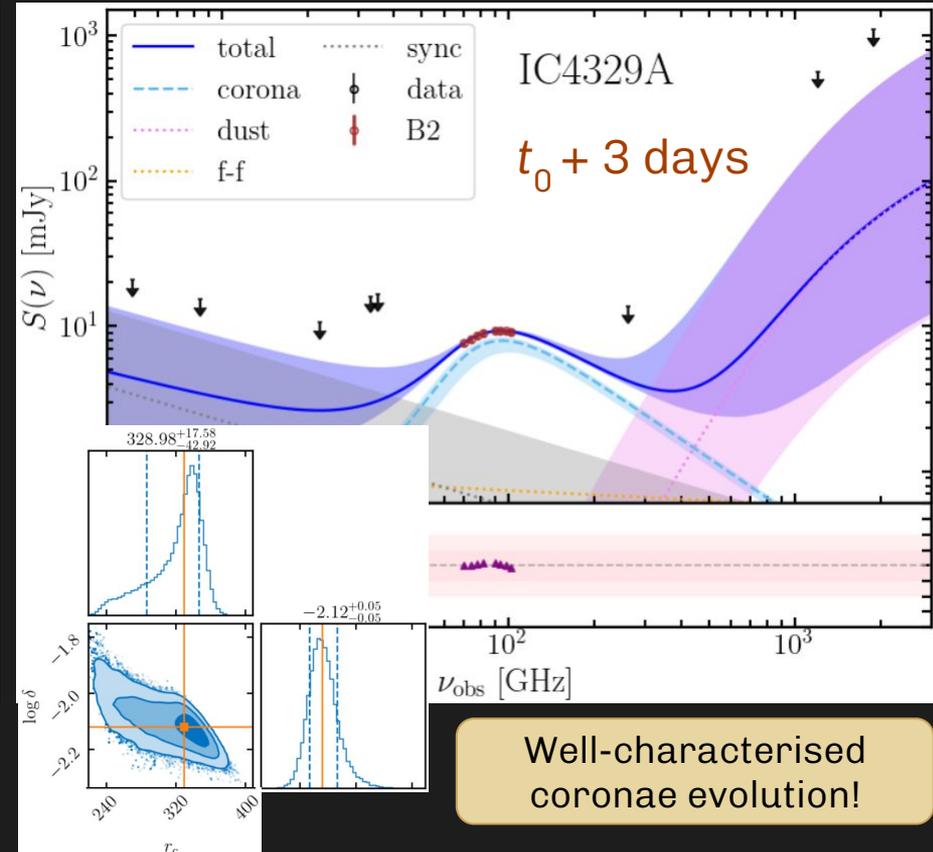
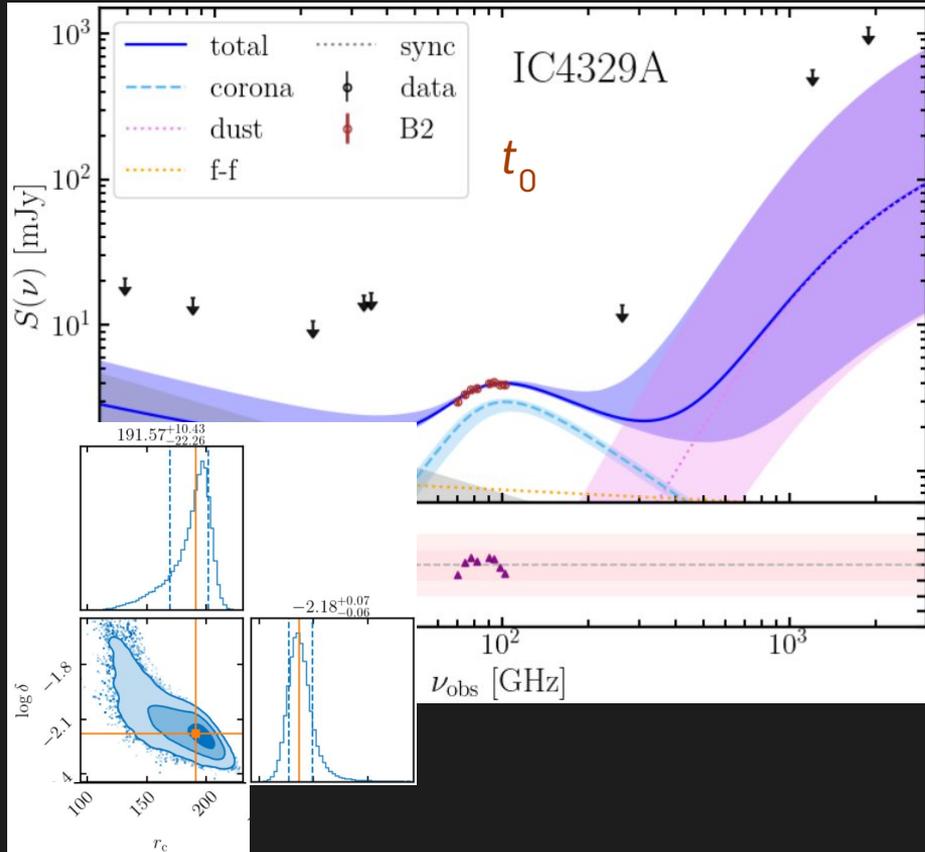
A possible way to estimate M_{BH} ?

del Palacio+25; in prep.

Variability studies



Variability studies with B2 (WSU)



Well-characterised
coronae evolution!

Conclusions

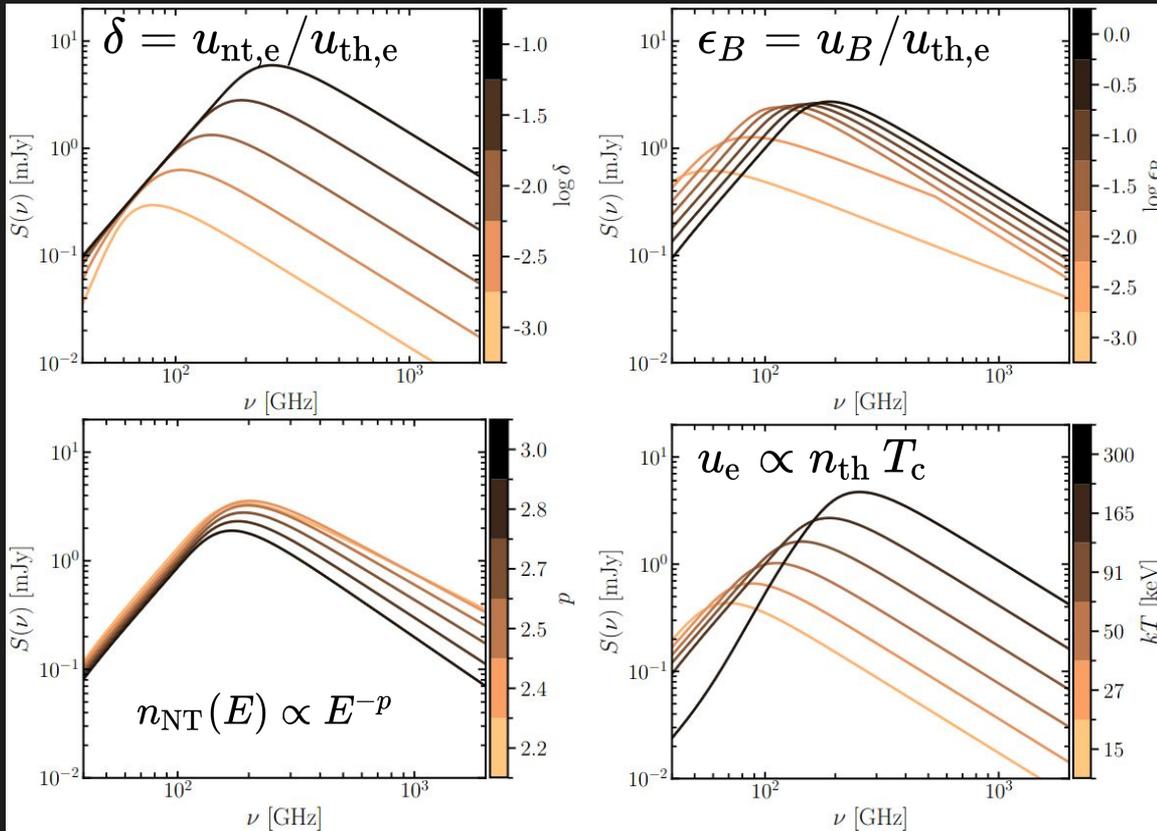
ALMA Band 2 will be key in the study of radio-quiet AGNs:

- Determine coronae **sizes** and non-thermal fractions (continuum SEDs)
- Dynamical evolution of the corona (variability studies with WSU)

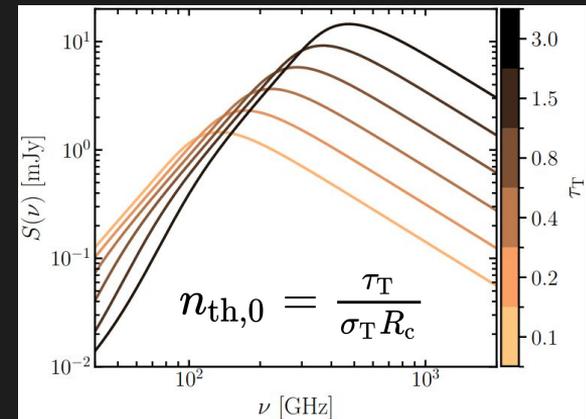


Extra slides

Parameter exploration



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



Parameter exploration

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

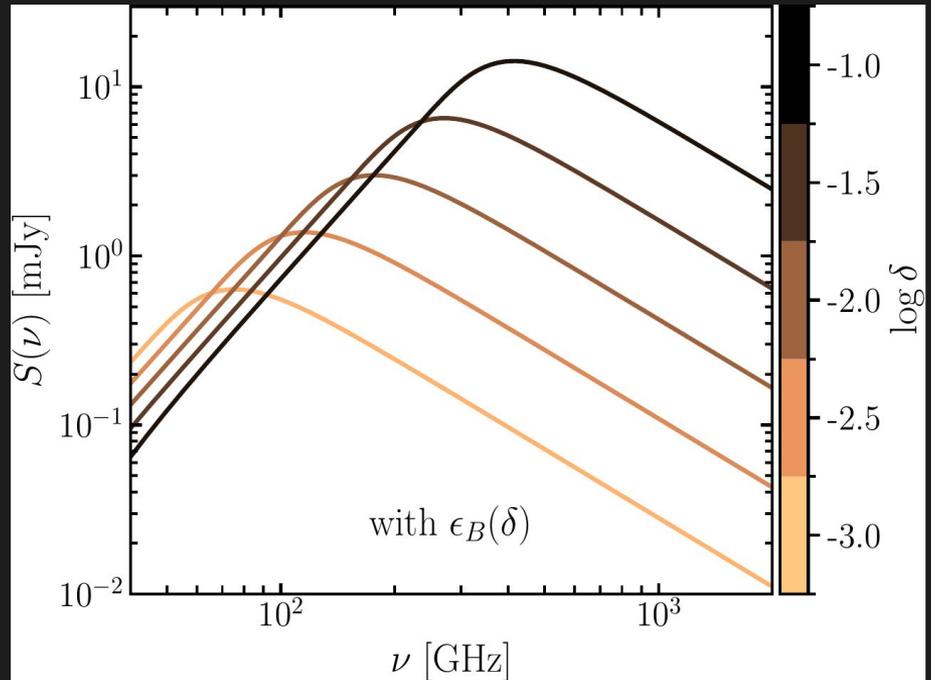
$$\delta = u_{\text{nt,e}}/u_e$$

$$\epsilon_B = u_B/u_e$$

Assume an energy condition

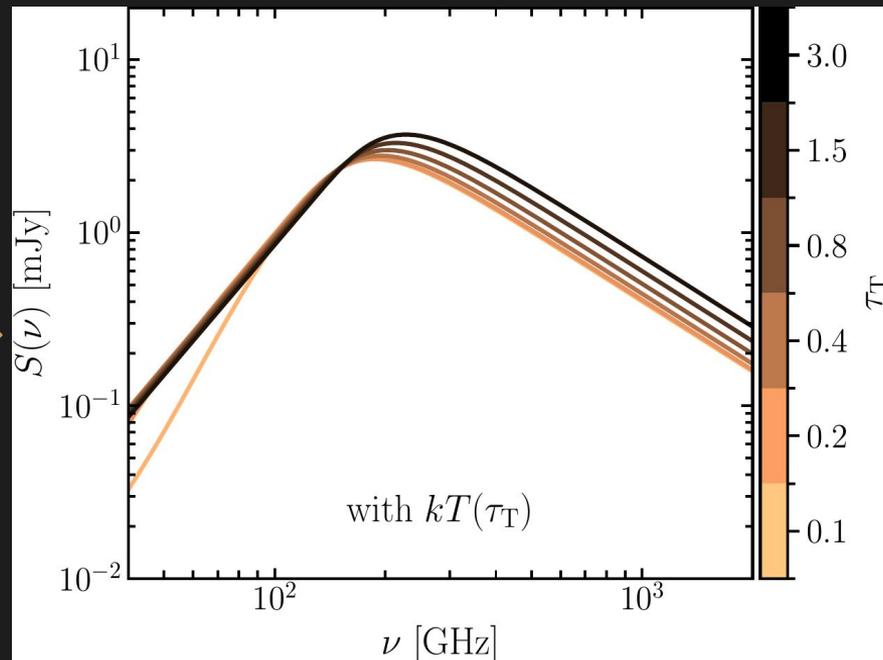
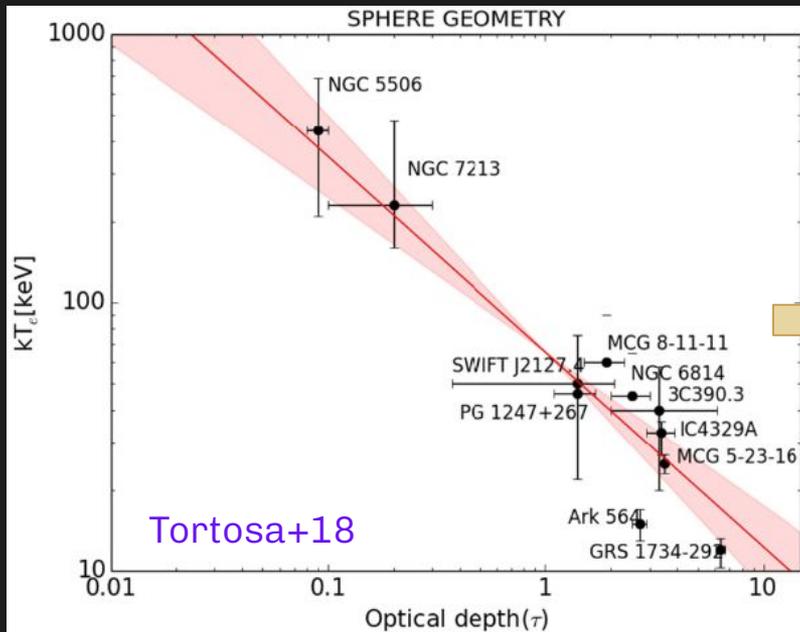
$$u_B = \eta_B u_{\text{nt}}$$

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



Parameter exploration

We aim to minimize the number of free parameters



del Palacio+25