AGN dust covering factors: What's wrong and how to fix them

Marko Stalevski

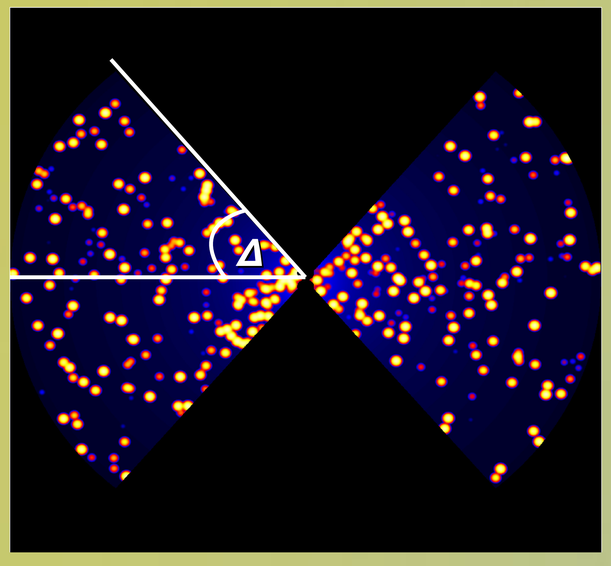
with

Claudio Ricci, Yoshihiro Ueda, Paulina Lira, Jacopo Fritz, Maarten Baes

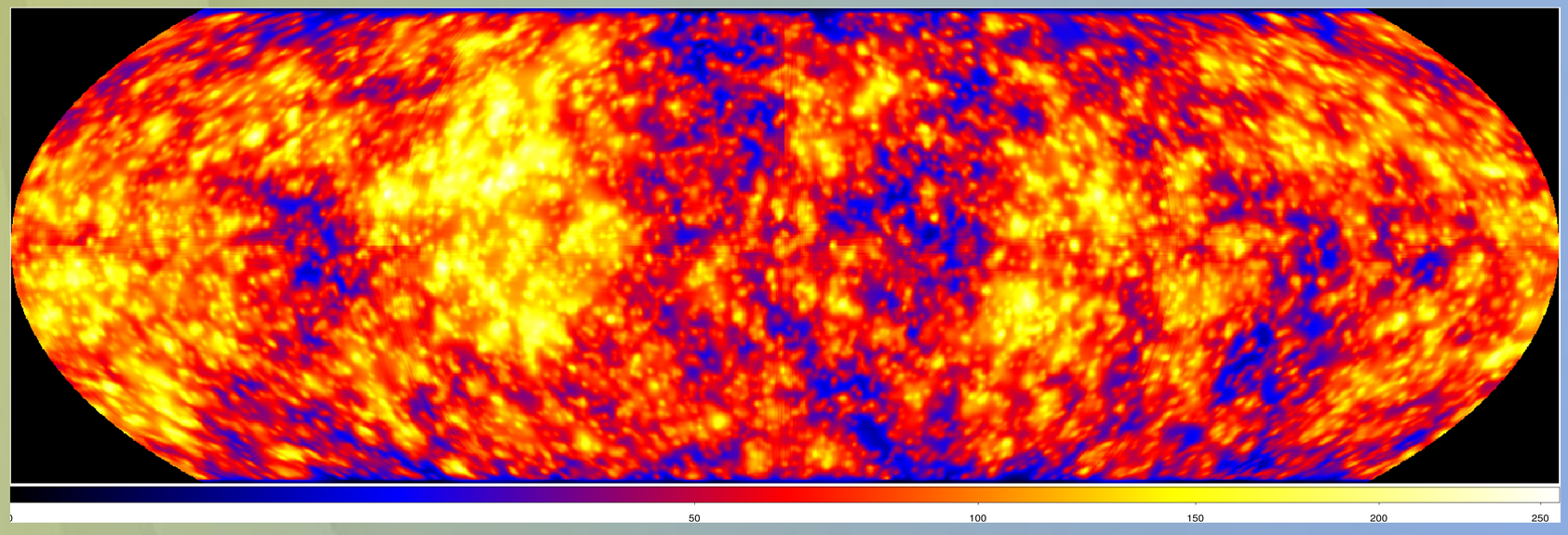
What is it ?

Covering Factor = sinΔ ≈ L_{torus}/L_{AGN}

***Δ* – torus opening angle**



The two-phase torus model: high-density clumps + low-density interclump dust. Density map of the *xz* plane.



Optical depth map (V-band) of the sky seen from center of AGN for the density distribution show on left.

What is it for ?

Inferring fraction of obscured AGNs as a function of luminosity and redshift – important role in studying AGN evolution !

What's the problem with it ?

$$L_{torus}/L_{AGN} = \sin\Delta \cdot DA \cdot TA$$

Torus Anisotropy

Accretion Disk Anisotropy

Both the accretion disk and the dusty torus are emitting anisotropically – the relation between L_{torus}/L_{AGN} and *CF* is far from trivial !

How to fix it ?

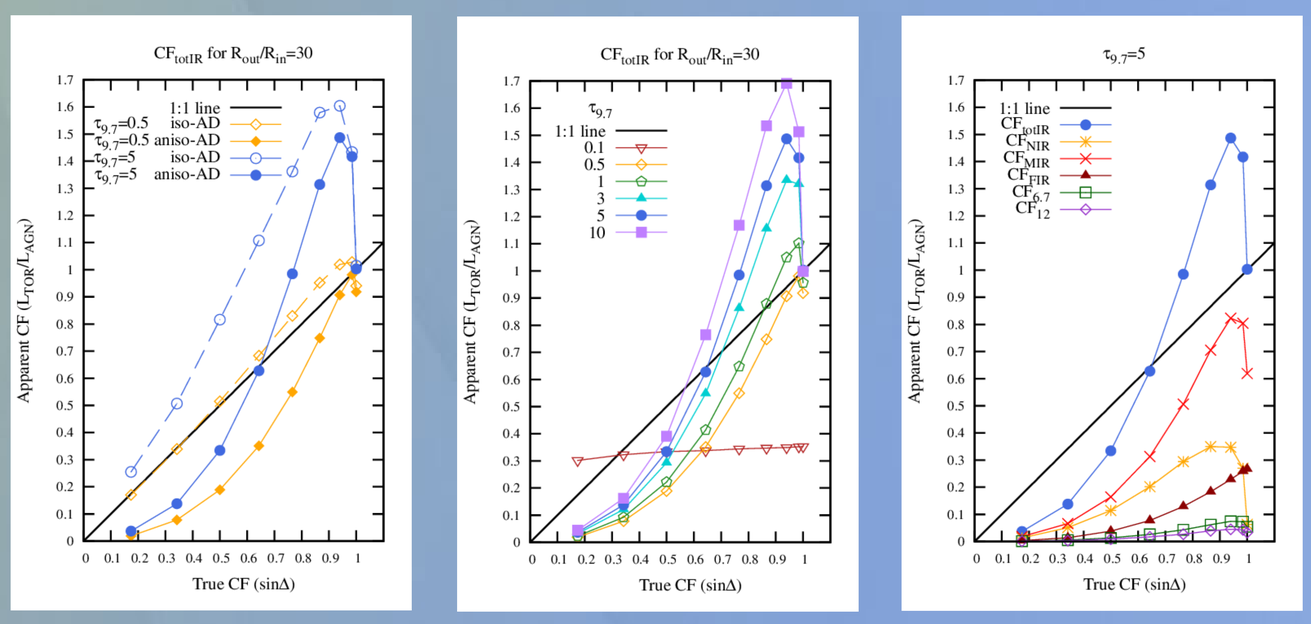
– Take Monte Carlo Radiative Transfer code SKIRT

– Calculate grid of model SEDs for:
  – iso/anisotropic accretion disk
  – optically thin/thick torus

– Measure L_{torus}/L_{AGN} from model SED and compare it to $\sin\Delta$

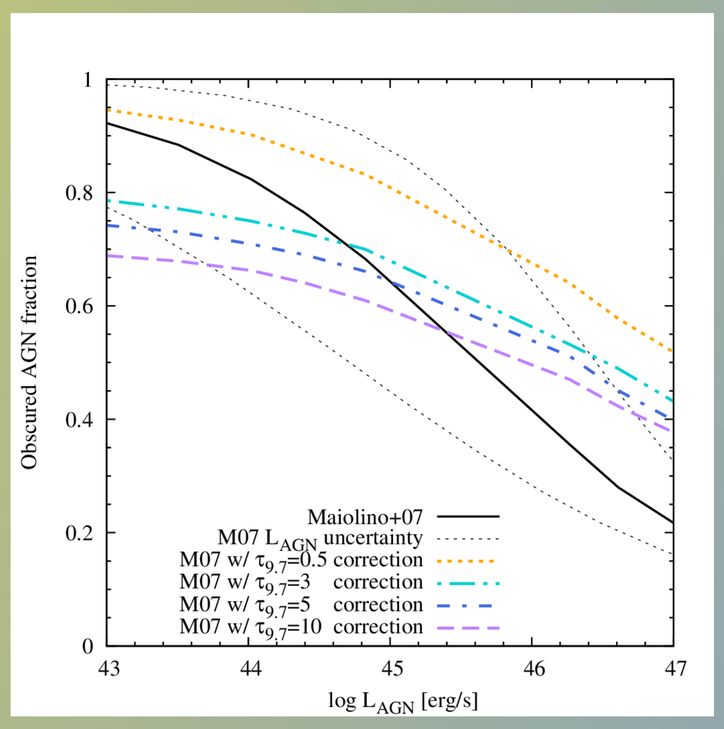
– Study the L_{torus}/L_{AGN} – *CF* relation

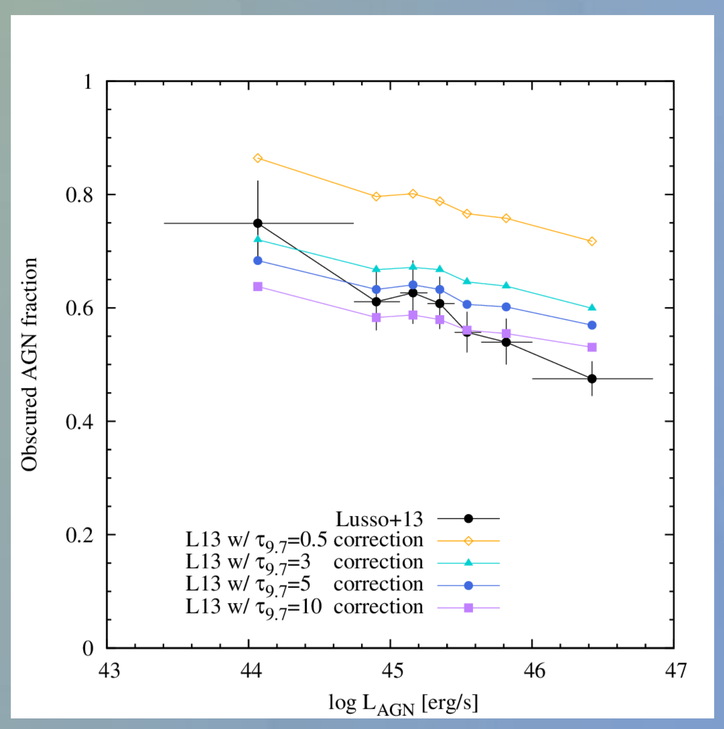
– Use it to correct the observed fraction of obscured AGNs !



Comparing L_{torus}/L_{AGN} to *CF* in our MCRT dusty torus models. *Left*: Cases of isotropic and anisotropic disk emission and optically thin and thick torus. *Middle*: Cases of different optical thickness of the torus. *Right*: total L_{torus} and L_{torus} in NIR-MIR-FIR bands and at 6.7 and 12 μm as proxies of *CF*.

OK, let's see it in action !





Obscured AGN fraction vs. L_{AGN} from Maiolino et al. (2007) (left) and Lusso et al. (2013) (right) in black lines. Colored lines are the same data after applying our corrections. Yellow line is an unrealistic case of optically thin torus. Other lines represent cases of moderate-to-high optical thickness of the torus.

→ The anisotropy of the torus and the accretion disk conspire to make the observed evolution of *CF* with L_{AGN} appear steeper than it actually is !

Stalevski et al. in prep.

Ask me for preprint: marko.stalevski@gmail.com