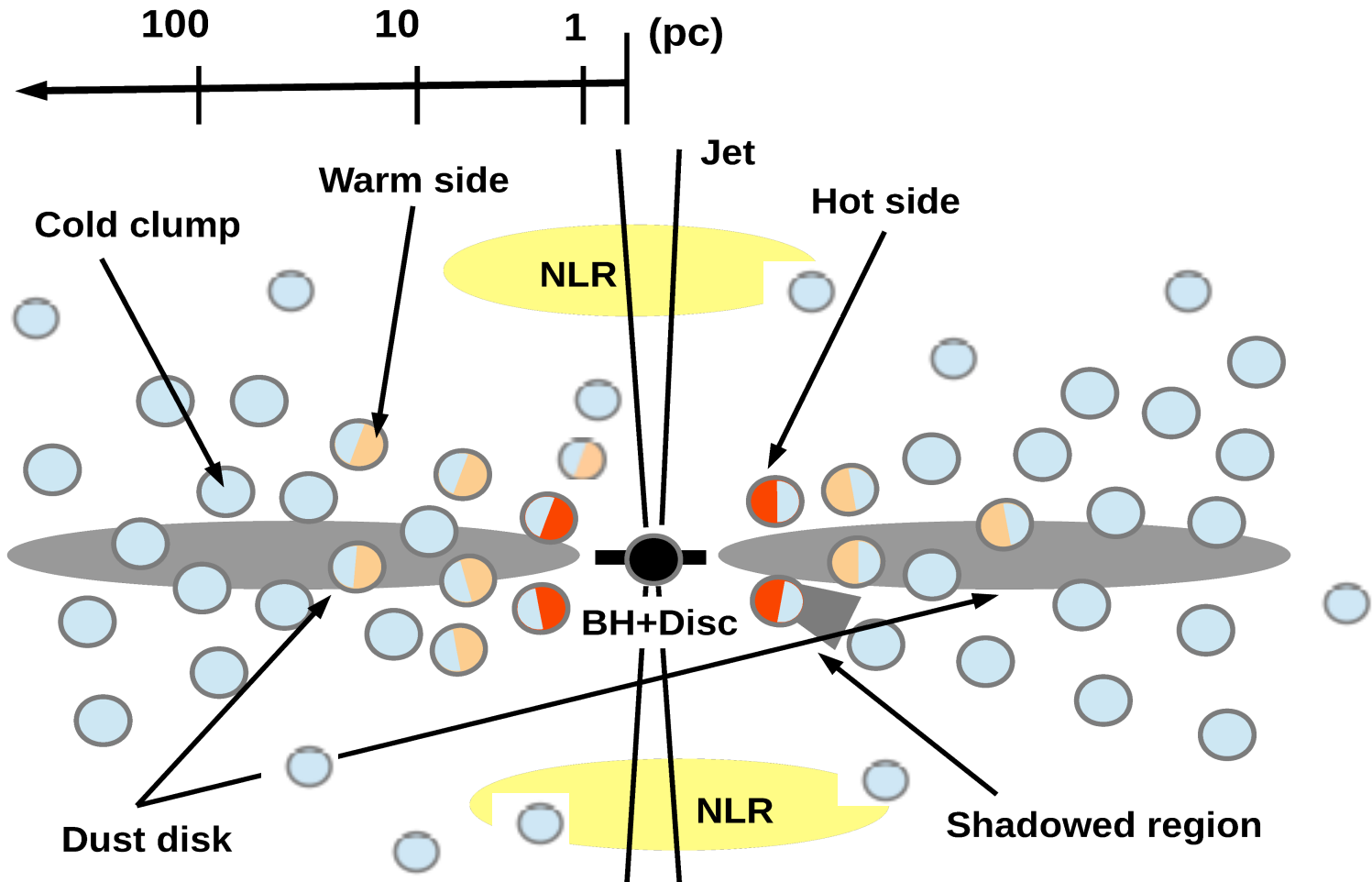


Self-consistent 2phase AGN tours model SED library for observers

Ralf Siebenmorgen, Frank Heymann, Andreas Efsthathiou

Self-consistent 2phase AGN tours model SED library for observers

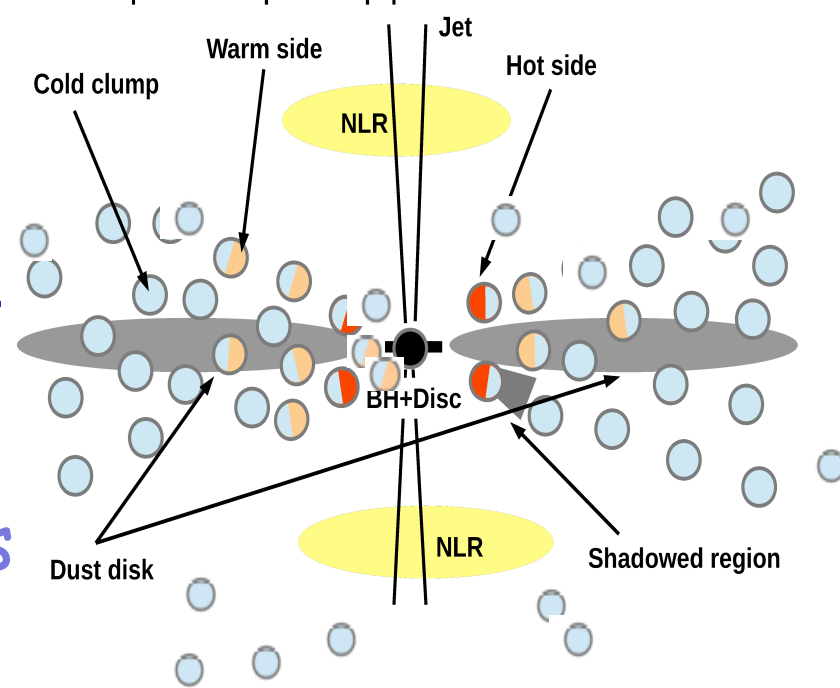
Ralf Siebenmorgen, Frank Heymann, Andreas Efsthathiou



Phenomenology of the AGN dust geometry

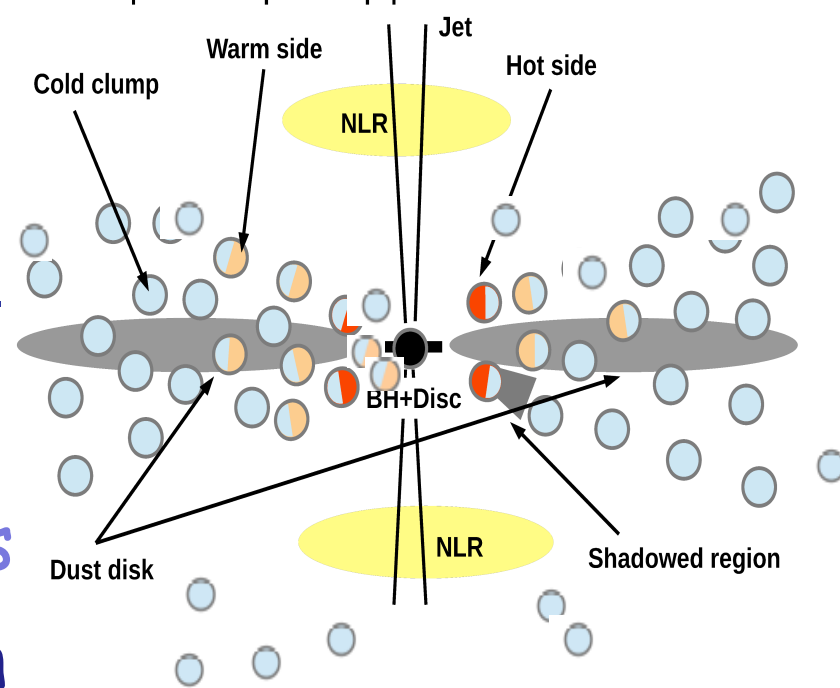
AGN 2phase model

- a) 3D radiative transfer
- b) ISM dust viz. fluffy grains
- c)
- d)



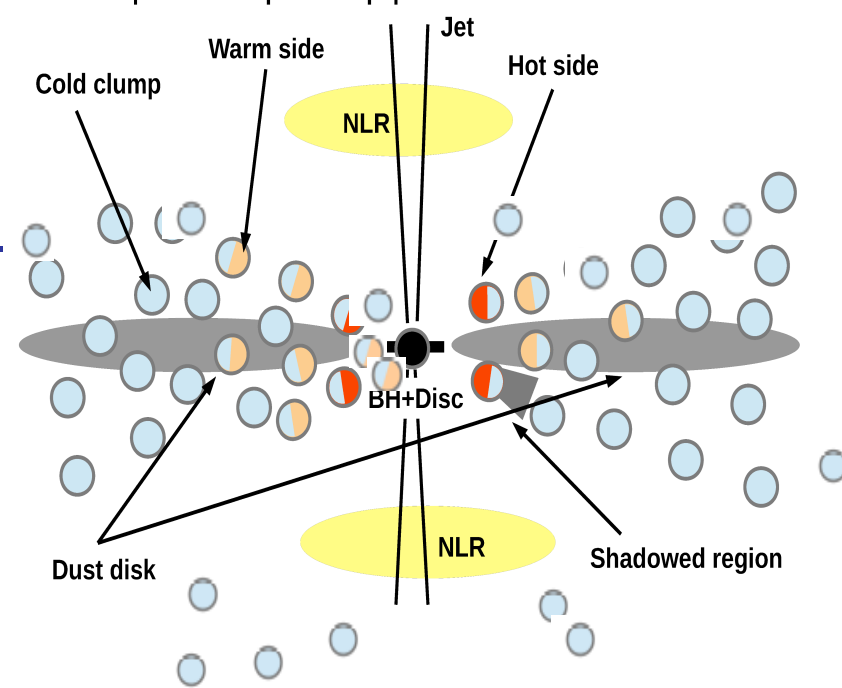
AGN 2phase model

- a) 3D radiative transfer
- b) ISM dust viz. fluffy grains
- c) Caveats on AGN extinction
- d)

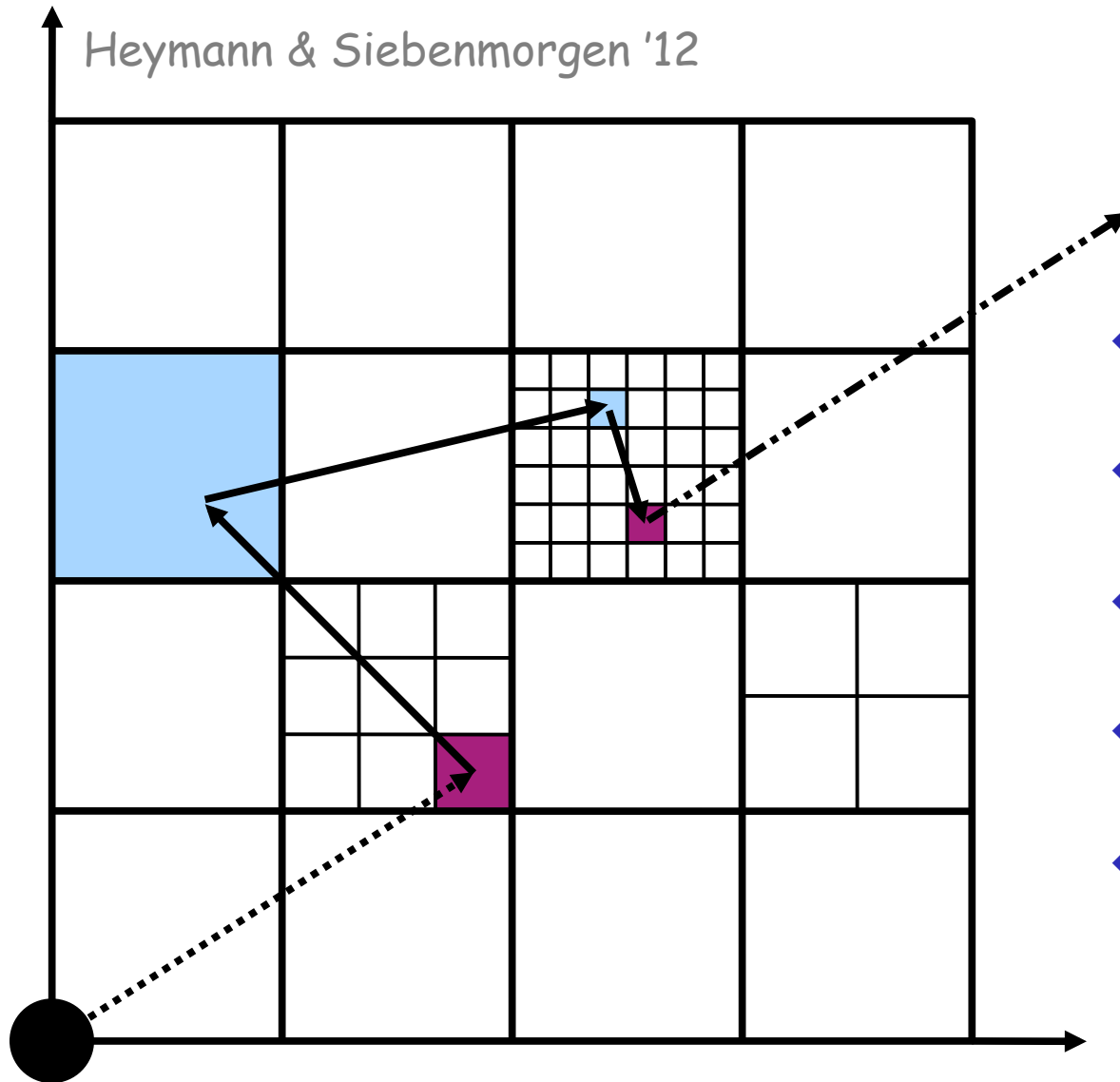


AGN 2phase model

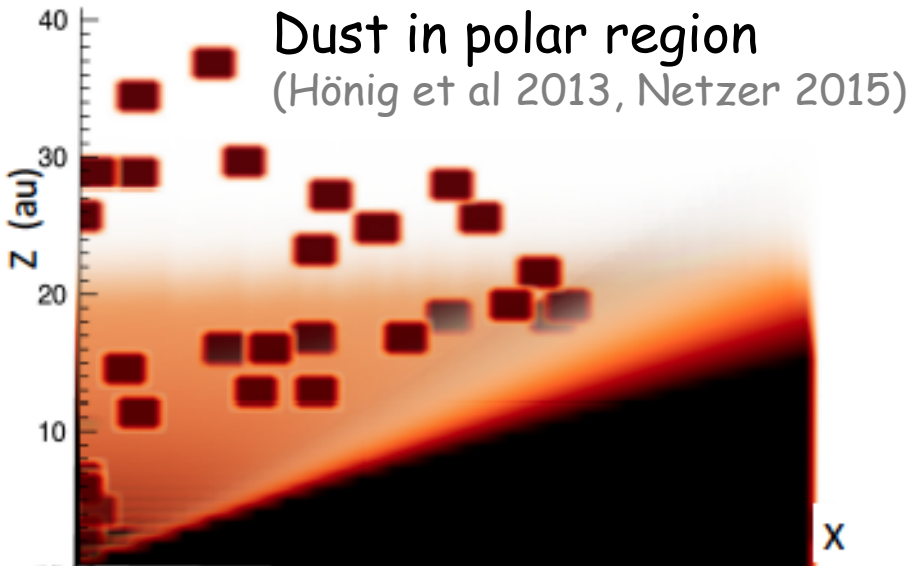
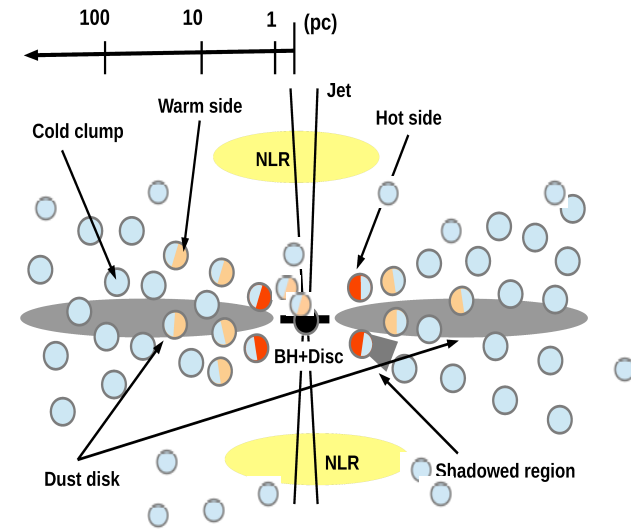
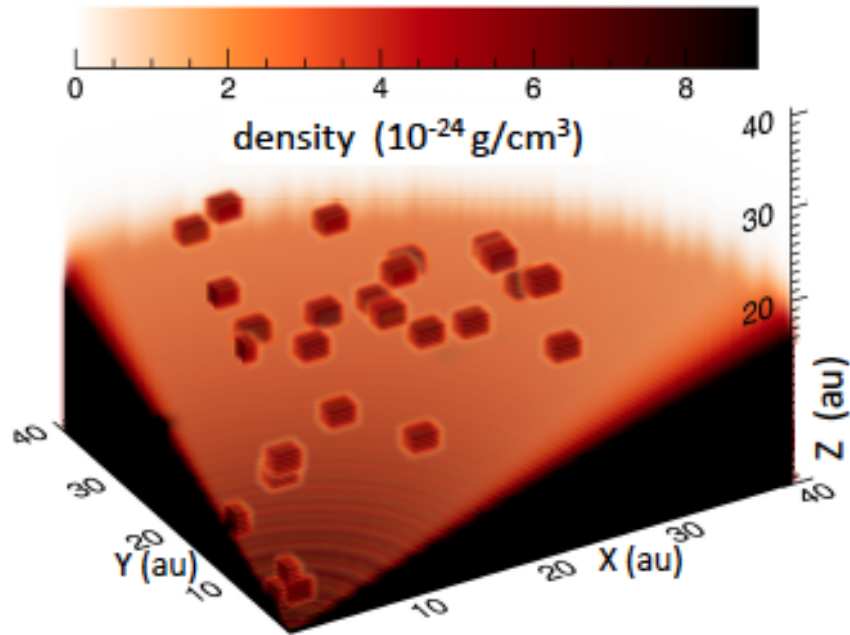
- a) 3D radiative transfer
- b) ISM dust viz. fluffy grains
- c) Caveats on AGN extinction
- d) “ approx. treatments
- e) 5 parameter SED library:
 - NIR, 10 μ m band, intrinsic L_{AGN}
 - IRAC colors (Stern'05)
 - Seyferts \sim AGN + host
 - Type I+II \sim pure AGN



Monte Carlo dust radiative transfer

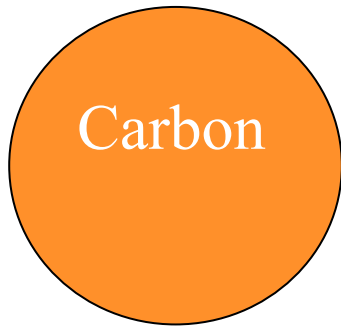


- ◆ Adaptive 3D mesh
- ◆ Source
- ◆ Inter-action
- ◆ Temperature
- ◆ Detection



Dust density
distribution

diffuse ISM dust \longleftrightarrow fluffy grains



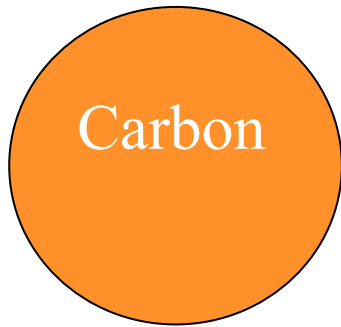
+



diffuse ISM
 $n \sim 1 \text{ atom/cm}^3$

Draine'11, Feltre et al 2012, Siebenmorgen et al. 2014

diffuse ISM dust \longleftrightarrow fluffy grains

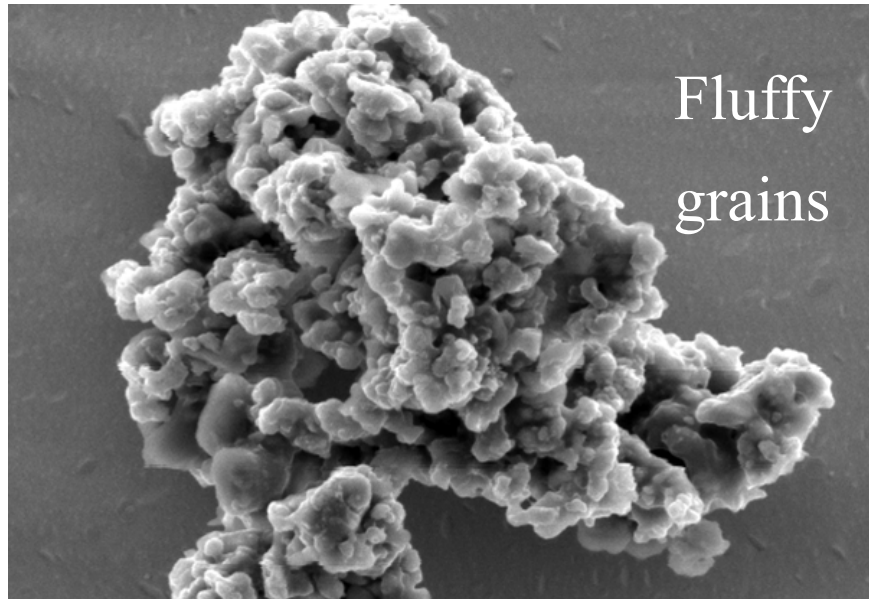


+



diffuse ISM
 $n \sim 1 \text{ atom/cm}^3$

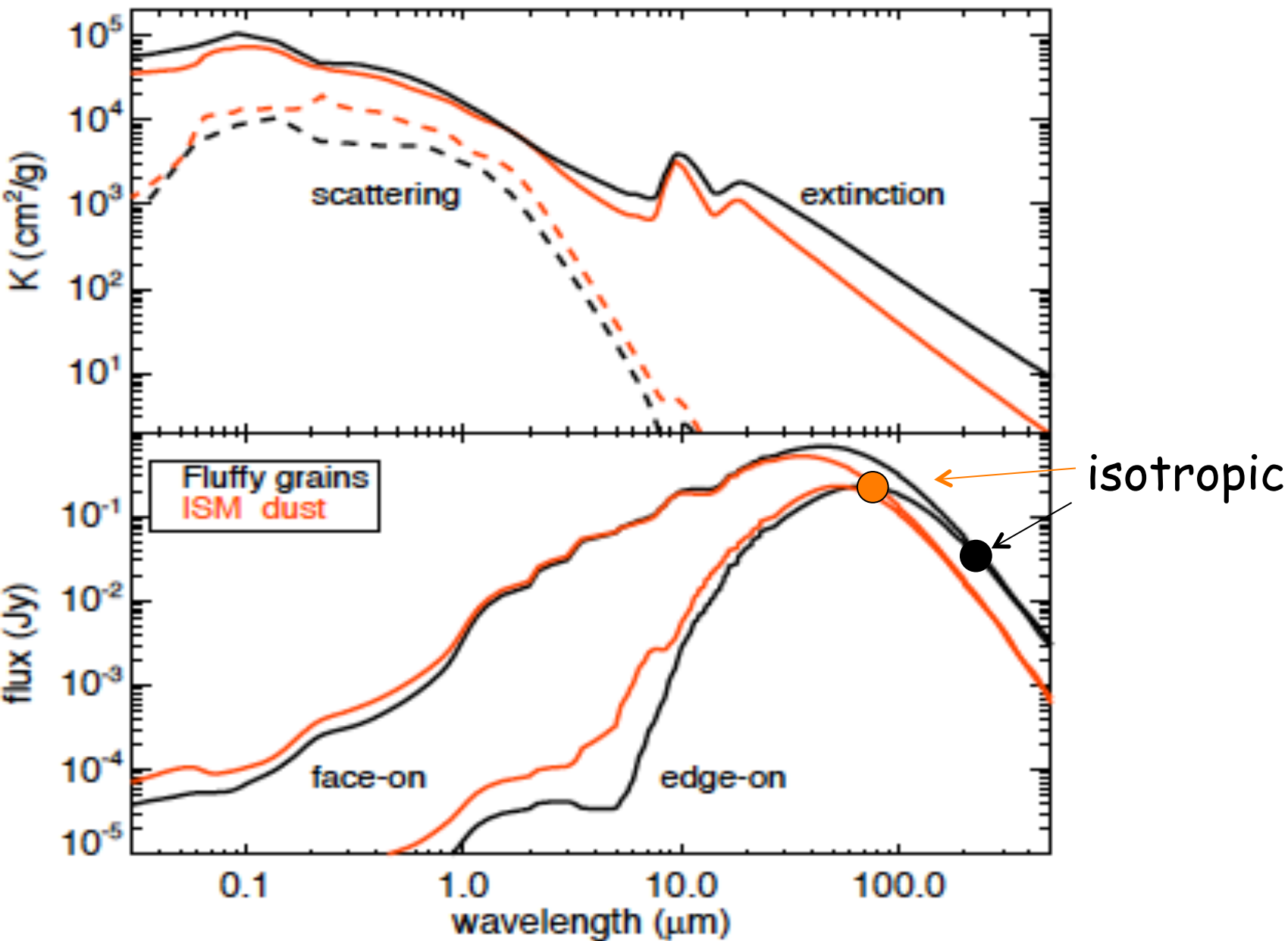
Draine'11, Feltre et al 2012, Siebenmorgen et al. 2014



AGN dust
 $n \sim 10^{2..6} \text{ atom/cm}^3$

Krügel & Siebenmorgen 1994

diffuse ISM dust \longleftrightarrow fluffy grains



Caveat on extinction measurements

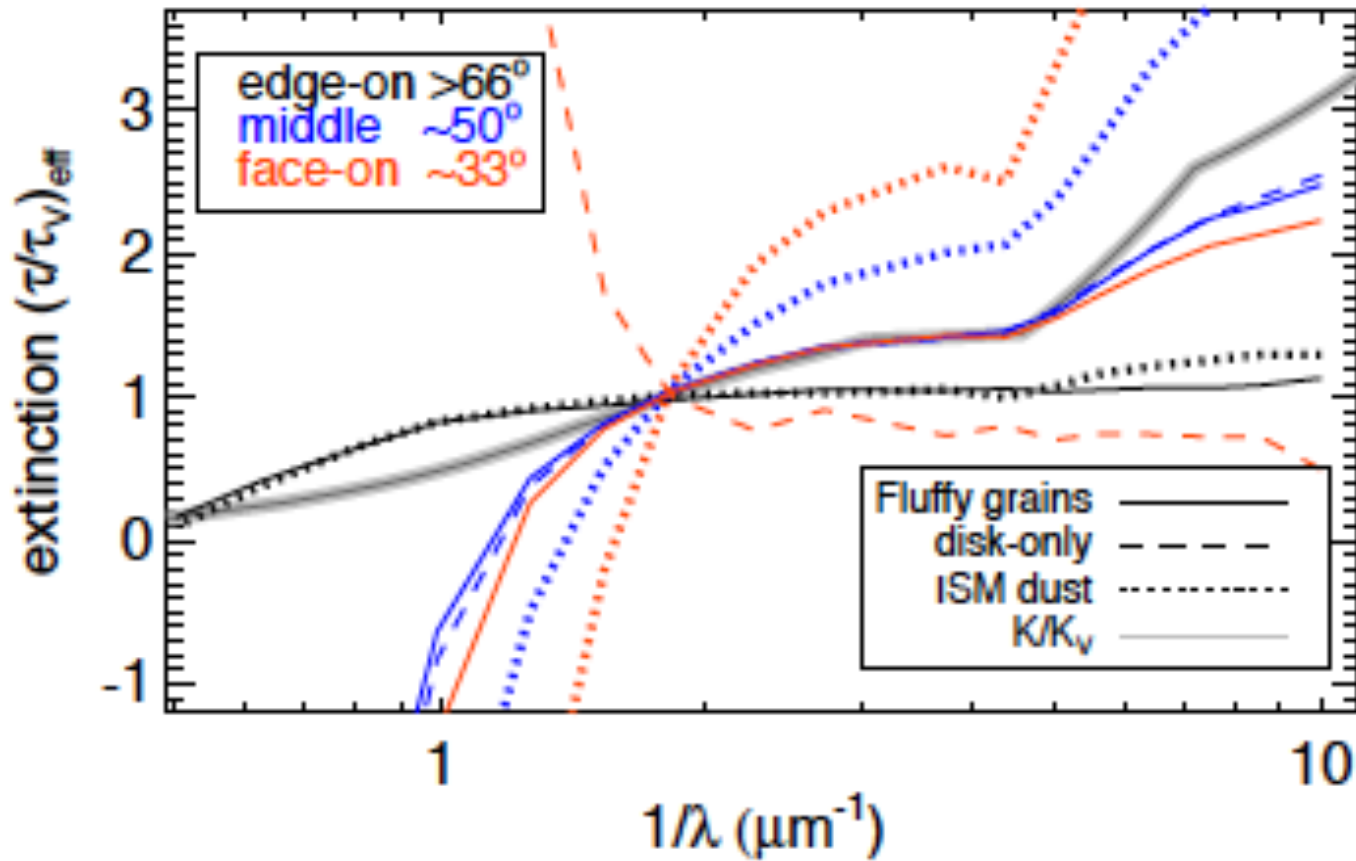
ISM dust \times scattering medium



SMC extinction curve

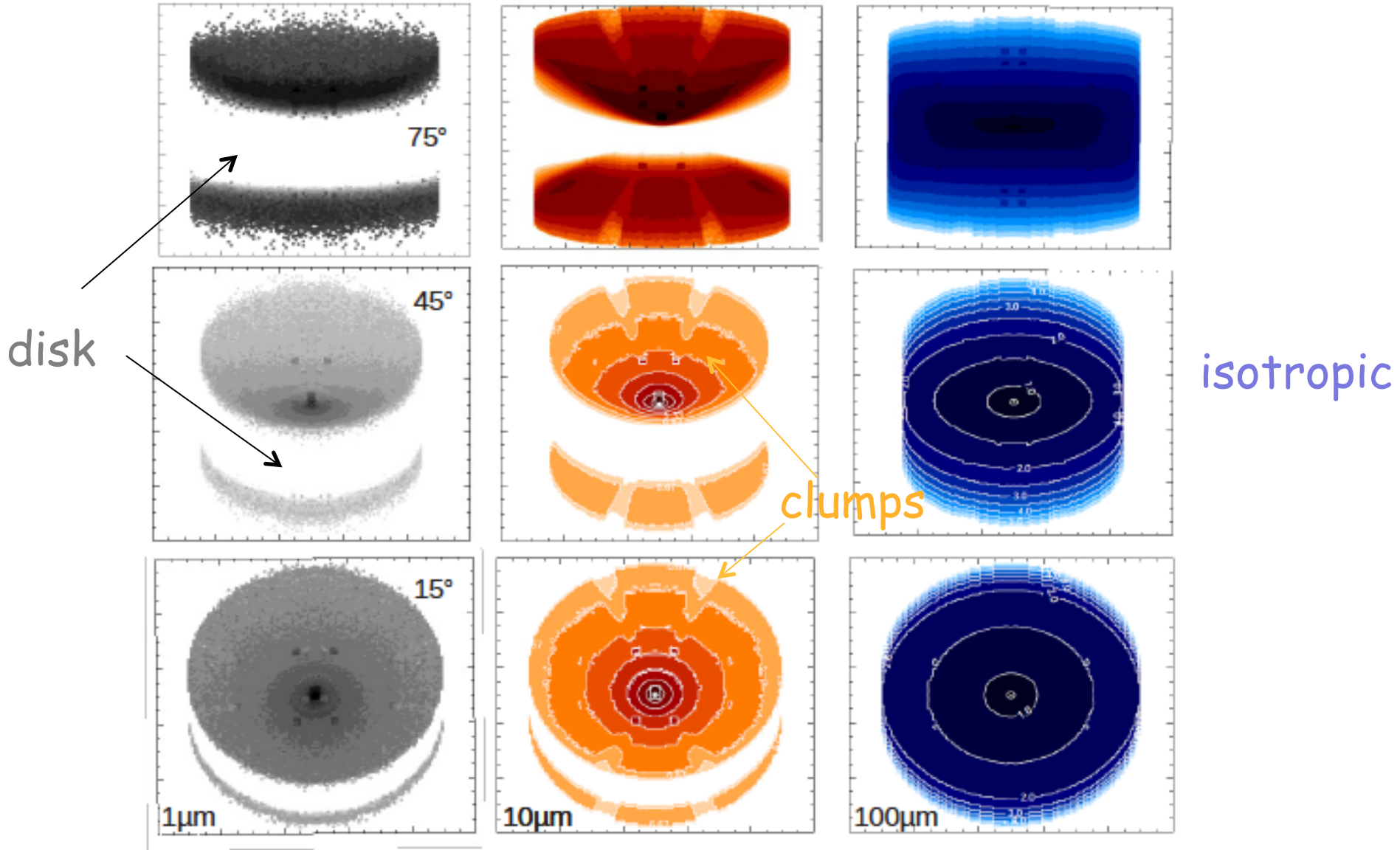
(Krügel 2009)

AGN torus extinction \leftrightarrow viewing angle



-> no 1:1 link to dust properties

AGN imaging



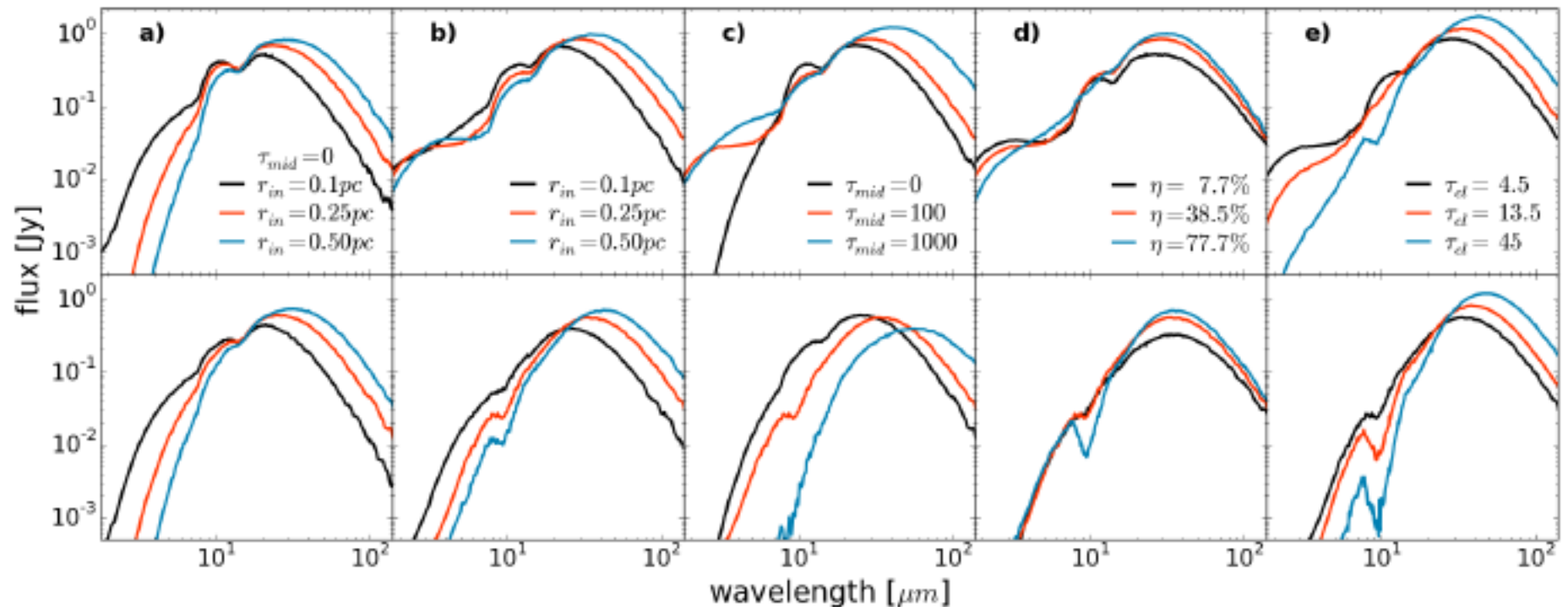
SED library

Parameter	Symbol
Viewing angle ^{a)}	θ ($^\circ$)
Inner radius	r_{in} (10^{17} cm)
Cloud volume filling factor ^{b)}	η (%)
Cloud optical depth ^{c)}	τ_{cl}
Optical depth of disk midplane ^{d)}	τ_{mid}

5 free parameters to reduce degeneracy
Library includes ~3600 SEDs

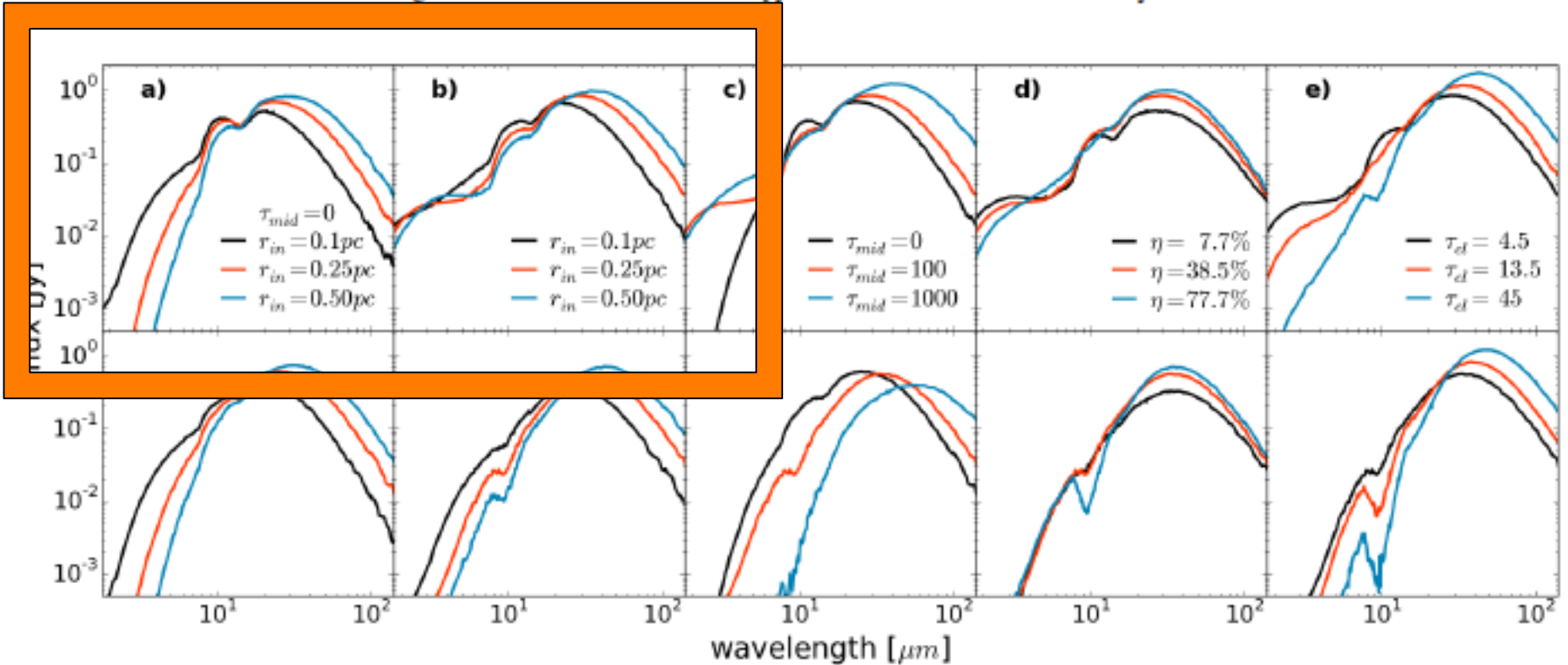
Impact of parameters on SED

Ralf Siebenmorgen et al.: Self-consistent clumpy AGN torus models: SED library for observers

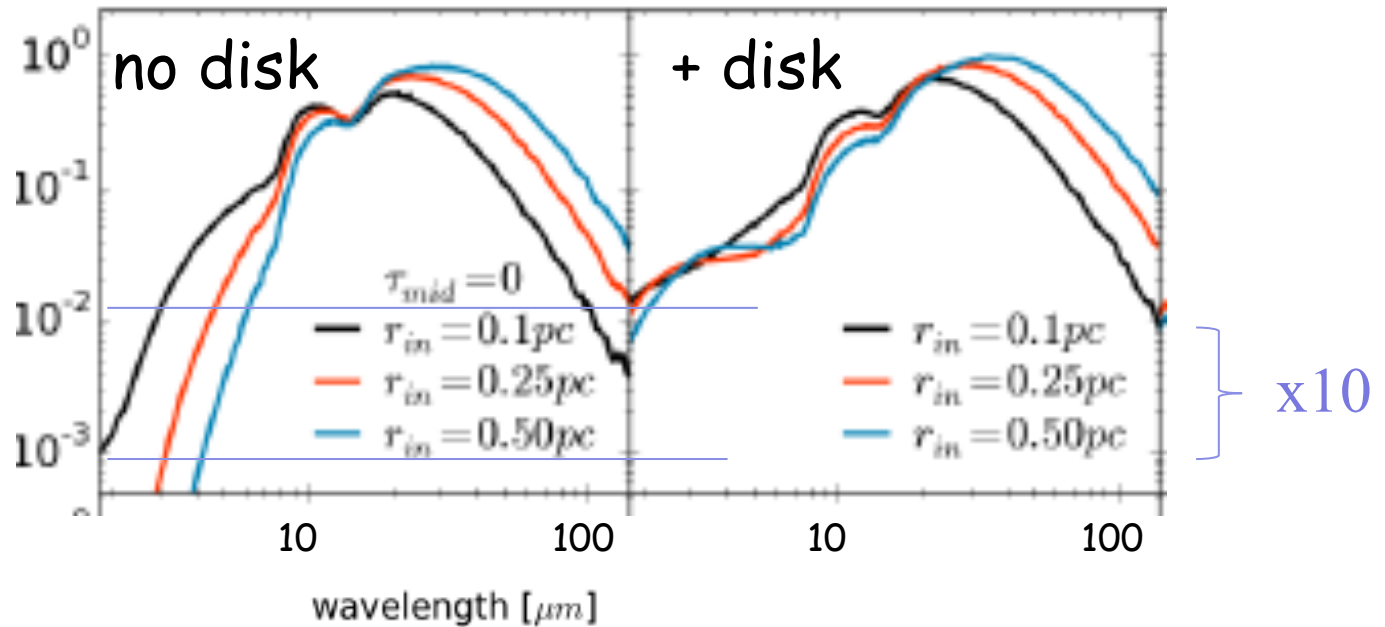


Impact of parameters on SED

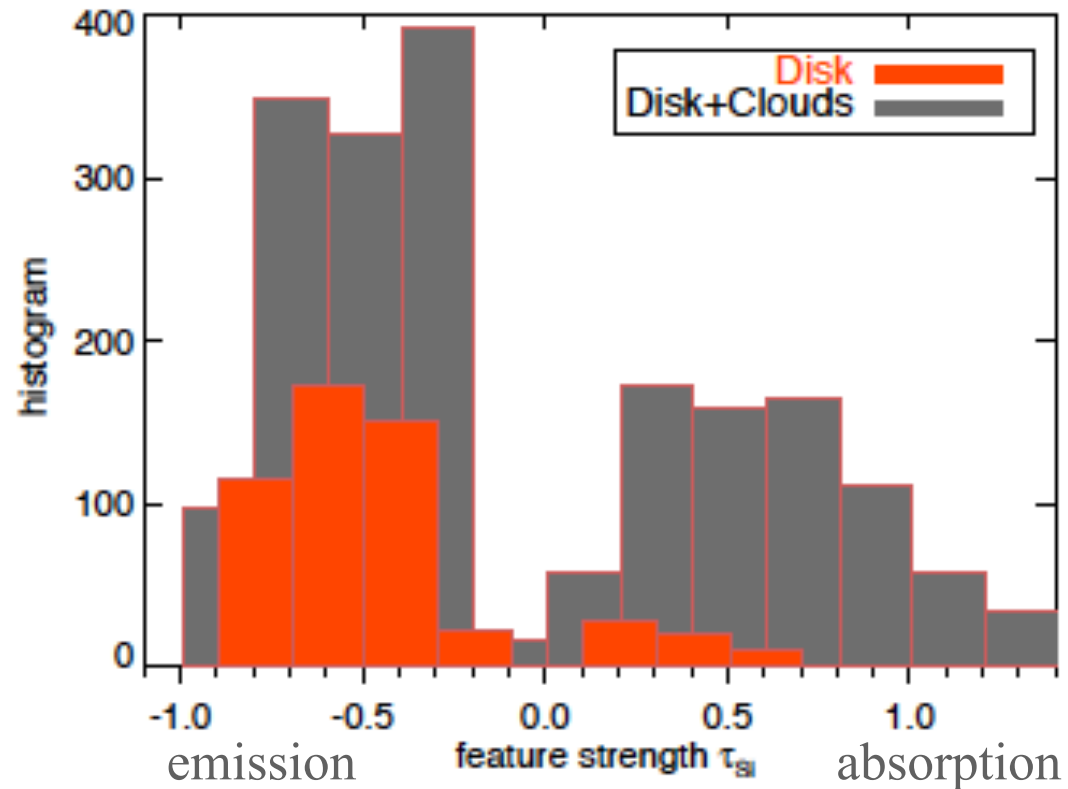
Ralf Siebenmorgen et al.: Self-consistent clumpy AGN torus models: SED library for observers



NIR fluxes enhanced by disk



Strength of the 10 μ m silicate band



Levenson et al 2008

Schartmann et al 2008

Sirocky et al 2008

Thompson et al 2009

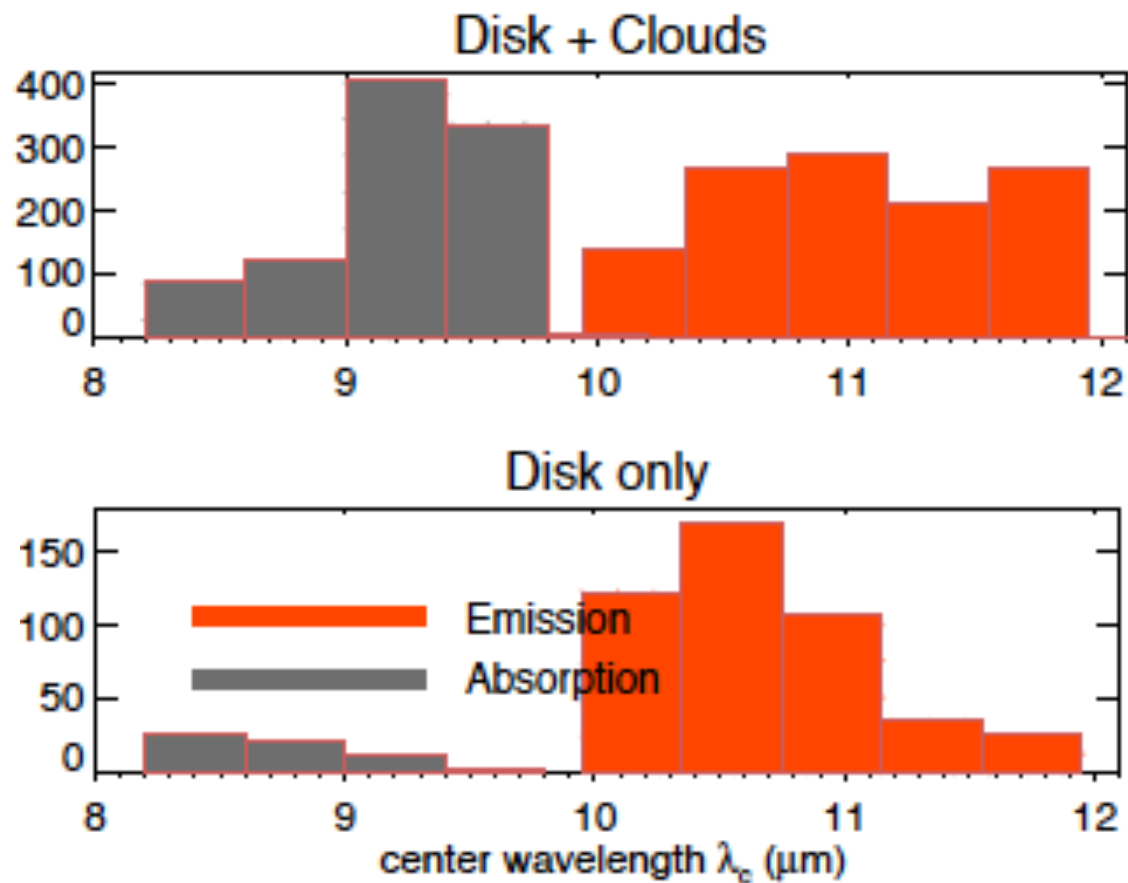
Hatziminaoglou et al. 20015

Ralf Siebenmorgen

$$\tau_{\text{Si}} = - \ln \left(\frac{F_{\text{peak}}}{F_{\text{cont}}} \right)$$

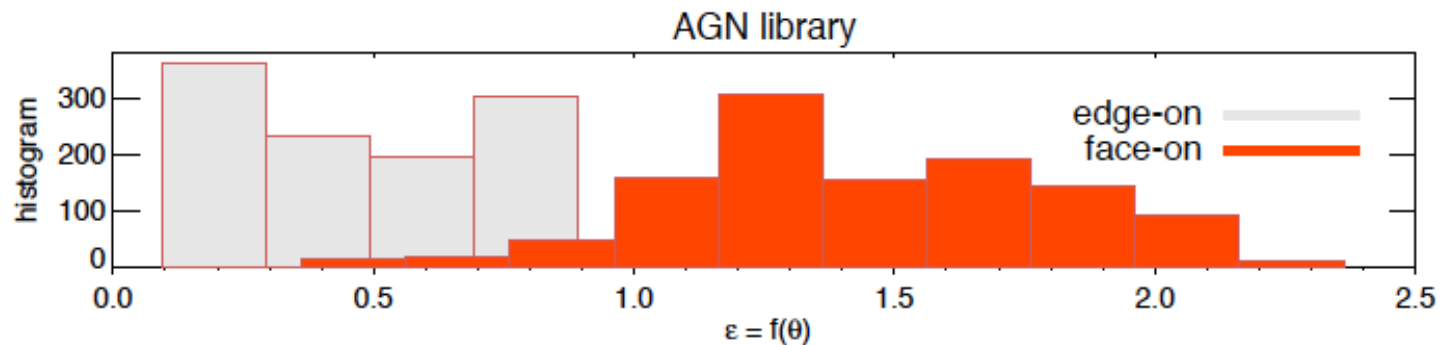
Cyprus 2015

Center wavelength of the 10 μ m feature



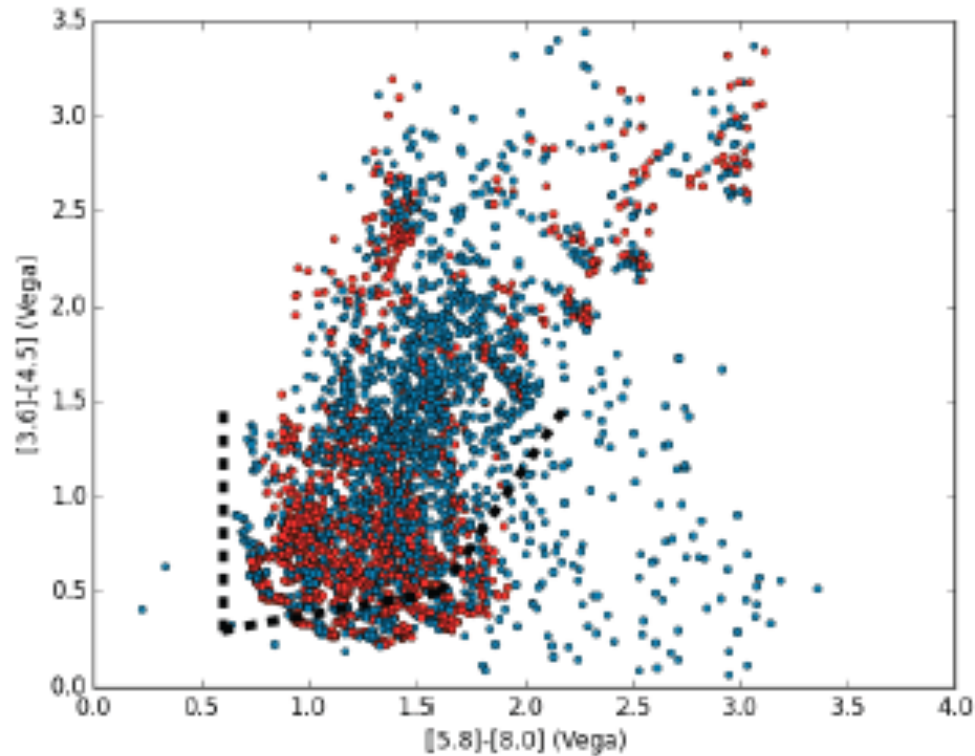
Intrinsic AGN luminosity L_{AGN}

$$\epsilon = \frac{F(\theta)}{F_{\text{nd}}} = \frac{L_{\text{obs}}(\theta)}{L_{\text{AGN}}/9}$$

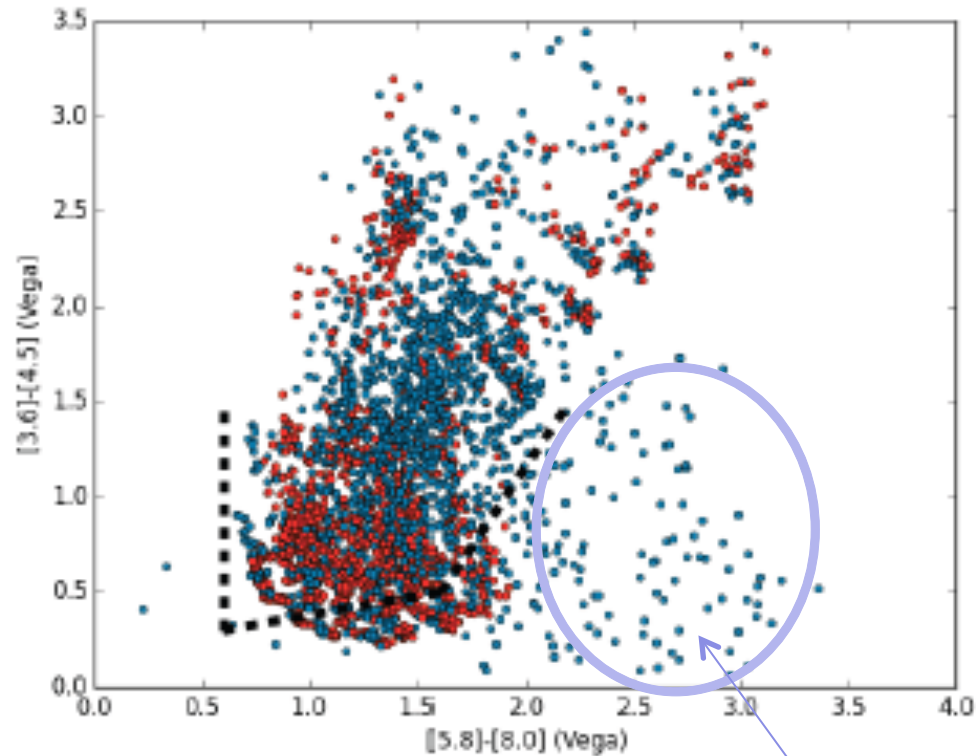


(assuming isotropic AGN emission, Stalevski et al 2012)

Library \leftrightarrow IRAC colors of AGN (Stern'05)



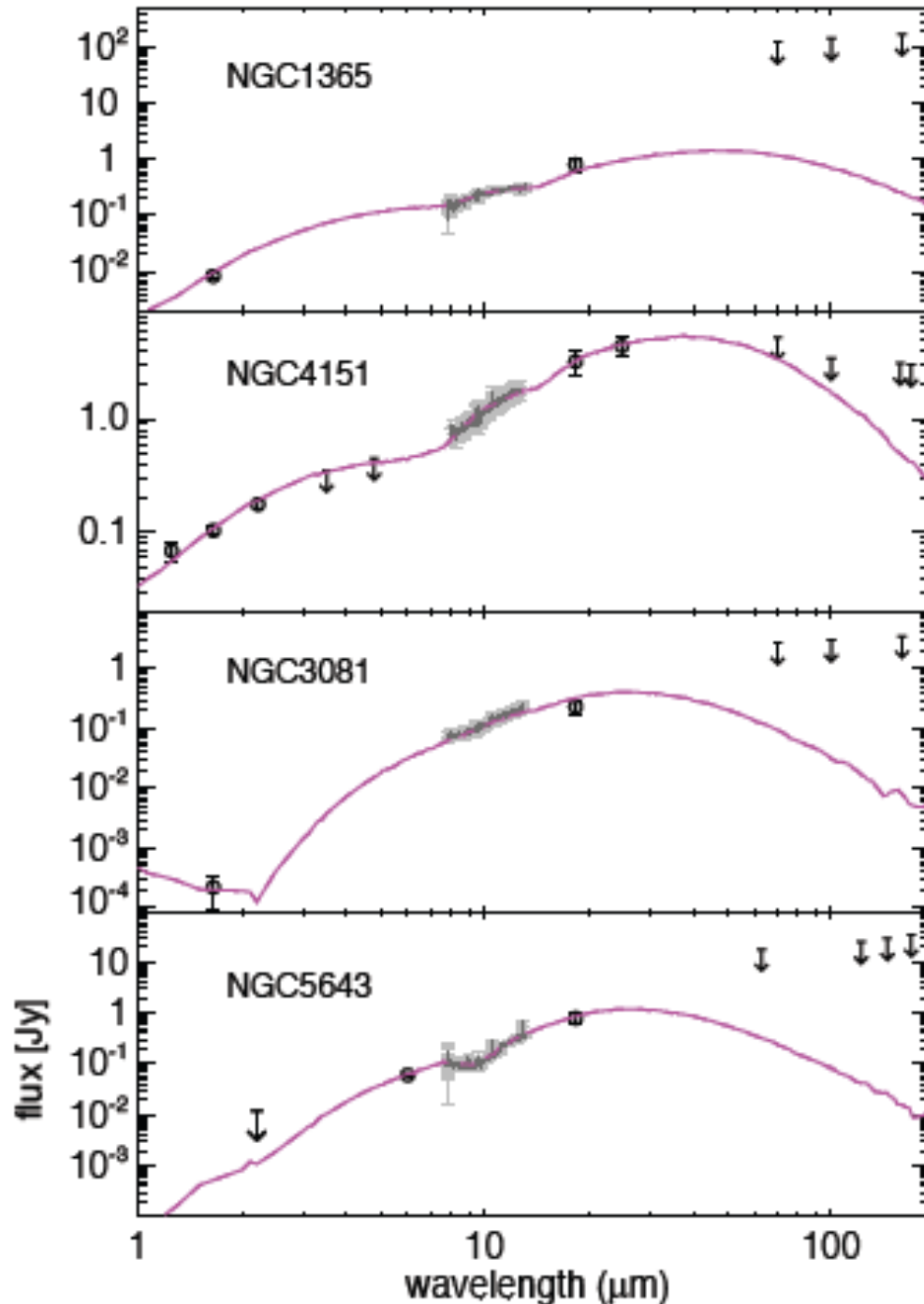
Library \leftrightarrow IRAC colors of AGN (Stern'05)



edge-on, high extinction AGN

Seyferts

High spatial resolution data:
Ramos-Almeida et al. (2014)



Ground based MIR:

Alonso Herrero et al 2011

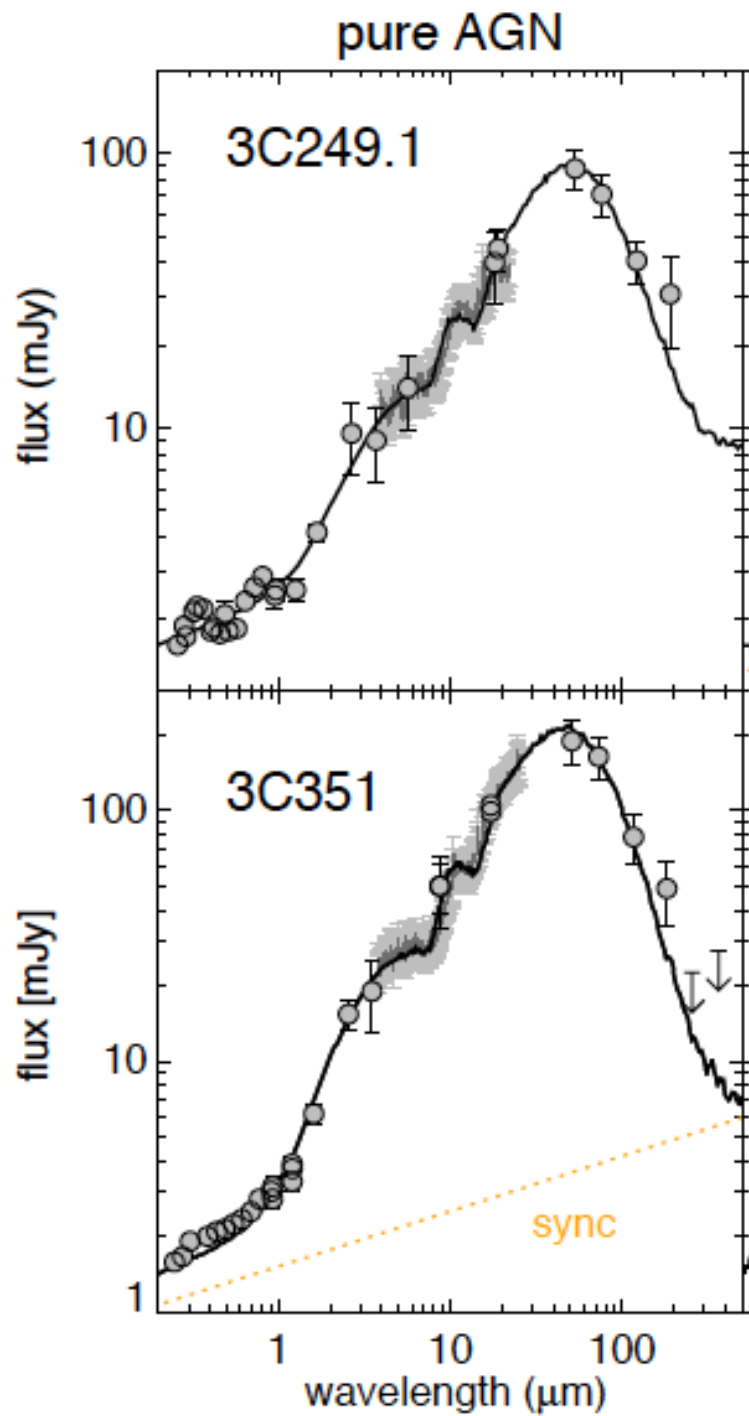
Gonzales- Martin et al 2013

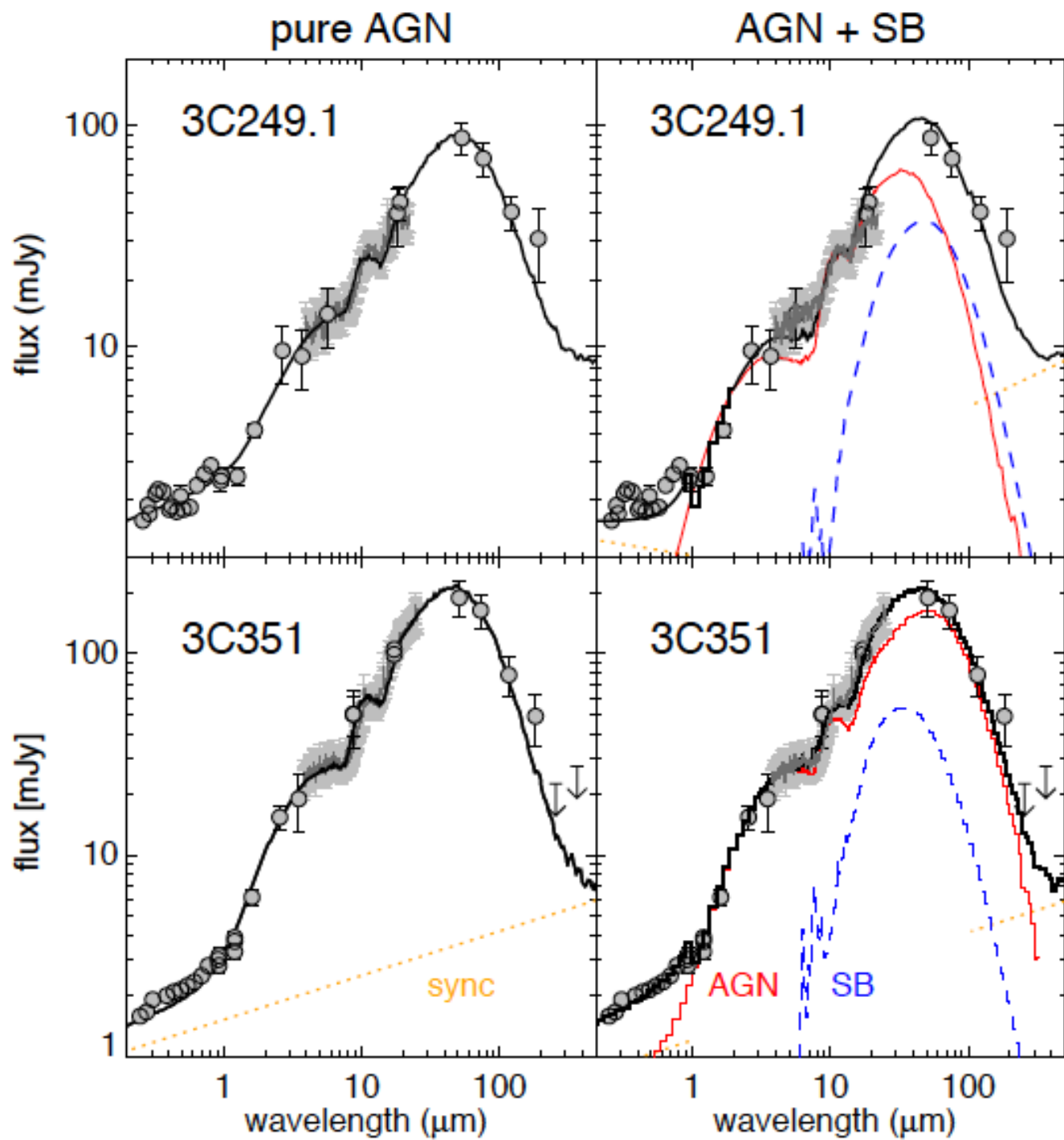
Esquej et al. 2014

Ruschel-Dutra et al 2014

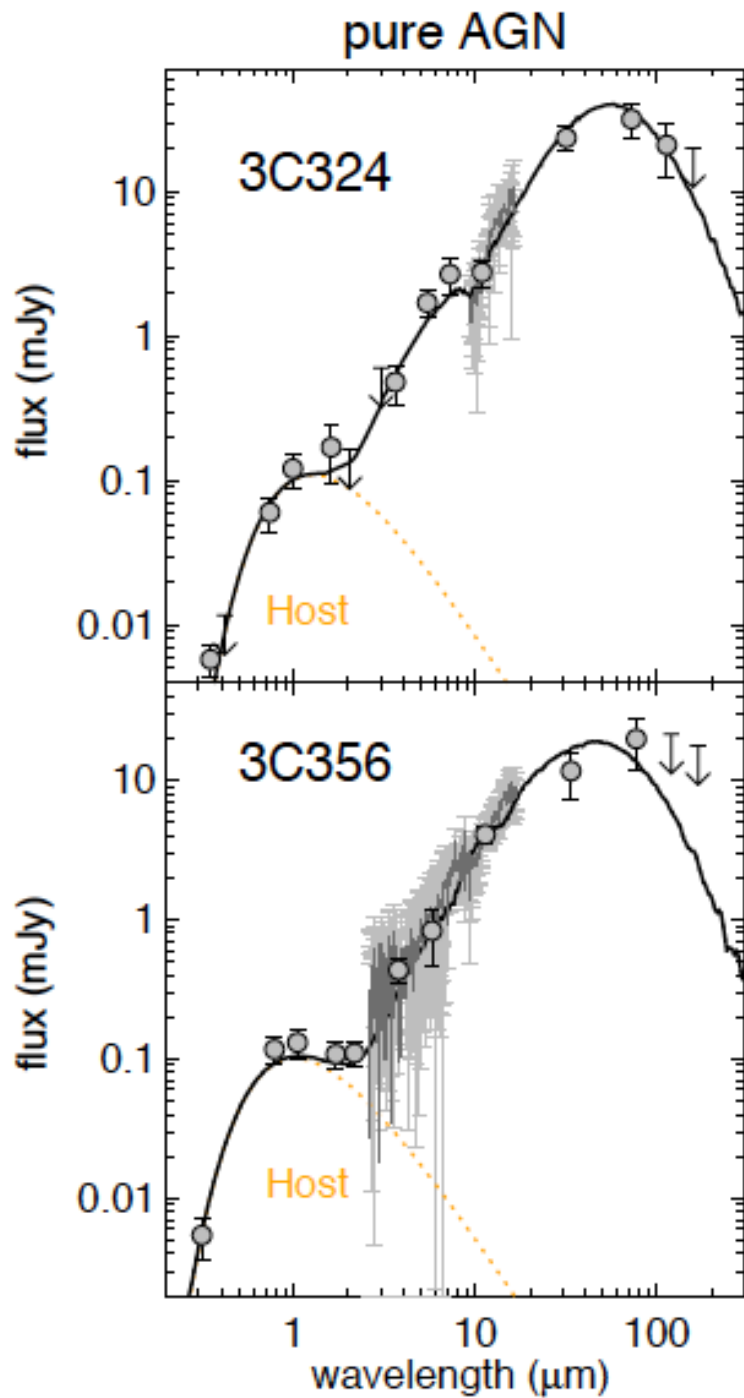
Ichikawa et al 2015, ...

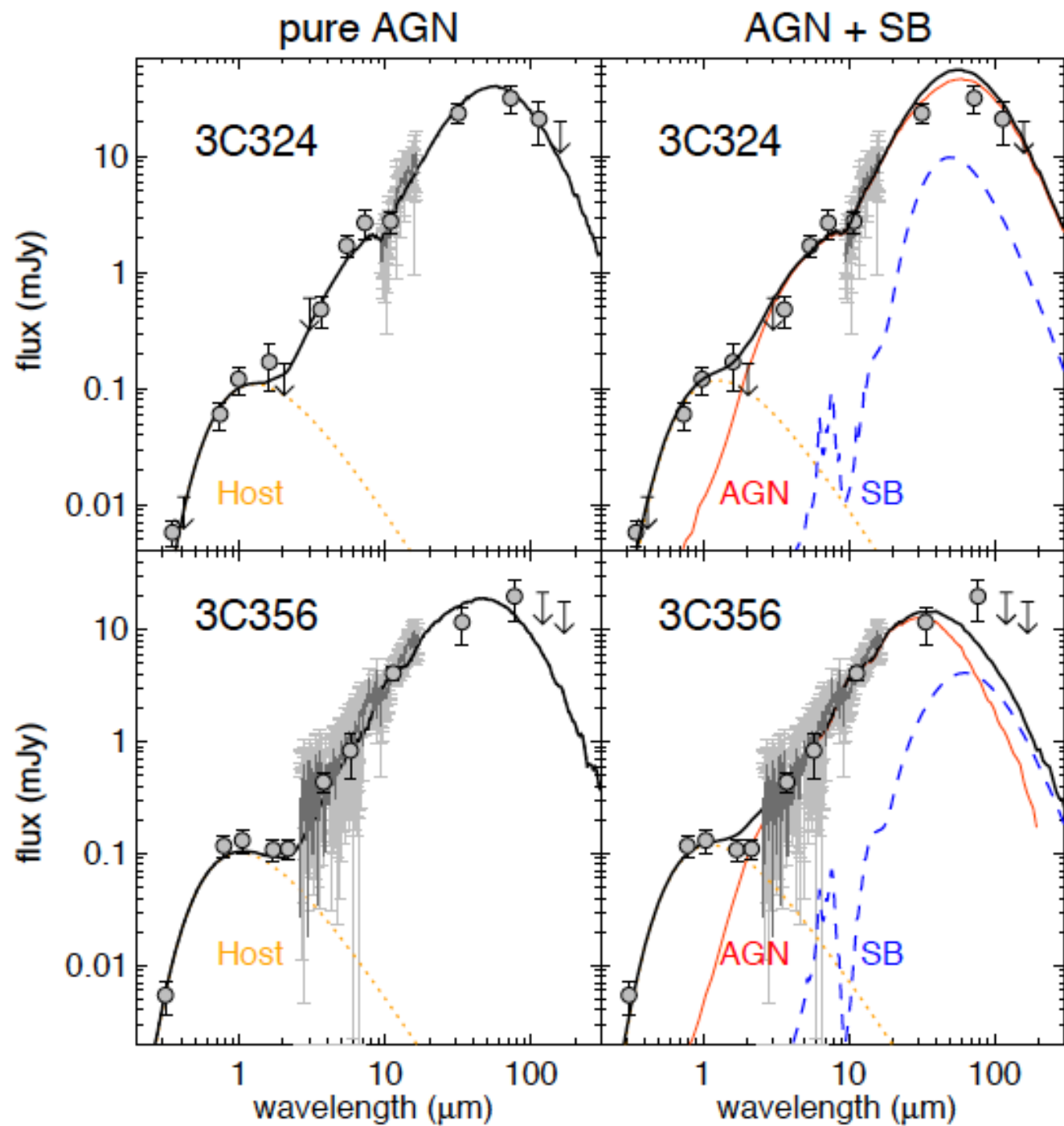
Type I





Type II





Hyper-luminous galaxy

