The nature and structure of obscuration

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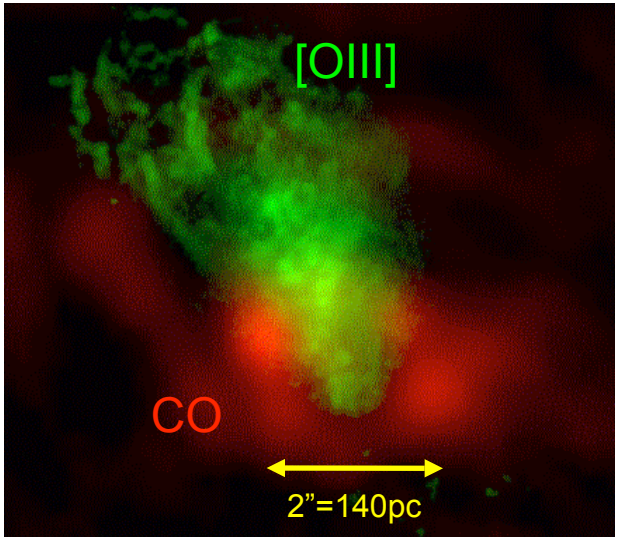
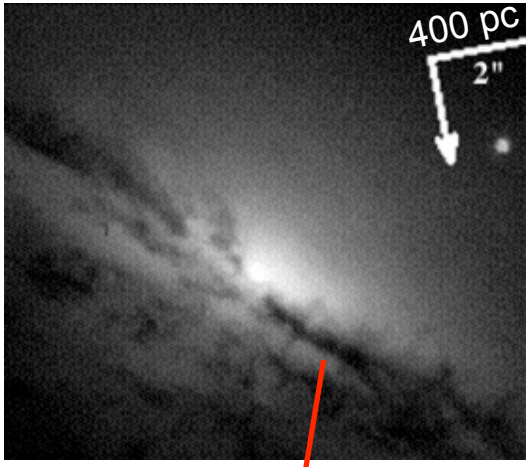
Obscuration on large scales (≳100 pc)

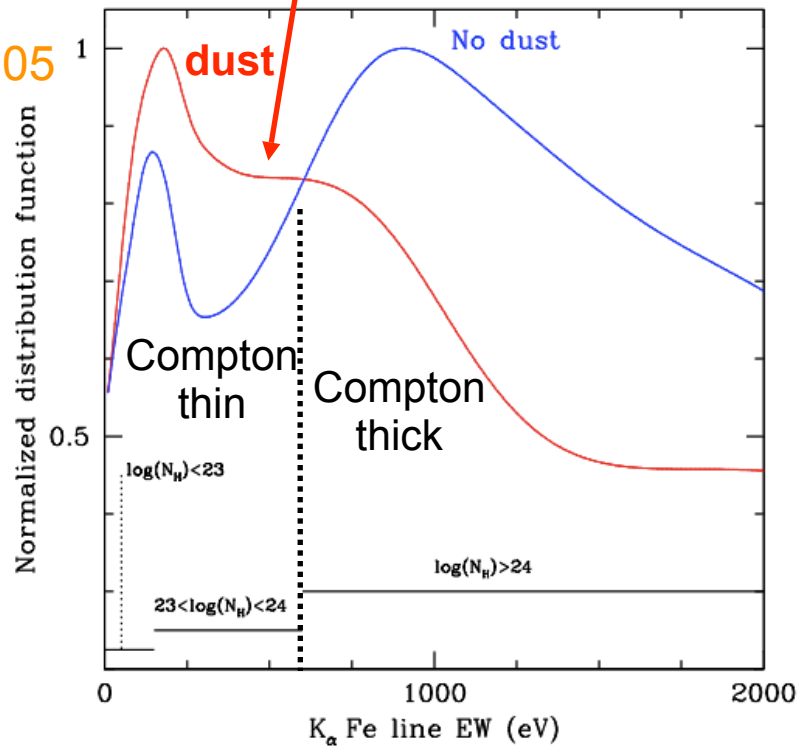


Schinnerer+00
Tacconi+



Malkan+97

Guainazzi+05

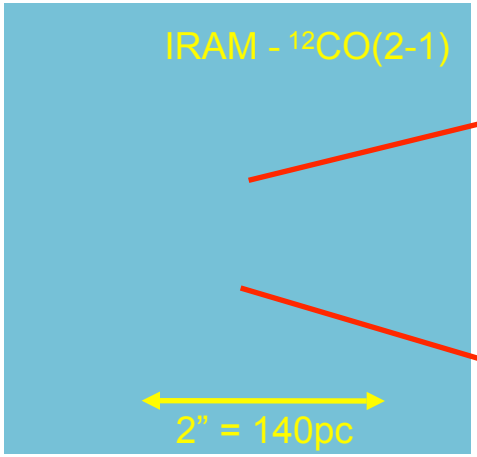


dust lanes
molecular rings/disks
host galaxy obsuration

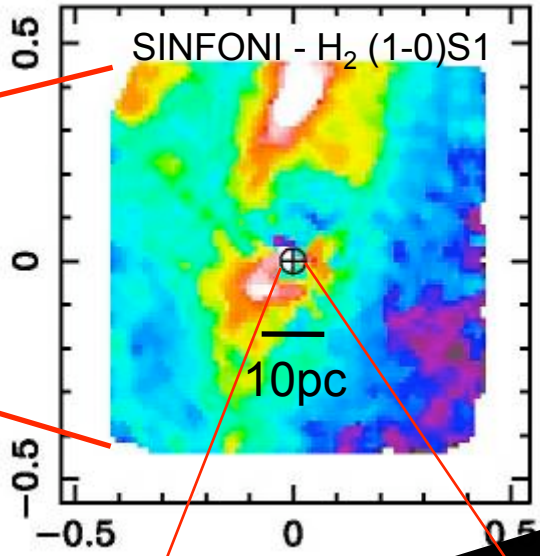
Compton thin
A_V ~ a few mags

Obscuration on small scales («100pc)

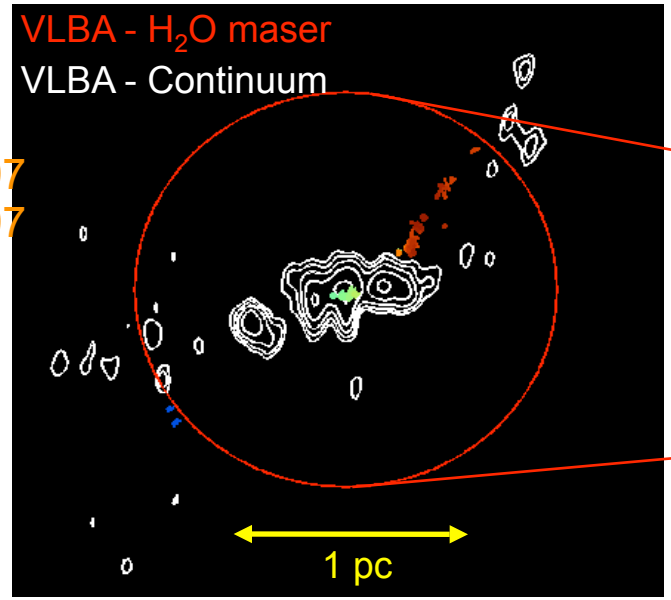
NGC1068



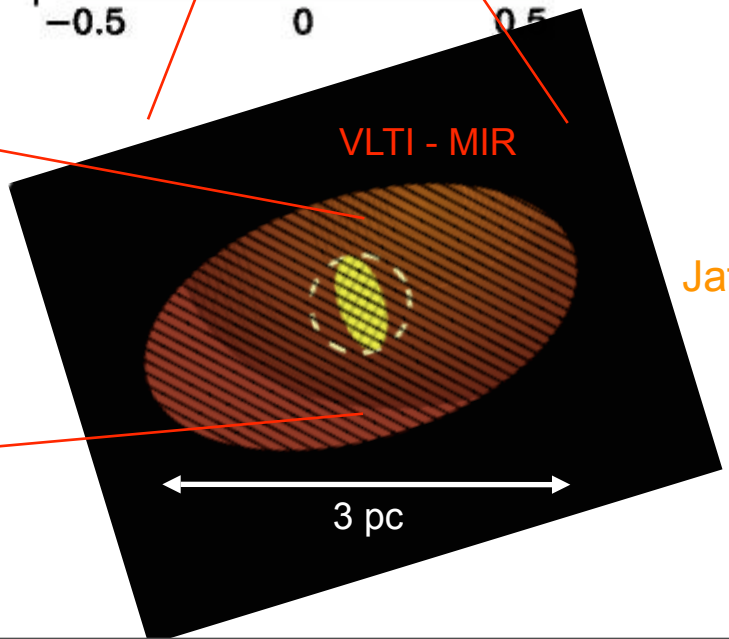
Schinnerer+00



Davies+07

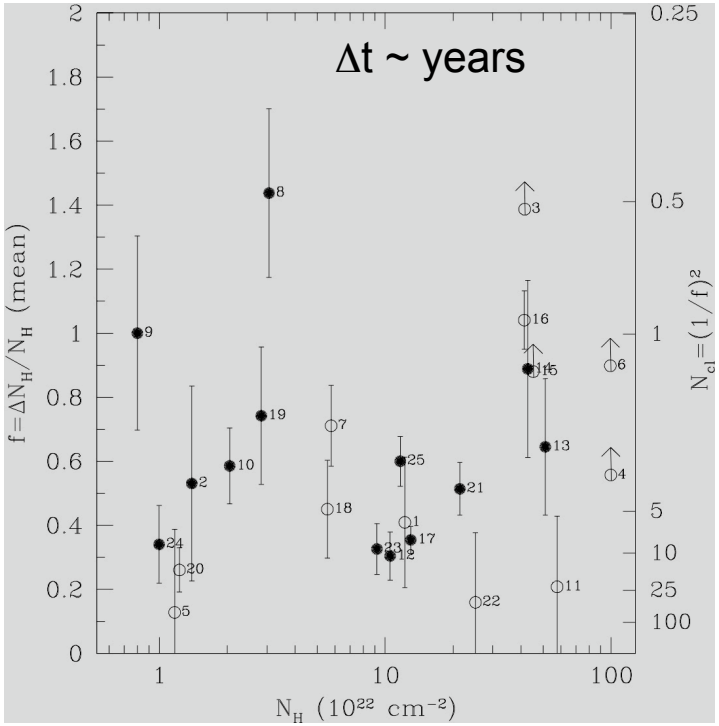


Greenhill+97
Gallimore+97

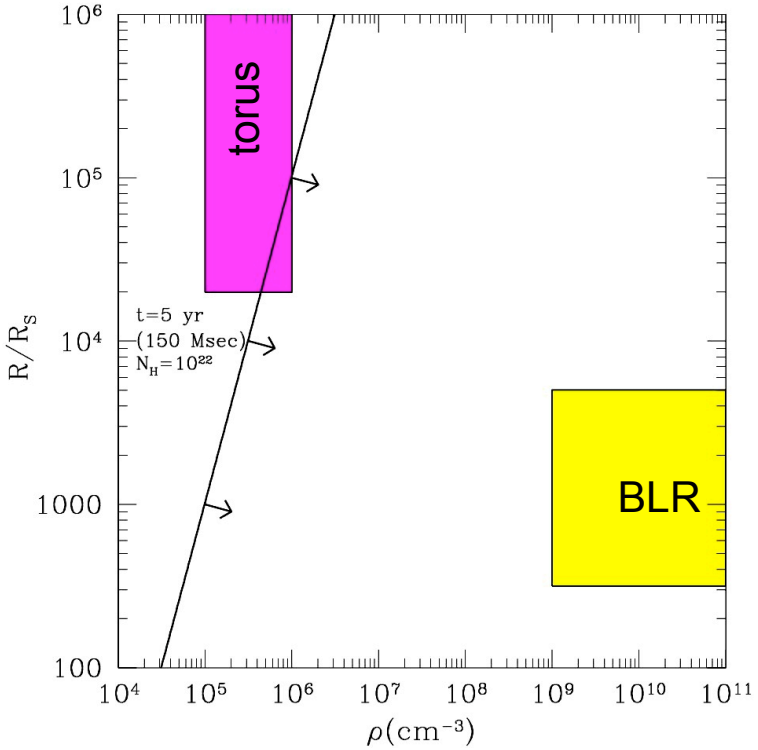


Jaffe+04

X-ray absorption on small scales: N_H variability



Risaliti+ 02



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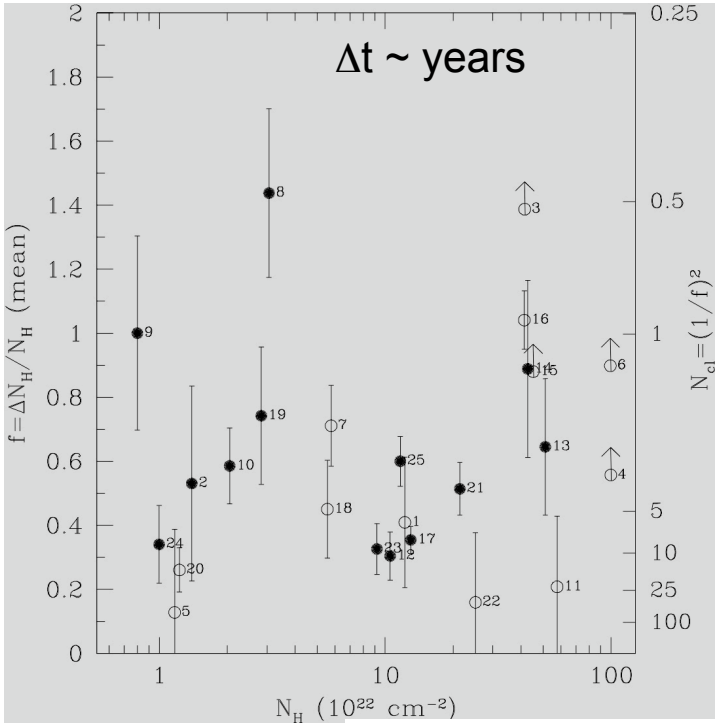

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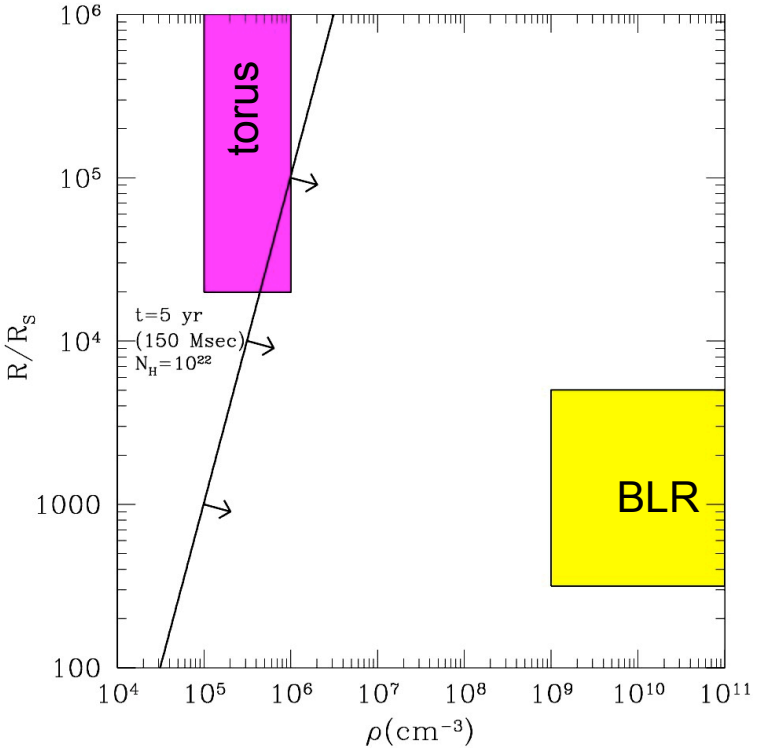
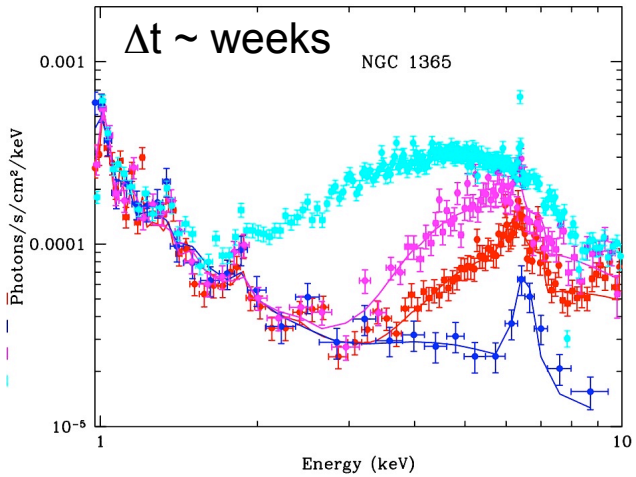
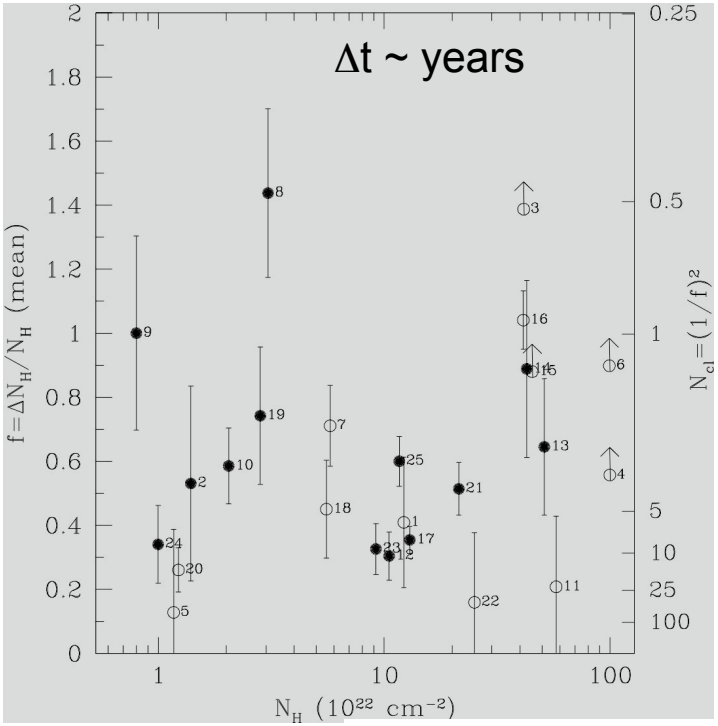


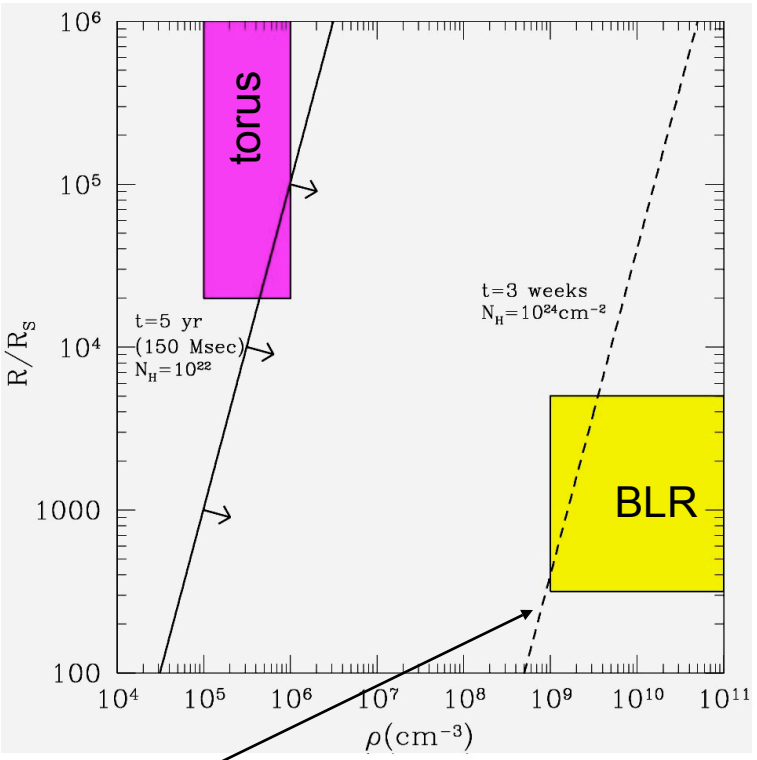


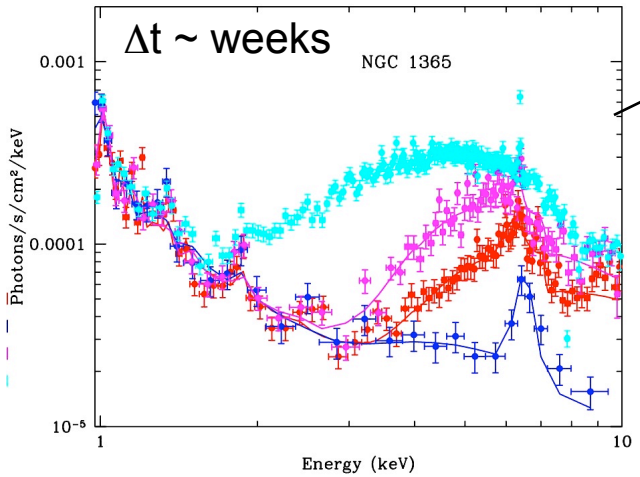
Risaliti+ 06
Elvis+ 05
Puccetti+ 06

X-ray absorption on small scales: N_H variability



Risaliti+ 02



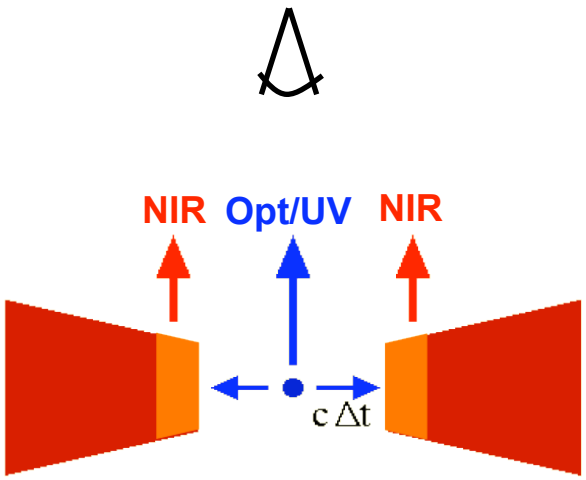


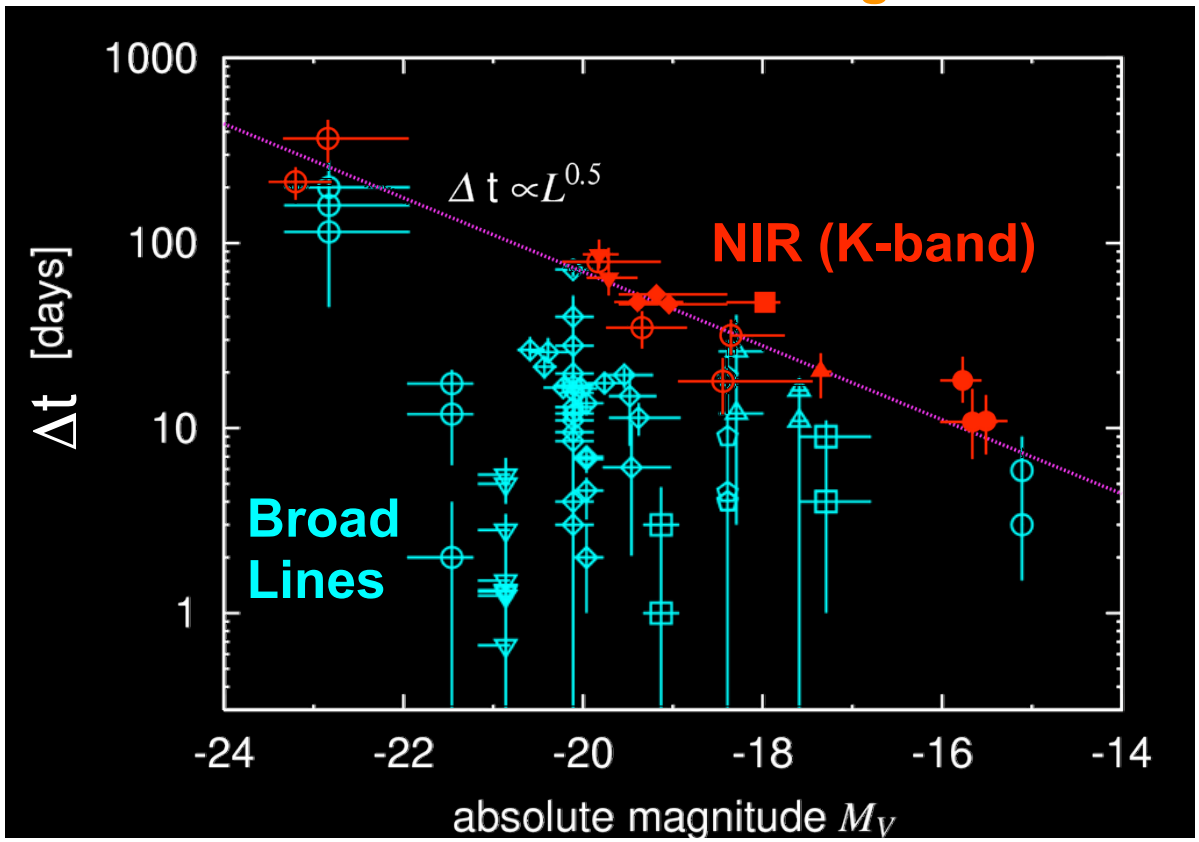
Risaliti+ 06
Elvis+ 05
Puccetti+ 06

Dust absorption on small scales: inner radius ~ sublimation radius > BLR

Sy1's near-IR reverberation

Suganuma+06





$R_{in} \propto L^{0.5}$

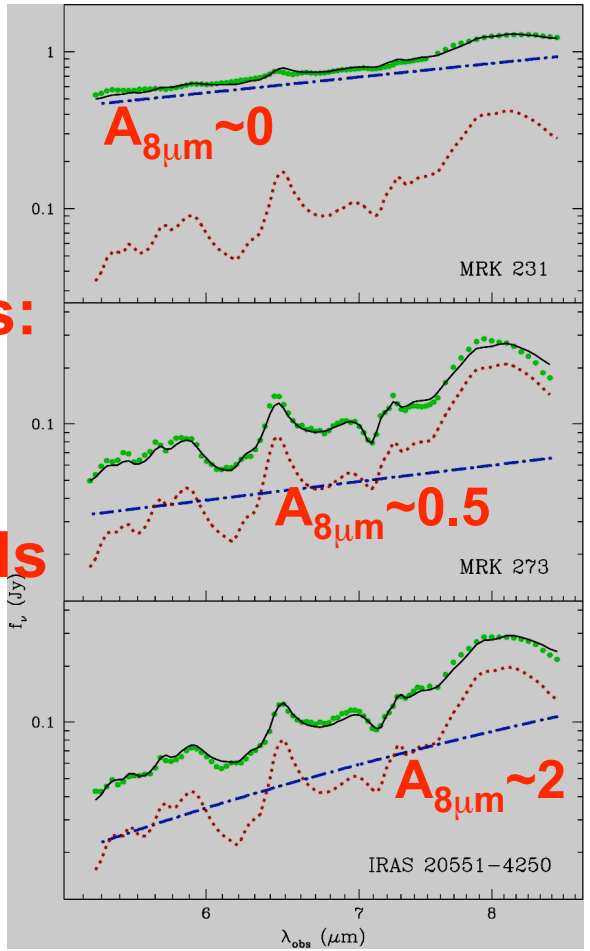
0.01 - 0.3 pc

Bulk of X-ray absorption ~ BLR < dust sublimation radius

- **decoupling of dust and gas obscuration**
- **A_V/N_H « Galactic**

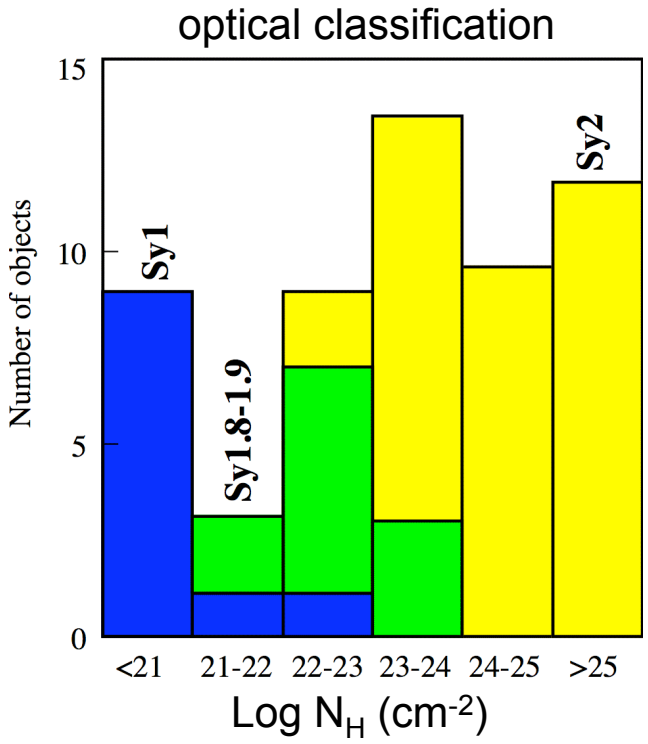
Especially relevant at mid-IR wavelengths:
AGNs are never totally absorbed at 5-20μm ($A_{8\mu m}$< 3mag)

⇒ mid-IR excellent window to detect AGNs

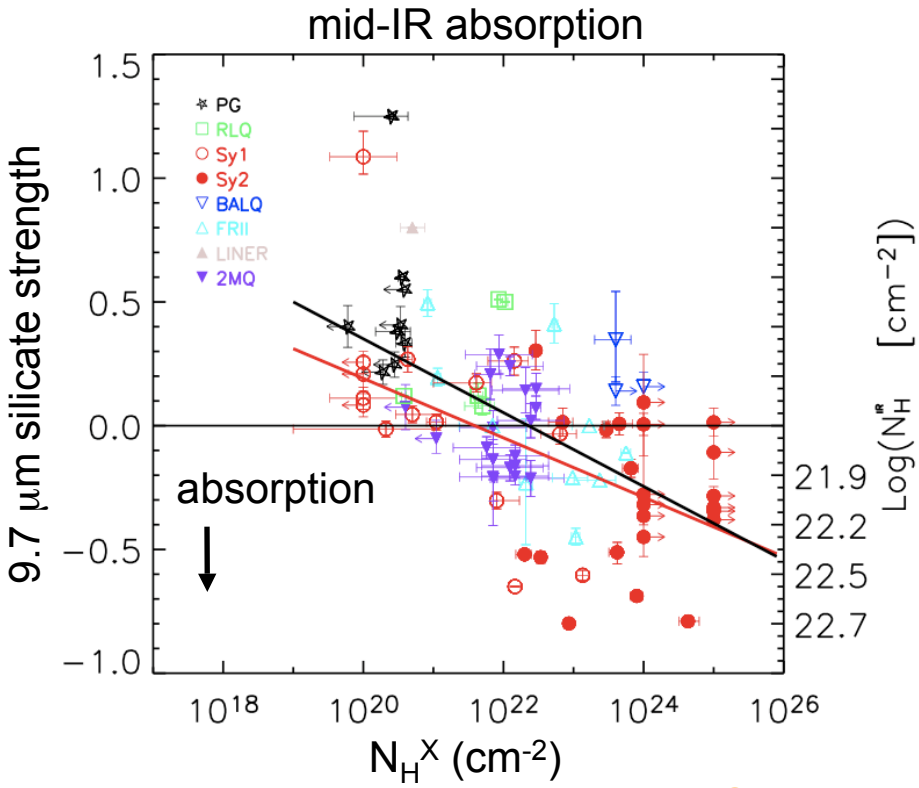


Nardini+07

However X-ray and dusty absorbers generally know each other...

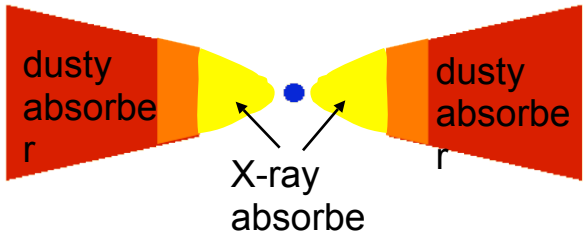


Risaliti+99



Shi+06
Hao
+07

⇒ **generally ~ coplanar**



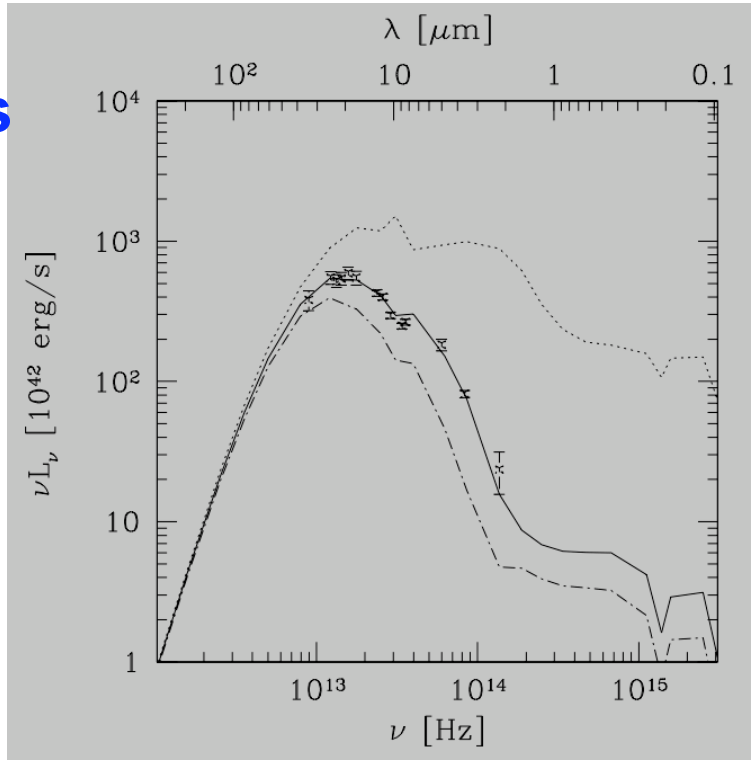
Geometry and structure of the dusty absorber

Uniform dust distribution models

Broad IR SED
-> wide range of T_{dust}

Large torus (~100 pc) required...

Granato+97



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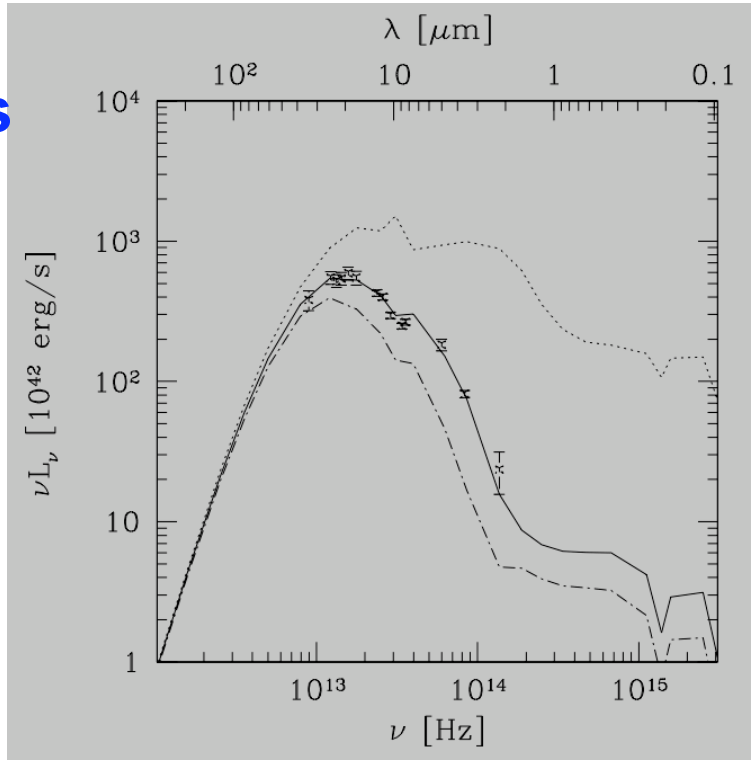
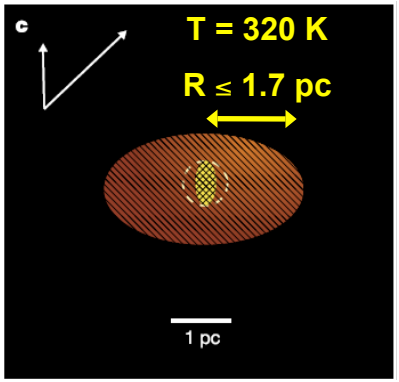
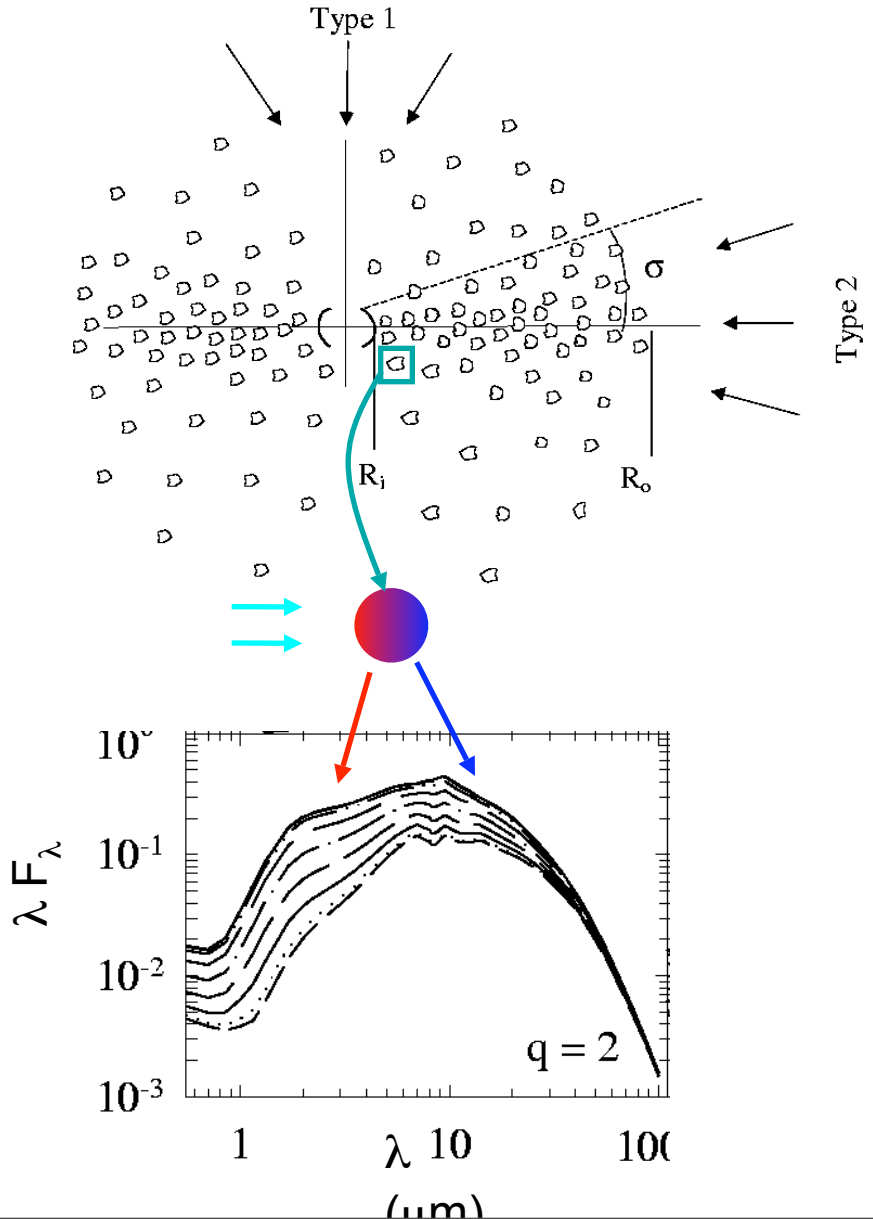


...but high-resolution 10-20μm data -> ~pc scale



Jaffe+04
Ponchelet+06
Mason+06

Clumpy models:
wide Temperature range on small scales

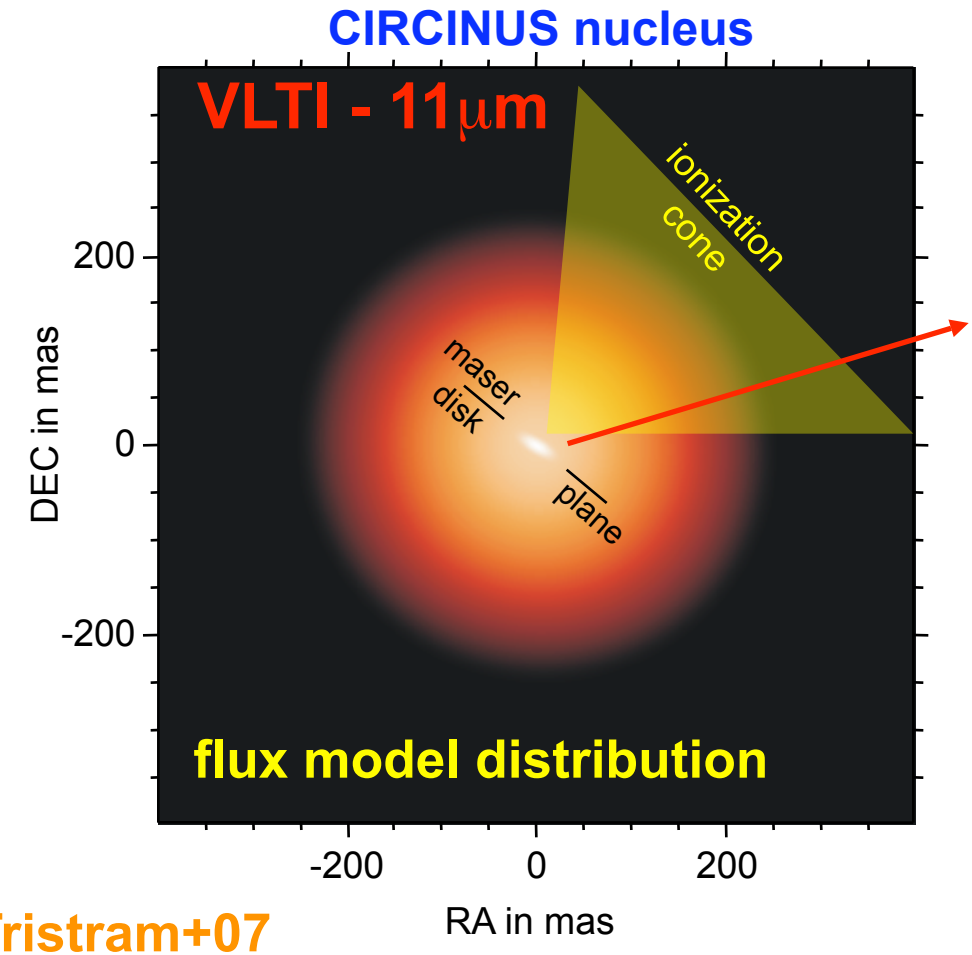


Nenkova+02,06
Elitzur+06
Hönig+06

$R_{in} = R_{sublimation}$

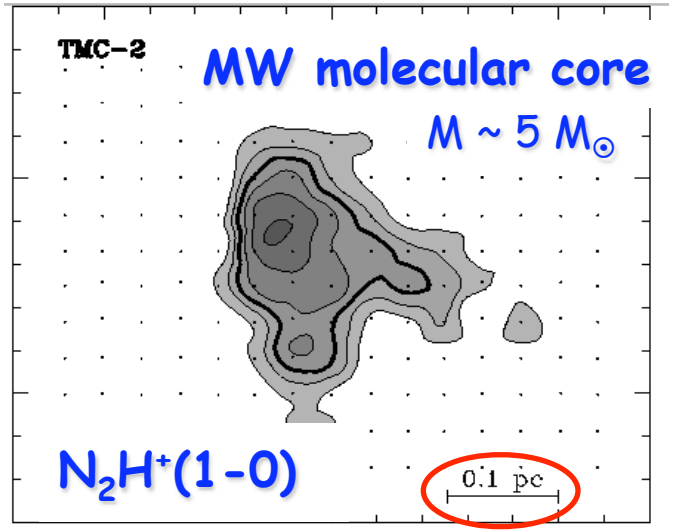
$R_{out} \approx 5\text{-}30\ R_{in}$

Clumpy models: some warnings



Tristram+07

size ~ 0.2 pc
ellipticity = 0.6
T = 330 K

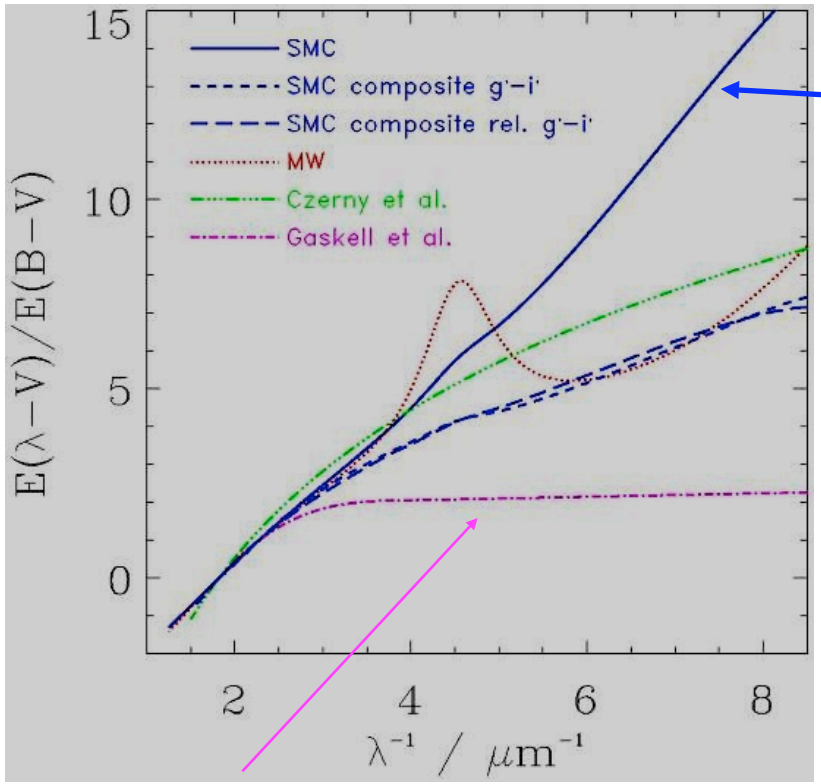


Caselli+02

gas-dust properties ≠ diffuse ISM

Dust properties in AGNs

Extinction curves give different results

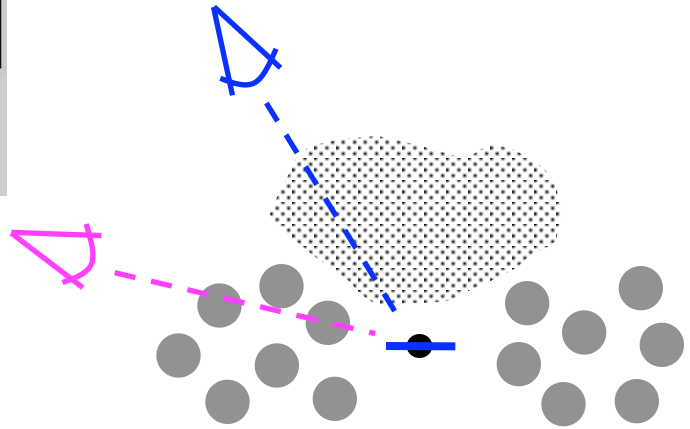


QSO1's

SMC-like ⇒ small grains

Reichards+03, Hopkins+04

No contradiction: they sample different media



strongly reddened AGNs

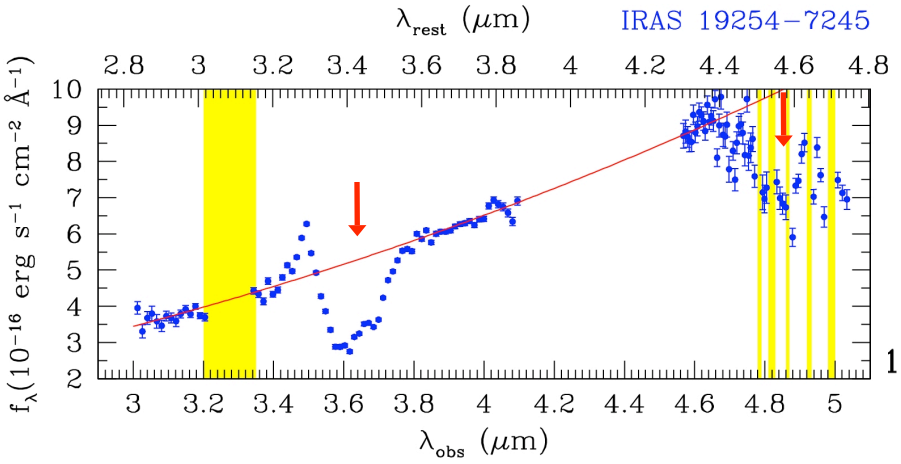
flattened ⇒ large grains

Gaskell+04,06

Czerni+04

(Willott+05)

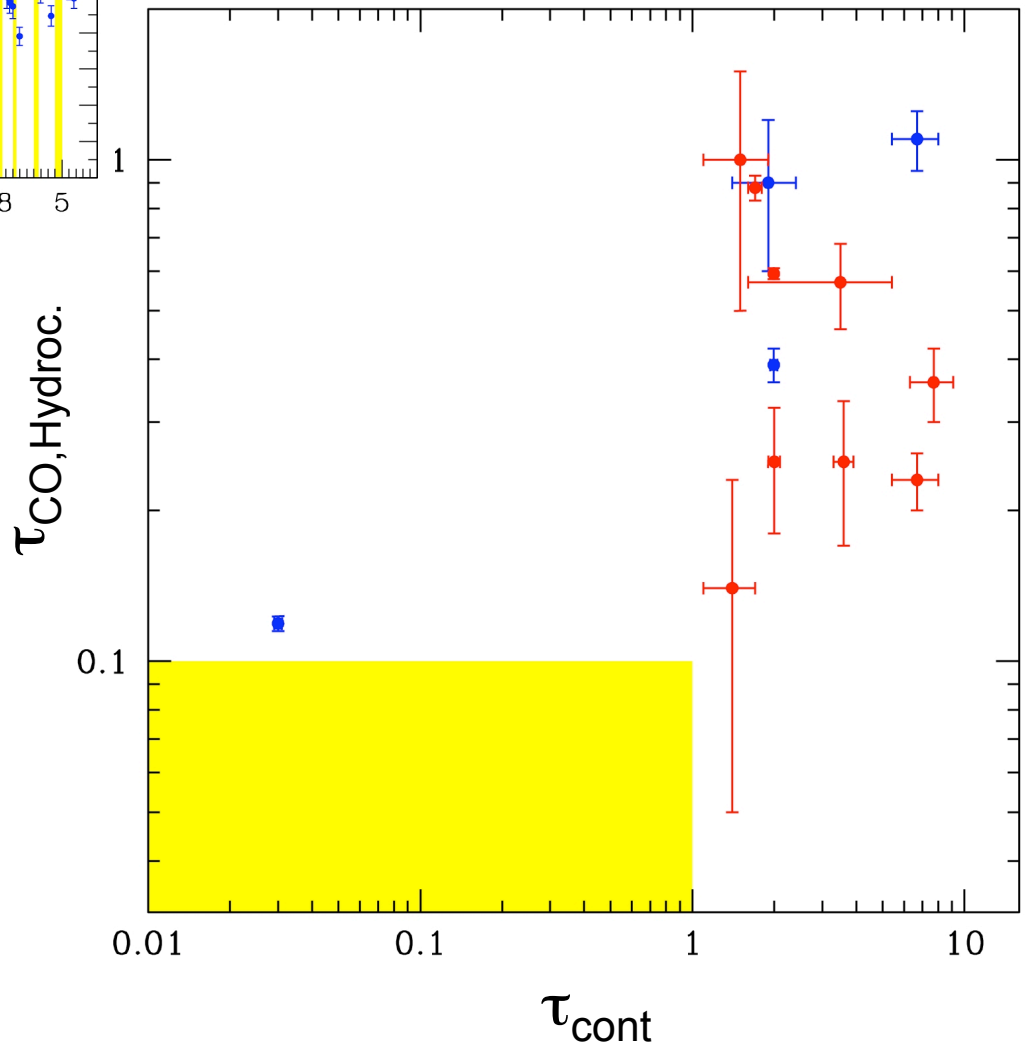
Dust properties in AGNs



Continuum and dusty features absorptions do not correlate

broad variety of dust properties

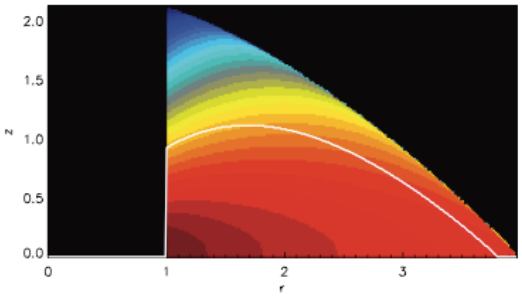
Sani+07



Stability of the dusty absorber

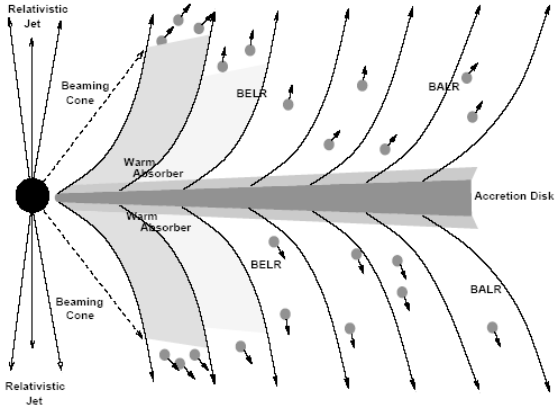
Must cover a large solid angle (~60-80%)
⇒ geometrically thick (as observed)

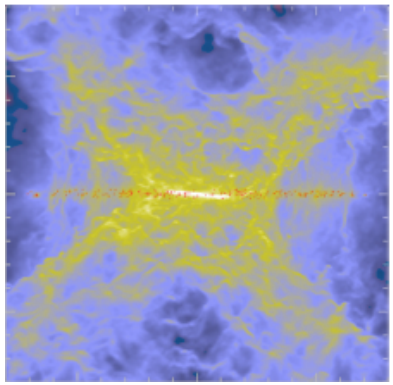
- **Radiation pressure** Krolik'07



- **Warped disk (observed in maser emission)**
  Nayakshin'05, Caproni+06

- **Not static, but dynamical stability: outflowing clouds** Elitzur+06, Elvis+02,03
  Everett & Konigl 00





- **Turbolence by SNe**
  Wada+04, Watabe+05

- **Nuclear stellar winds**
  Nayakshin+06

evidence for recent nuclear starburst

Davies+06, Mueller-Sanchez+06
SDSS results -> Heckman's talk

Evidence for alternative geometries

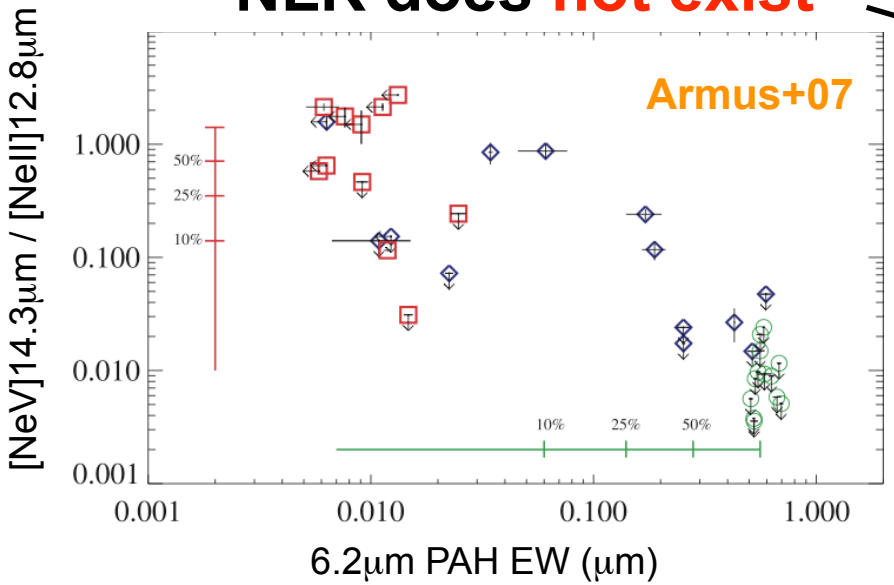
Powerful, obscured AGNs without NLR (generally U/LIRGs)

Imanishi+07,04, Franceschini+03, Maiolino+03, Ballo+04, Caccianiga+07...

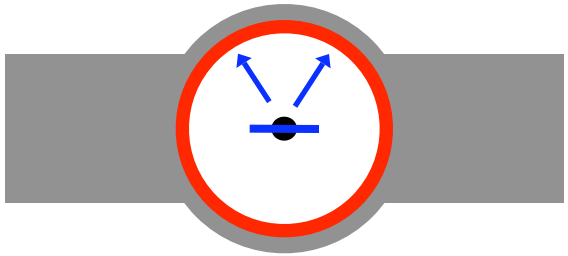
in some cases the NLR is obscured by dust in the host galaxy

Haas+06
talks by Martinez-Sansigre, Polletta, Alonso-Herrero

in some cases the NLR does not exist

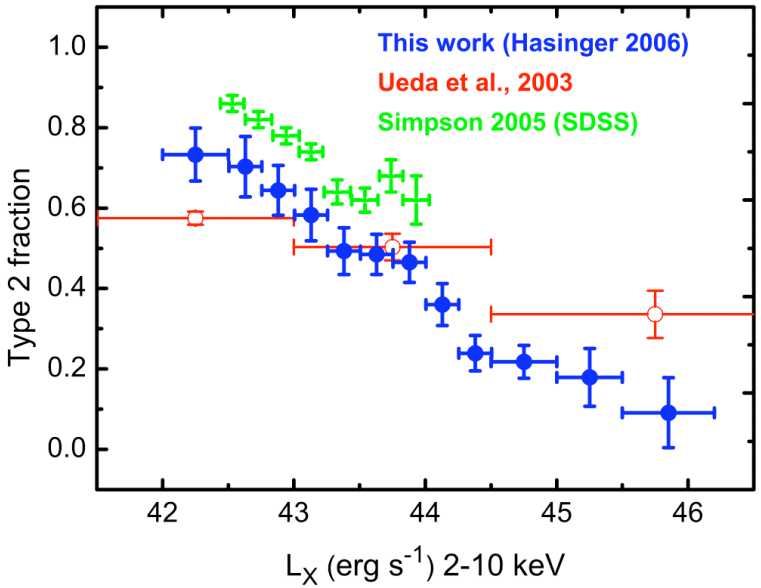


4π nuclear obscuration?



Covering factor versus luminosity

Contrasting results from X-ray and optical surveys



Ueda+ 04, Simpson+05, La Franca+05, Hasinger'06, Barger+05, Akylas+06, Steffen+04

AGN2 / AGN1 ratio decreases with luminosity

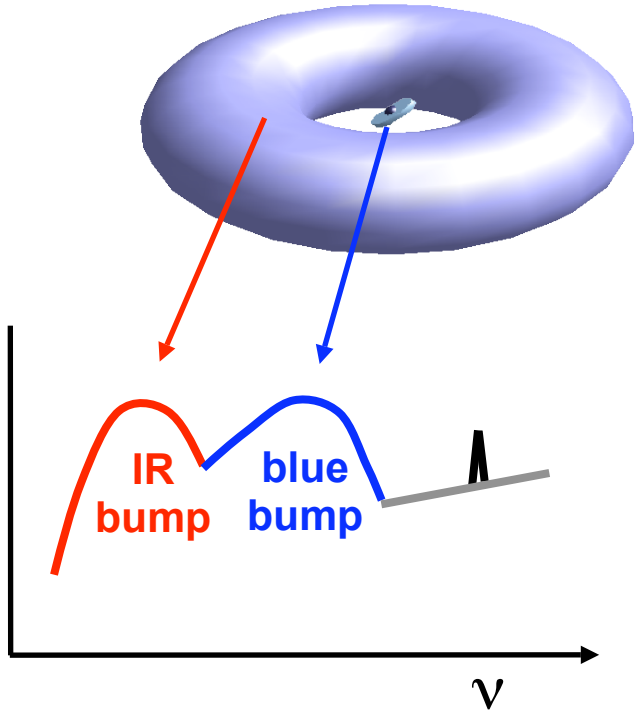
Dwelly+06, Wang+07

Ascribe the effect to incompleteness and selection effects

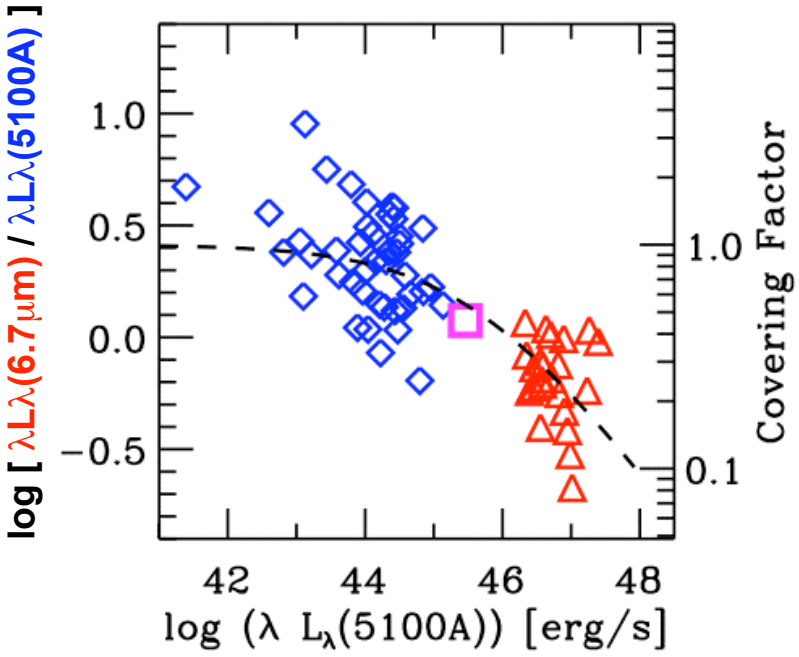
see also Zakamska's talk

Covering factor versus luminosity

Alternative approach: use only AGN1s



Maiolino+07



(but missing obscuration on host galaxy scales)

Covering factor versus luminosity

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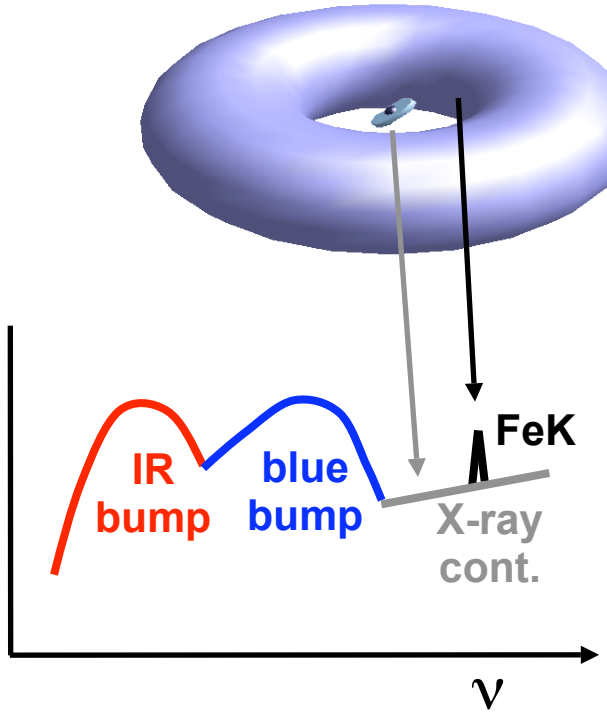
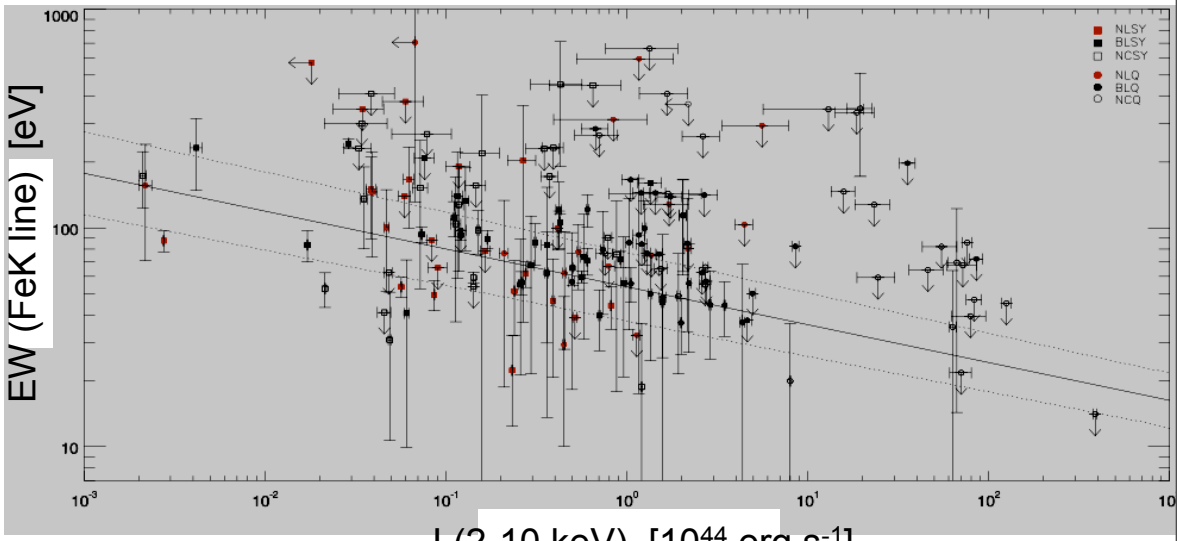


Same result for the X-ray Compton thick absorber/reflector

Bianchi+07



Iwasawa-Taniguchi effect (Balwdin for FeK line)

Physical origin of the Covering Factor (CF) dependence on luminosity

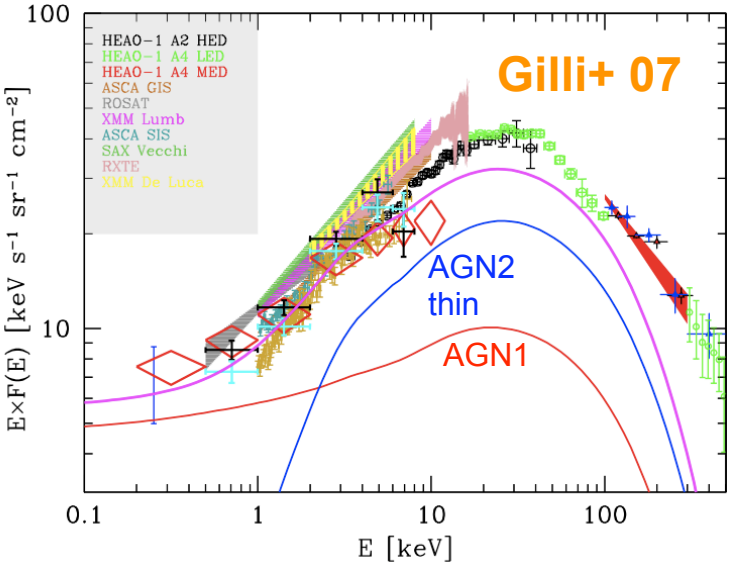
+ "Receding torus" (increasing $R_{sublimation}$) Lawrence'91
  - does not match observed trends Simpson'05
  - only for dusty torus

+ Gravitational effect of BH and galactic disk Lamastra+06
  - CF should correlate with M_{BH}

+ Radiation pressure
  - CF should correlate with L/L_{Edd}

Covering factor inconsistency between local and high-z Sy's

Locally Sy2:Sy1 = 4:1 Maiolino & Rieke'95, Ho+97
Sy2:Sy1 = 2:1 Hao +05



Resolved X-ray background (<8 keV)
Sy2:Sy1 = 4:1

but these are Compton thin!

Compton thick high-z sources certainly exist Alonso-Herrero+06, Fiore+07, Daddi+07, Martinez-Sansigre+06, Polletta+06, Tozzi+06

⇒ **Sy2:Sy1 = 8:1**

- Either local census of Sy2 highly incomplete
- or steep evolution of Sy2:Sy1 ratio at 0<z<0.7

La Franca+05, Tozzi's talk