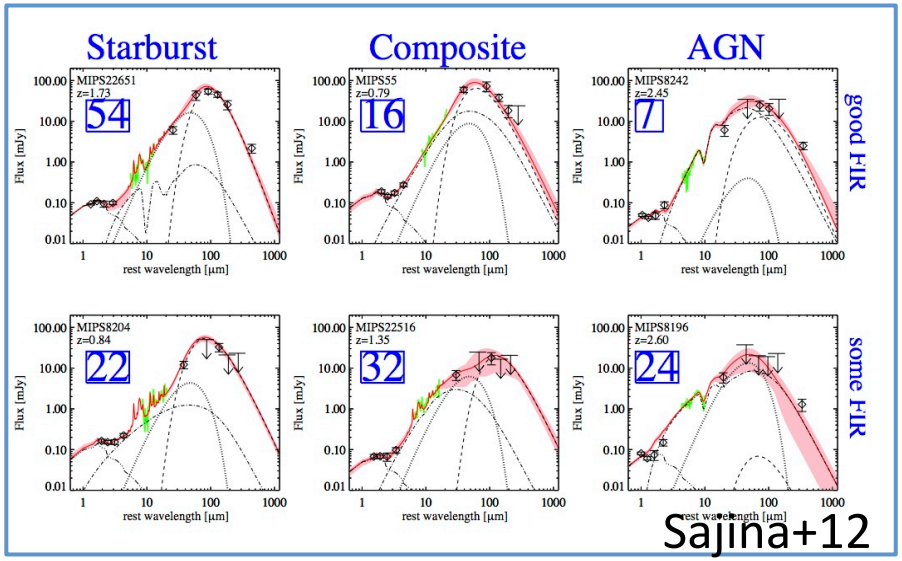
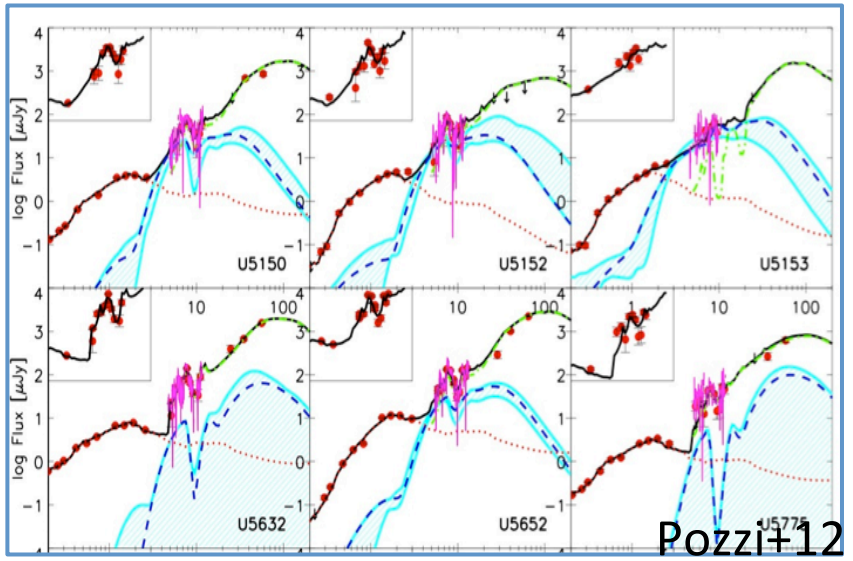
Evidence of obscured accretion: *High- Universe*

High-z: SED de-composition: IRS +phot-data



Sajina+12



Pozzi+12

★ HERMES survey (PI: S.Oliver)
200 sources, L_{IR}~ 10^{11}- 10^{13} $L_{\odot}$
0.3< z<3.0
53 % harbour AGN
23% dominated source

★ PEP survey (PI: D.Lutz)
24 ULIRGs (10^{12} $L_{\odot}$) @ z~2
35 % harbour AGN (@ 3σ)
(<10% dominated AGN)

The TORUS models assumed do not affect the results!

Facts:

Spitzer (IRS) + Herschel data: Reveal the presence of an AGN in almost 50% of the IR-selected sources (opposite to ISO results, Elbaz+99)

Only the peak of the iceberg: local sample, ULIGs@z=2

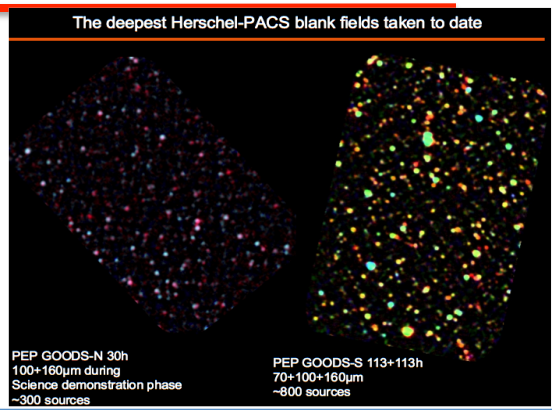
How many of them along the cosmic history?

Strategy:

I step: Statistical sample of IR selected sources (i.e. from surveys) - no IR spectra - ***HERSCHEL***

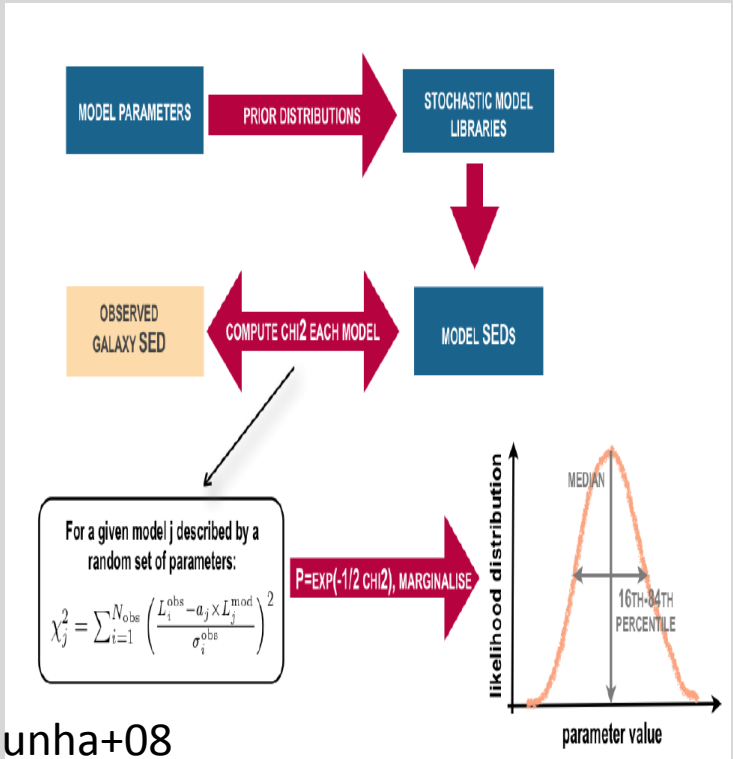
II step: Statistical sample of sources with IR-spectra ***Killer application for SPICA***

Accretion history from Herschel (I step)



★ Data PEP survey (PI: D. Lutz) (See Spinoglio's talk)
Fields: GOODS, COSMOS
3σ= 1.2 (5) mJy (Goods, Cosmos)
Bands: UV (0.16μm) - SPIRE (500μm) ~ 4 dex
~ 4000 sr. with redshift (70% (40) spec, COSMOS)

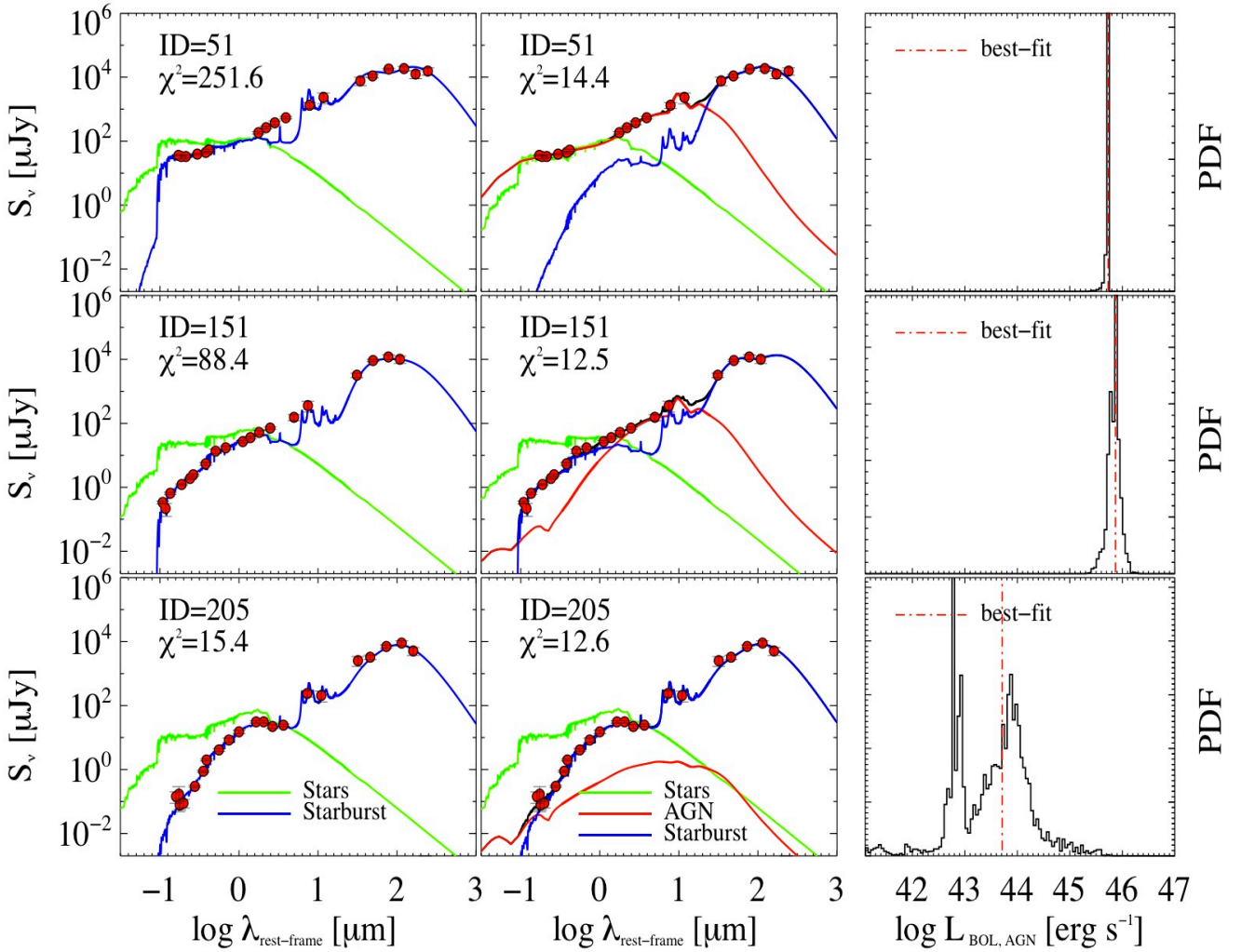
★ Strategy
SED-decomposition: 2 components
1. Galaxy : MAGPHYS (da Cunha+08)
Advantages of Magphys
a) Consistency between absorbed stellar Emission and far-IR emission (energy balance)
b) Bayesian approach: pdf of parameters
2. Torus from Fritz+06 (Feltre+13)
update in MAGPHYS (Berta+13)



Da Cunha+08

Accretion History from Herschel: *Results*

SED de-composition



DelVecchio+13, in prep

50 % of sources with an AGN component (95 % confidence level, F-test)

X-ray: Only 20 % of AGN are AGN from X-ray (2-10keV) in GOODS-S

Accretion History from Herschel: Results II

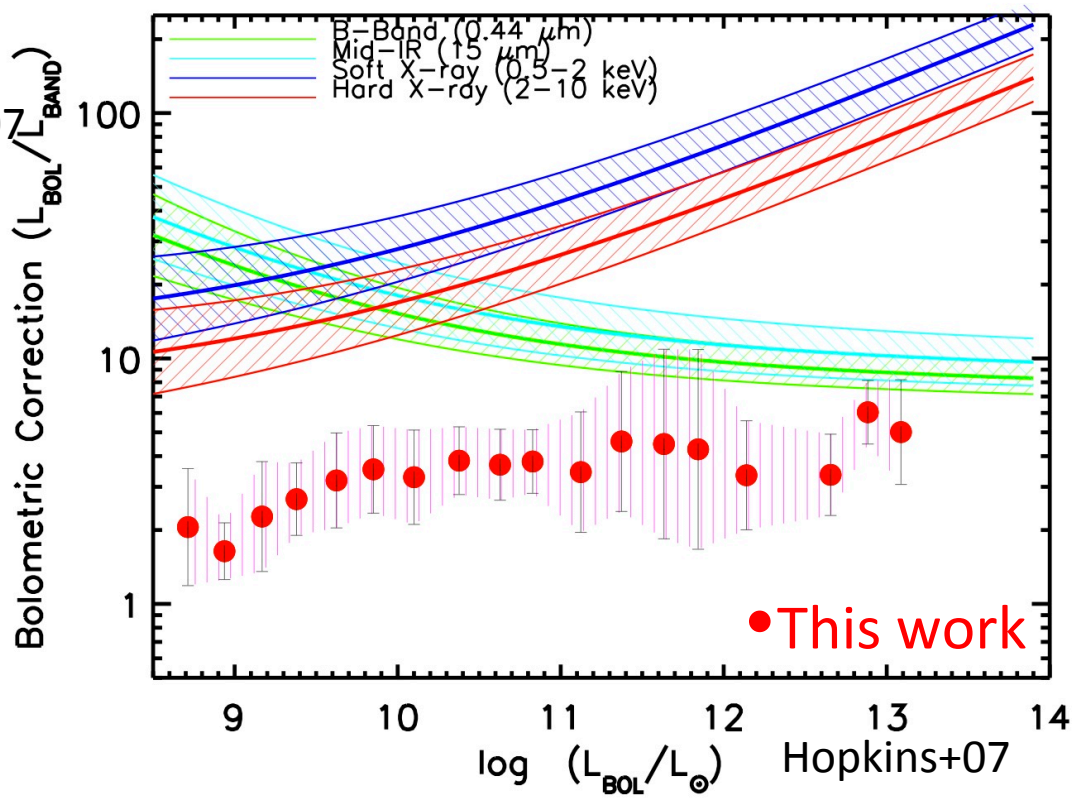
Bolometric correction

$$K_{BOL} = \left[\frac{L_{accr,INPUT}}{L_{1-1000\mu m}} \right]_{BEST-FITMODEL}$$

- Almost 1 dex smaller then other bands

No dependence on bolometric luminosity (required by Hopkins+07 to match type I AGN LF in different band. Mainly bases on Richard+06 SED).

Weakness of IR
Rely on assumed torus model



- *Why* $K_{BOL} > 1$ *?*

Geometric factor

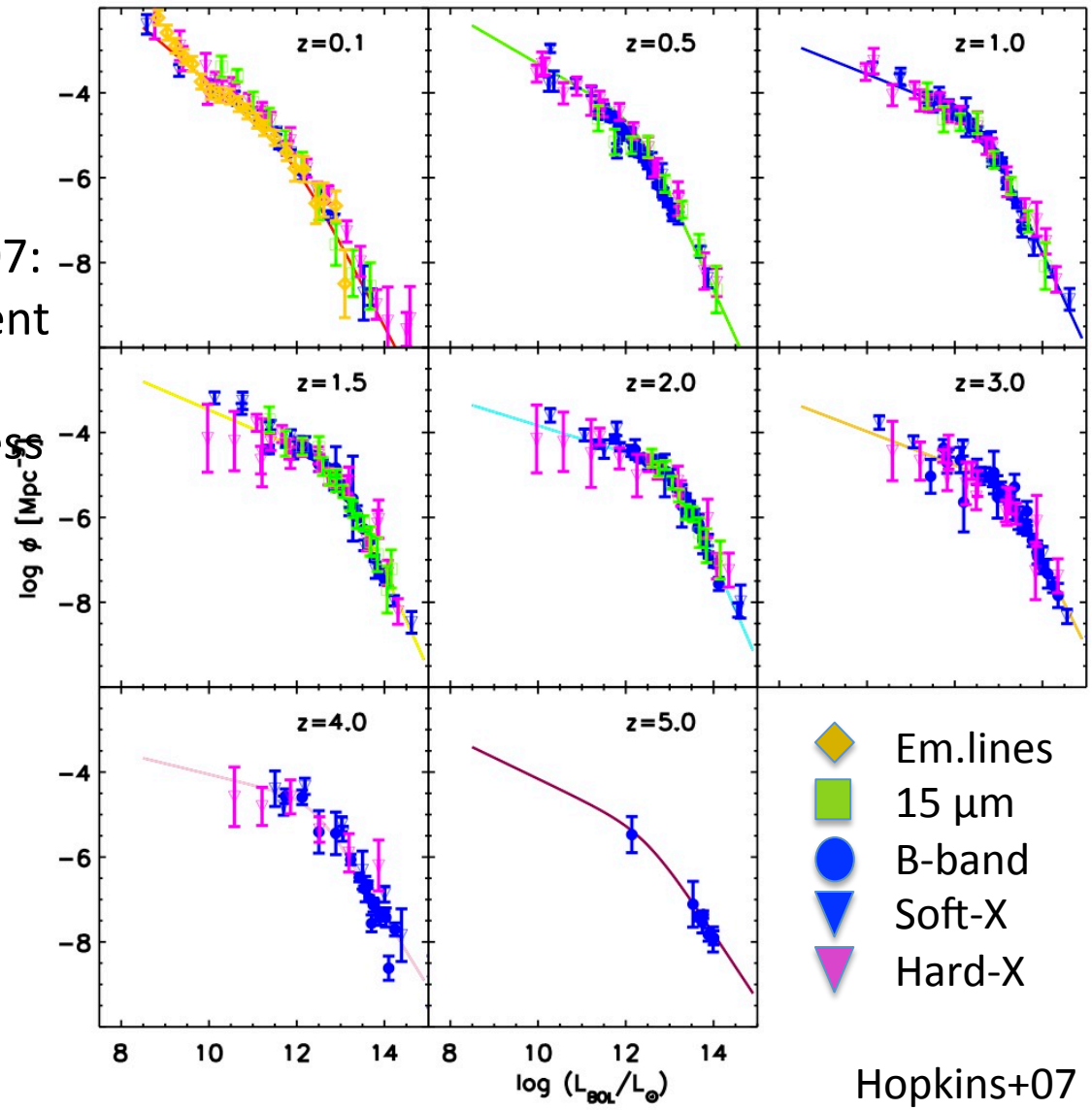
$\tau_{9.7\mu m}$: dust self-absorption mechanism for high- $\tau_{9.7\mu m}$

Accretion History from Herschel: Results III

Accretion Bolometric Luminosity function

Bol. LF obtained by Hopkins+07:

1. Applying K_{BOL} to the different LF in different bands
2. Corrected for incompleteness due to obscuration



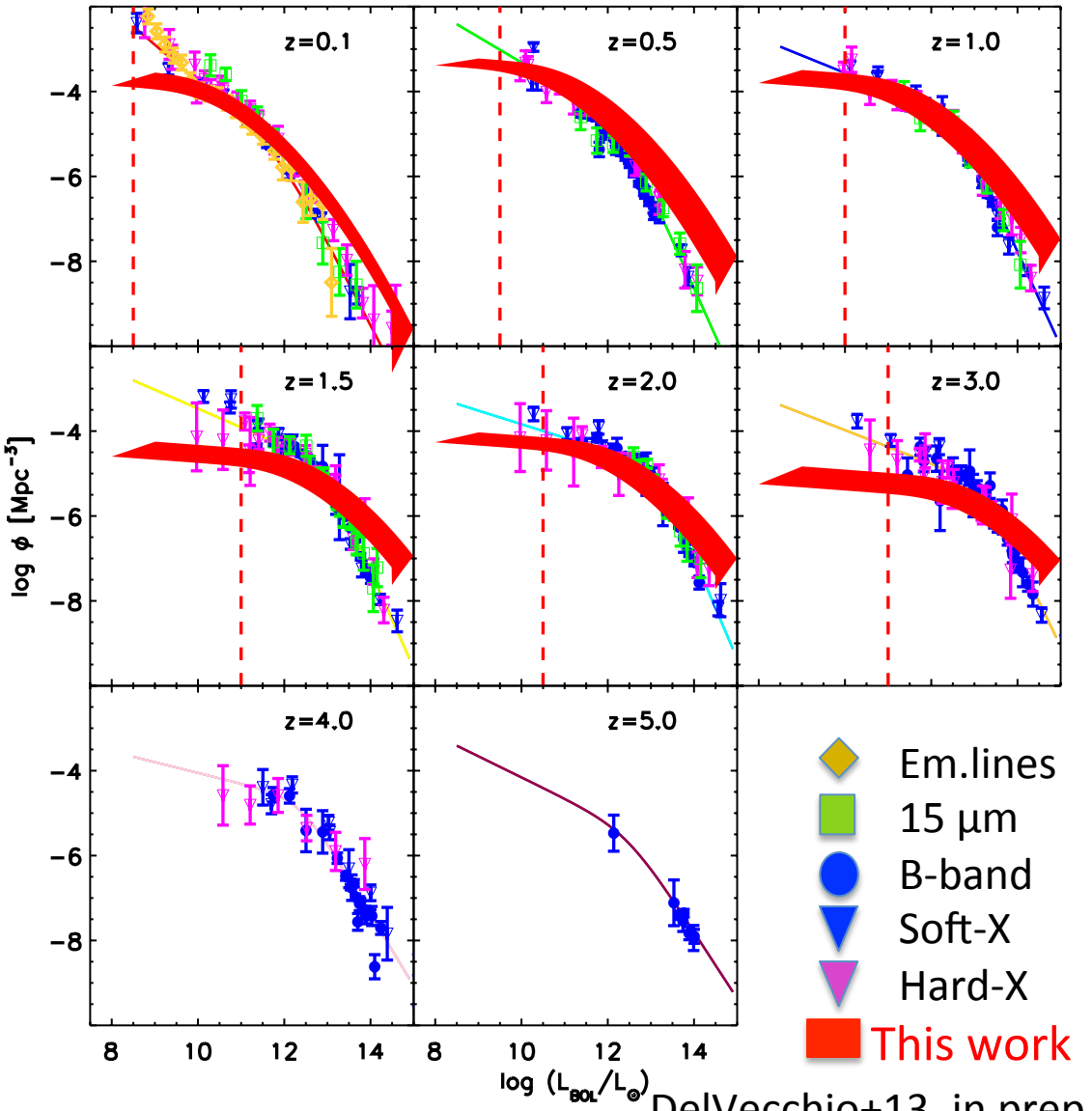
Hopkins+07

Accretion History from Herschel data

Accretion Bolometric Luminosity function

- Fair agreement with Hopkins+07. Completely independent
- Indication:
  Faint end slope less steep
  More sources @ high-luminosities ?

What important cosmological implications with different LF ?



DelVecchio+13, in prep

Accretion History from Herschel data: Results IV

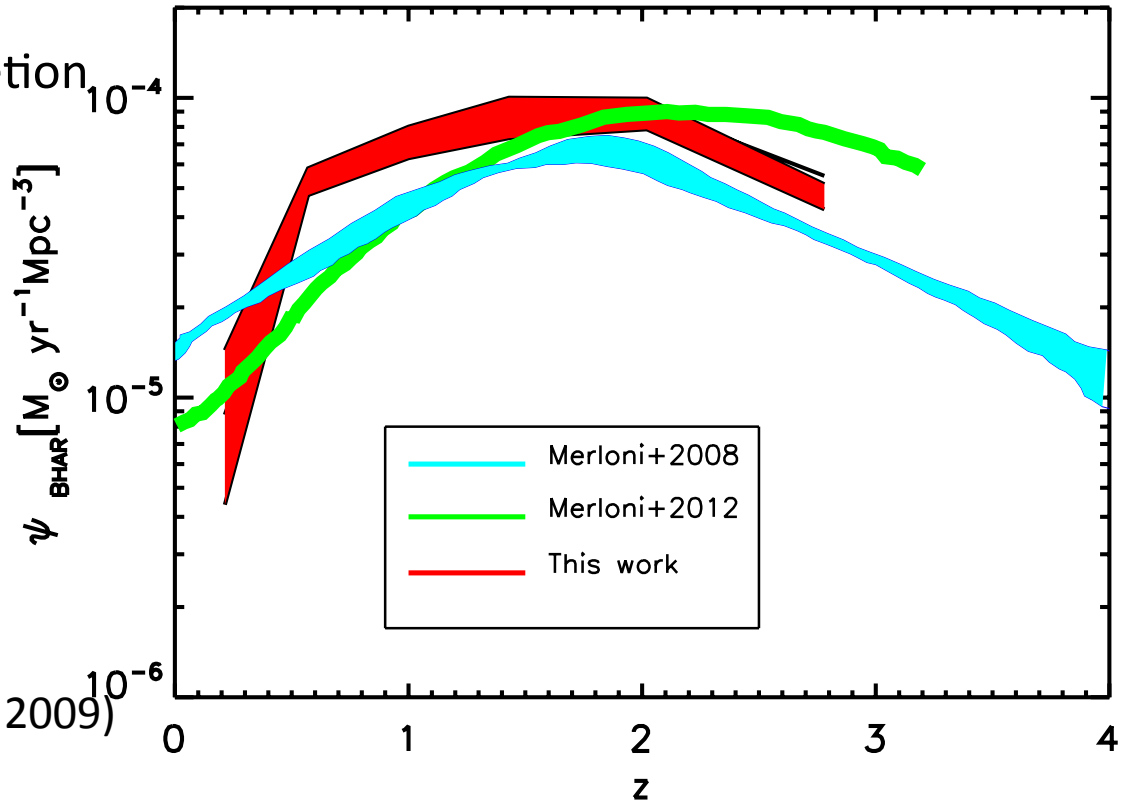
Accretion History

$$\Psi_{BHAR}(z) = \int_0^{\infty} \frac{(1-\varepsilon_{rad})L_{BOL,AGN}}{\varepsilon_{rad}c^2}\Phi(L_{BOL,AGN})d\log L_{BOL,AGN}$$

- *Hypothesis*
  Black hole grows mainly by accretion
  $L_{BOL}=\varepsilon\, c^2\, dM/dt$
  ε = *radiative efficiency*

- *Results*
  First time ψ_{BHAR} from IR (ε =0.08)
  $\psi_{BHAR,IR} > \psi_{BHAR,X}$ (0.5<z<1.5)

- *Implications*
  ρ_{BH0}=4.2 X10^5 $M_\odot$Mpc^{-3} (Shankar, 2009)
  BH physics: $\varepsilon \sim 0.3$ (?)



DelVecchio+13, in prep

Facts:

Spitzer+ Herschel have shown multi-bands study (optical-IR) very promising for study obscured accretion $0<z<3$, and results only partially consistent with X-ray

BUT..

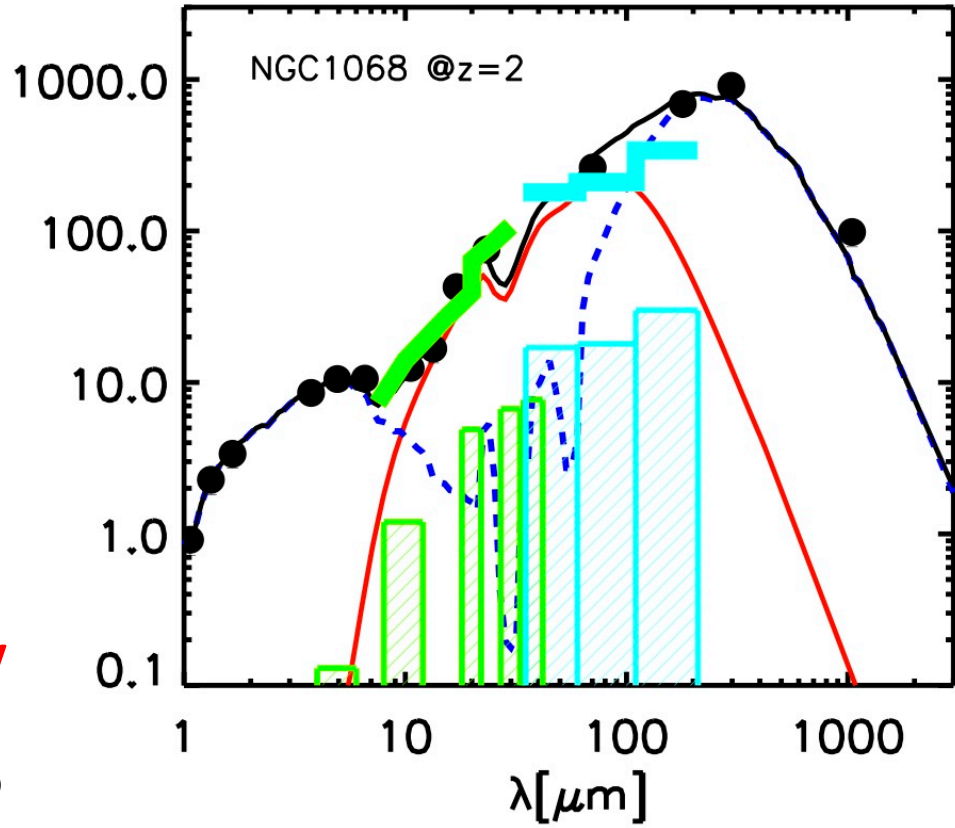
★Detailed studies performed only in small sample (IRS)

★Studies on large data sample based on phot-z, on statistical methods and not on physically motivated diagnostics.

A lot of work SPICA can to in this field !!

I see a killer application For obscured AGN with SPICA

Combined Mid & Far-IR spectroscopy



Instruments:

LR Mid-IR at low resolution (5-38μm)

5σ= 15 μJy @ 20 μm (600 sec, R=50)

SAFARI spectral -mode (35-210 μm)

5σ= 180 μJy @ 40 μm (3600 sec, R=20)

Science:

1. Given the sensitivities

Detect almost all the sources detected by Herschel up to z~2 (ULIGs up to z~3).

2. Given the spectra resolution: (similar to IRS) **able to resolve 9.7μm, strong PAHs**

Get redshifts, recover dusty bump (i.e luminosities) and clear diagnostic AGN/ starburst.

JWST (0.6-30μm):

1. Not able to recover the whole IR bump

2. Smaller FOV (factor~10), i.e. much time consuming for surveys.