Active Galactic Nuclei 13 :
Beauty and the Beast

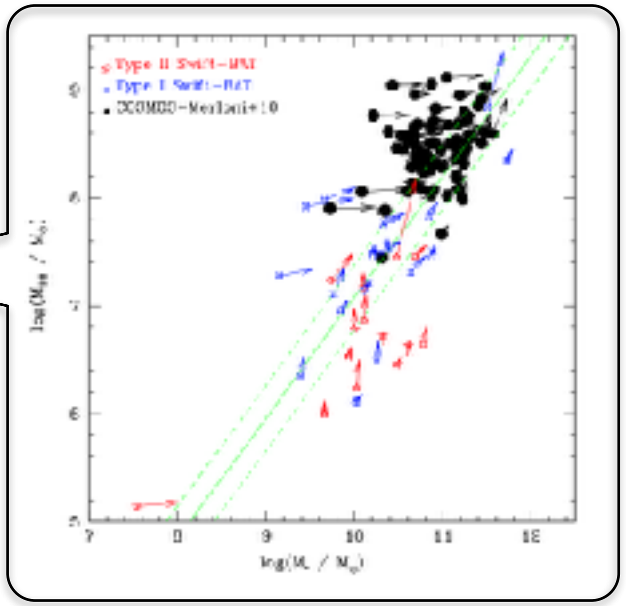
October, 9-12 2018 - Milano

Probing the AGN/galaxy coevolution in the widest dynamical range ever

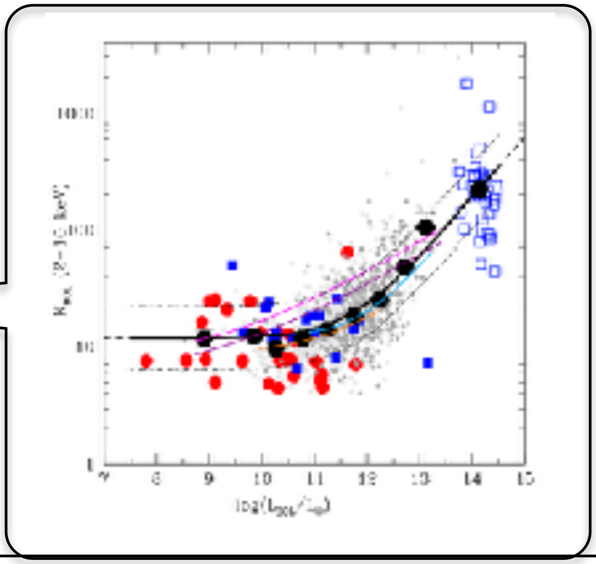
F. Duras, A. Bongiorno, F. Ricci
E. Piconcelli, F. La Franca, F. Fiore
… and all the WISSH collaboration

Simplifying the problem : the 5 W- questions

- WHAT? AGN/Galaxy co-evolution



- WHO? TWO complementary samples of AGN
- WHEN? at both high and low redshift
- WHERE? at the extremes of the AGN luminosity function



The perfect sample to build up a **new hard X-ray bolometric correction** valid **over 5 orders of magnitude** !

- WHY? because every galaxy is potentially an AGN!

Two complementary samples

The WISSH sample

TYPE I sources

high redshift

2<z<4

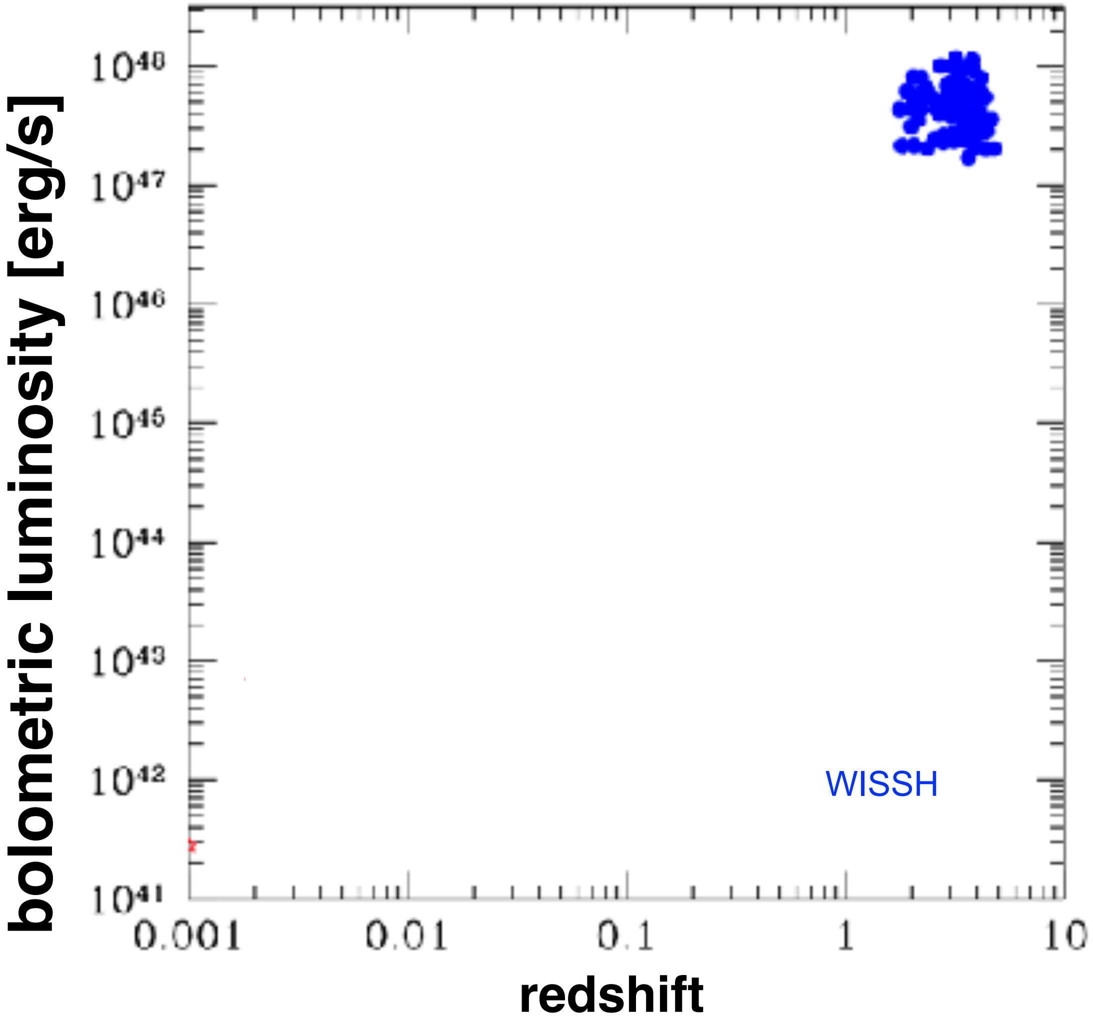
most luminous sources known

$L_{BOL}>2\ 10^{47}$ erg/s

evidence of **strong winds** see Bischetti+17 and Vietri+18

high BH masses

$10^9 - 10^{10}$ solar masses



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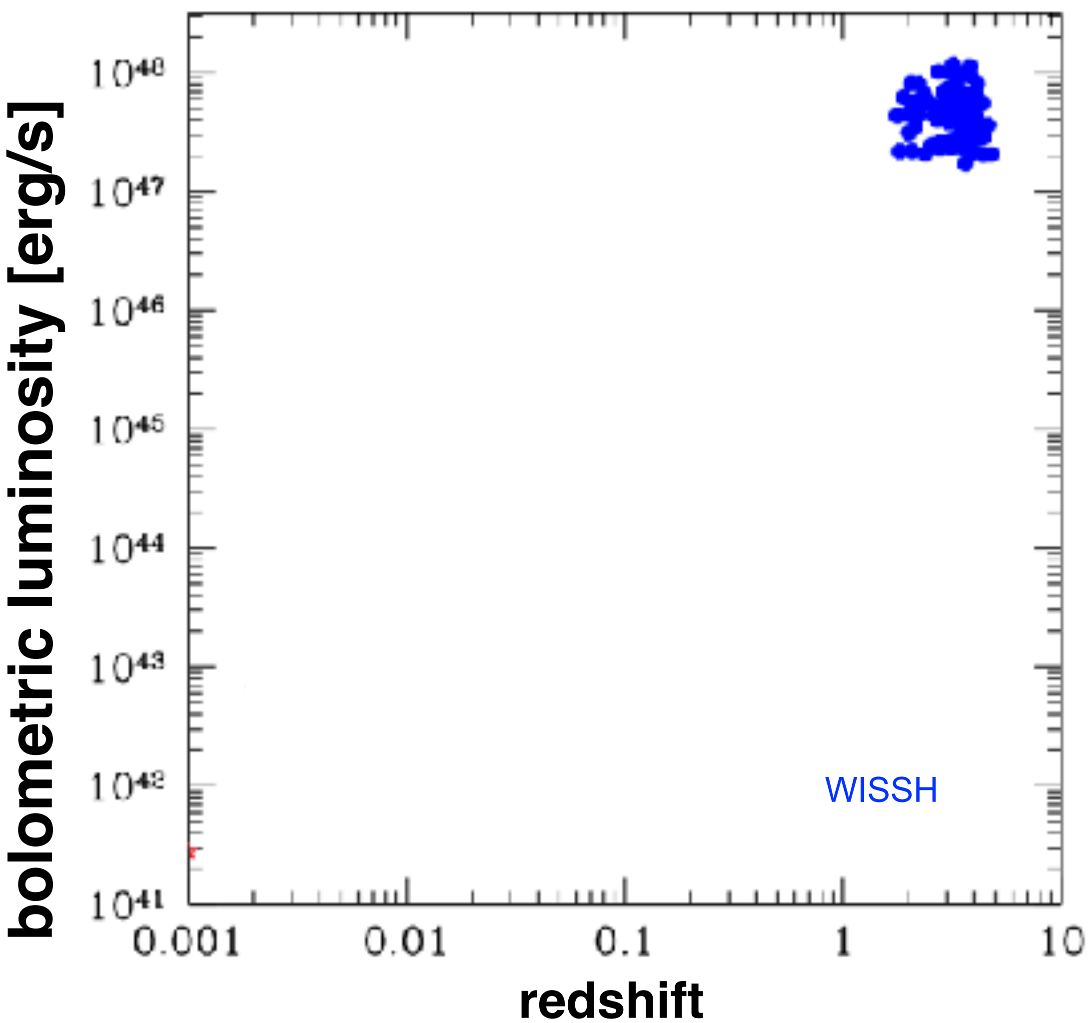


The SWIFT/BAT sample

TYPE I + TYPE II sources

low redshift

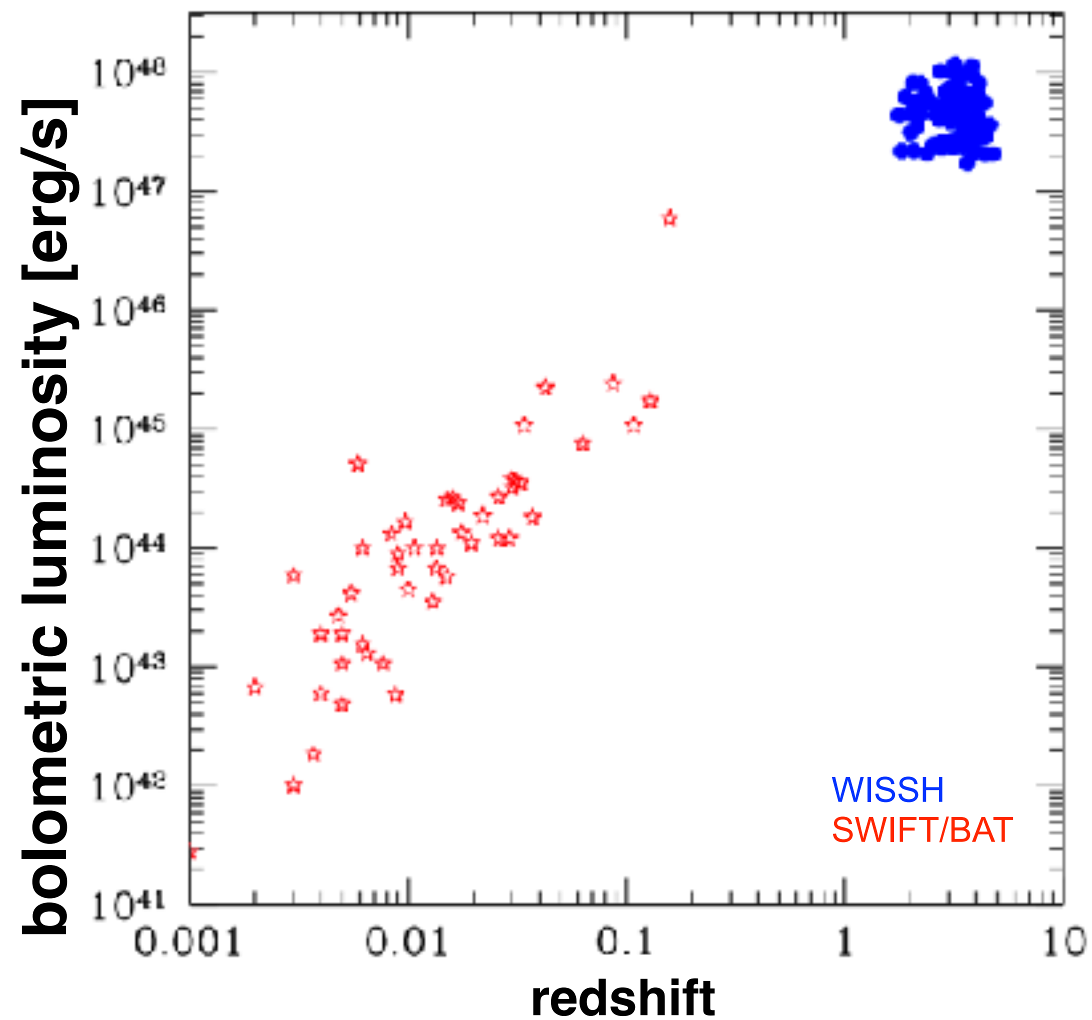
z<0.1

low - luminous sources

L_{BOL}~10^{42}-10^{45} erg/s

low BH masses

10^6 - 10^8 solar masses

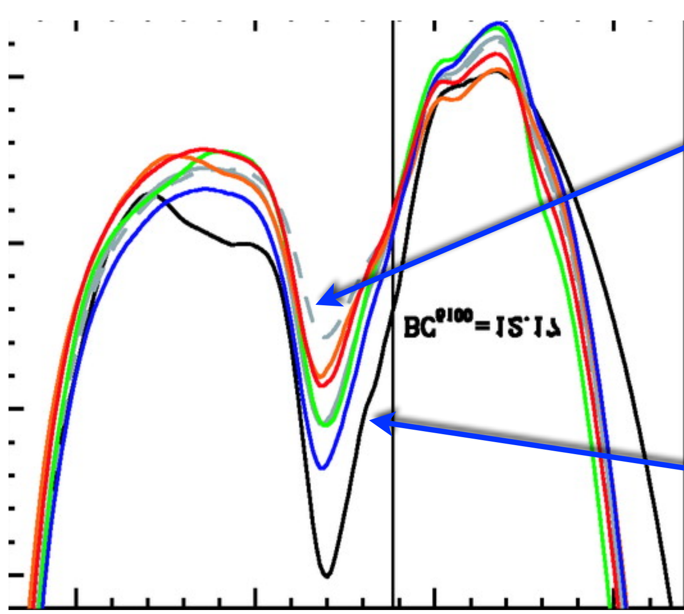


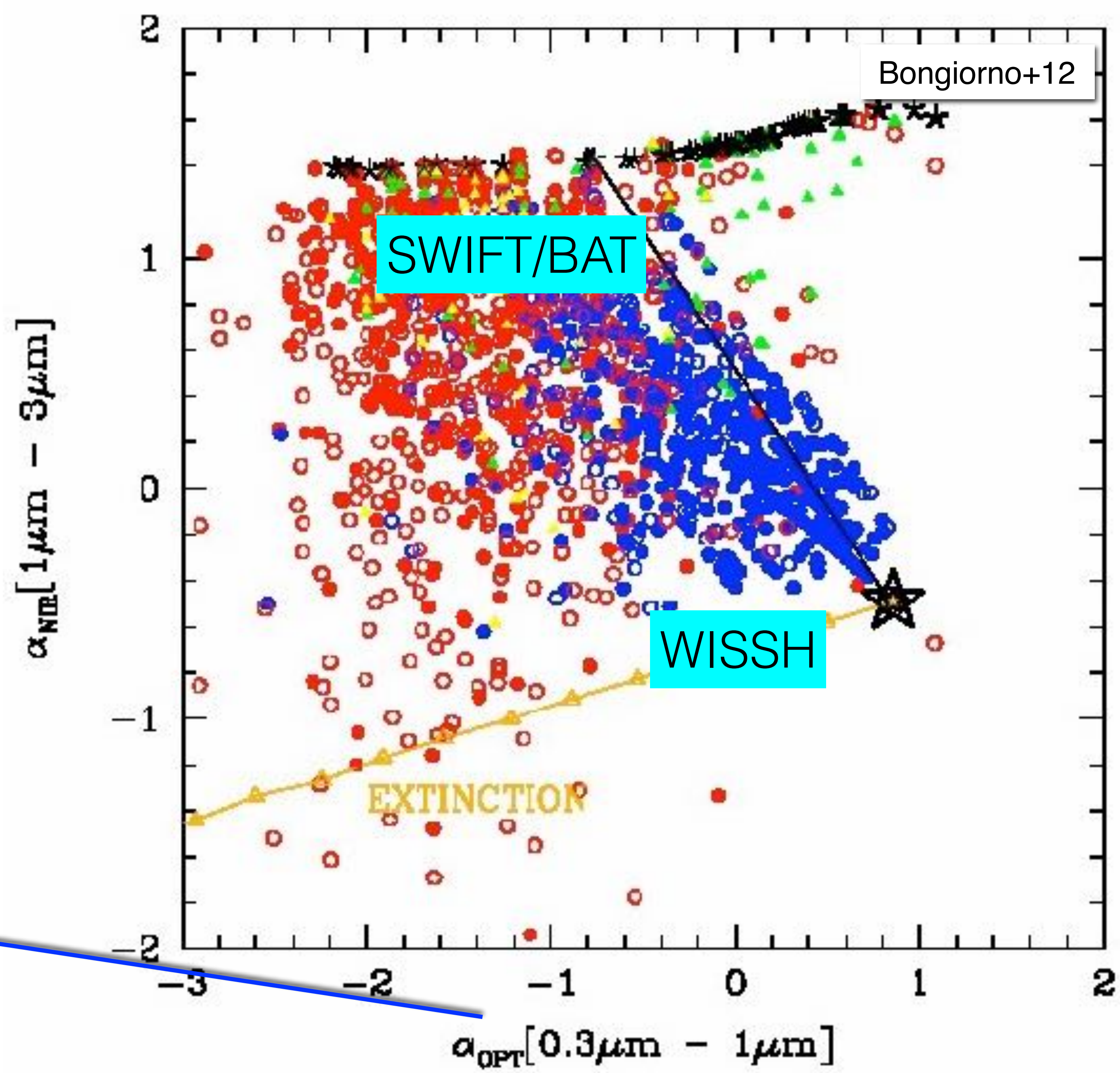
The H question : SED-fitting procedure

- HOW? deriving the physical properties through the SED - fitting and studying how they correlate (or not) with each other

But why can we do that?

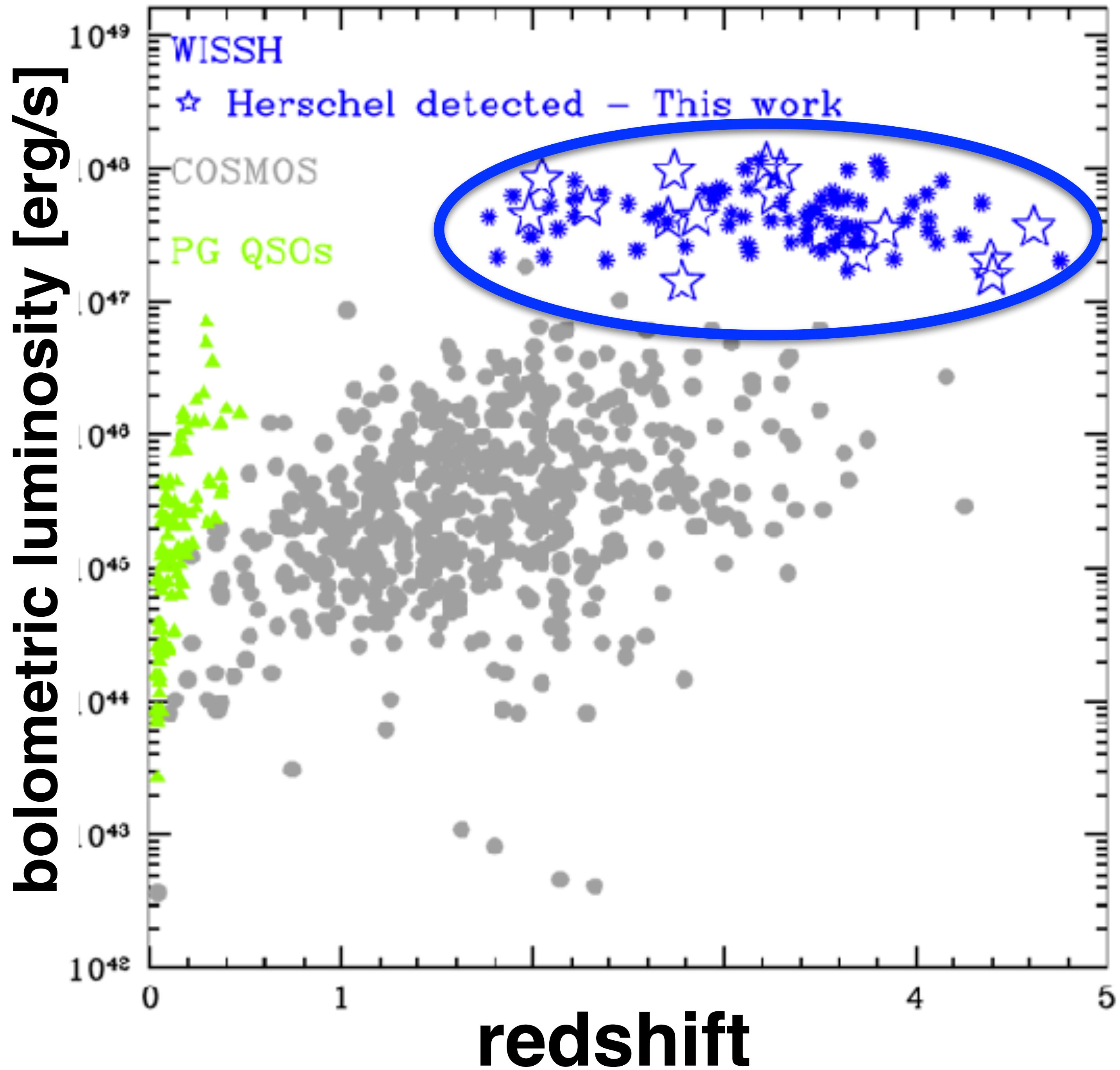
Most of the SEDs can be explained as a combination of a <u>pure AGN</u> eventually <u>ABSORBED</u> and/or contaminated by the <u>HOST GALAXY</u>





Studying the monsters : the WISSH sample

A focus on the 16 WISSH AGN with FIR data



The 16 WISSH QSOs with Herschel data coverage are <u>representative of the entire sample</u>, being not previously pre-selected, and being **randomly distributed** within it both in **z** and **luminosity**

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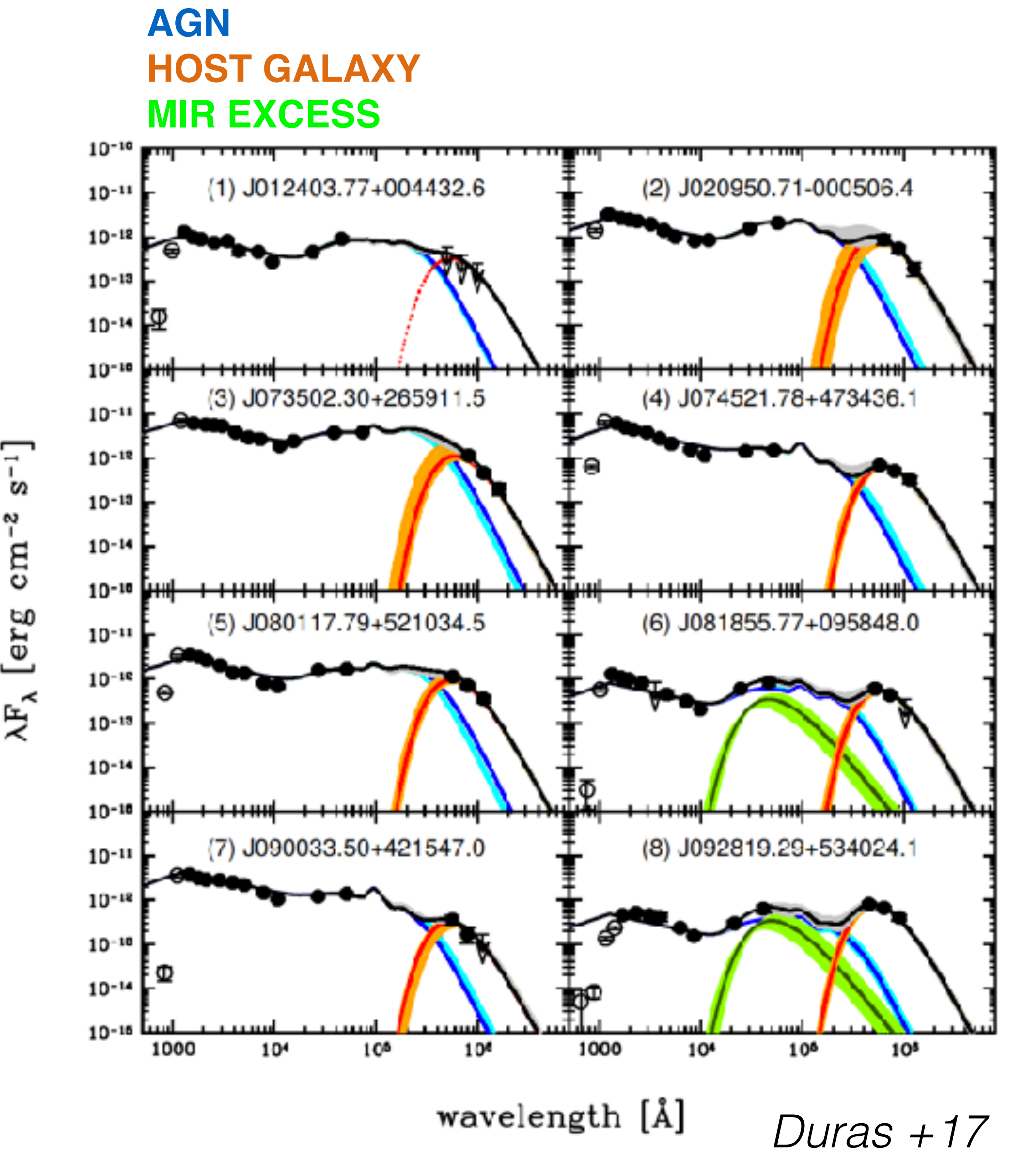


Duras +17

Three fitting components to describe the emission:

Accretion disk + Torus

Feltre+12, Stalevski+16

Cold dust in the FIR

excess in the MIR (which turned out to be necessary in 30% of the cases) found in several works on luminous AGN

see Edelson&Malkan+86, Mor+09, Hernan-Caballero+16
talk by Bisogni this morning

Warm dust (pure graphite?) near the nucleus

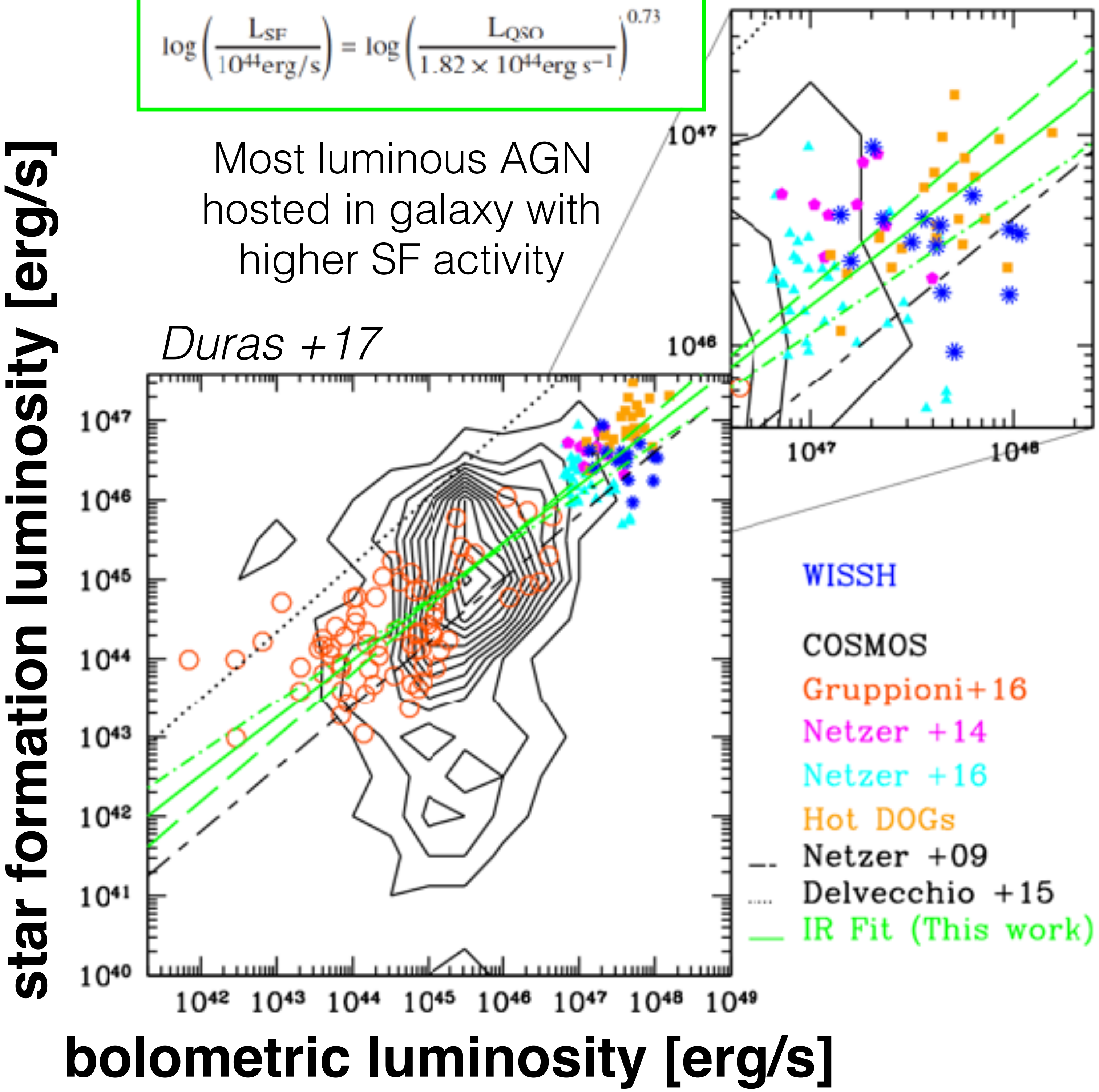
Studying the monsters : the WISSH sample

A focus on the 16 WISSH AGN with FIR data

$$\log\left(\frac{L_{SF}}{10^{44}\mathrm{erg/s}}\right) = \log\left(\frac{L_{QSO}}{1.82\times10^{44}\mathrm{erg\ s^{-1}}}\right)^{0.73}$$

Most luminous AGN hosted in galaxy with higher SF activity

Duras +17



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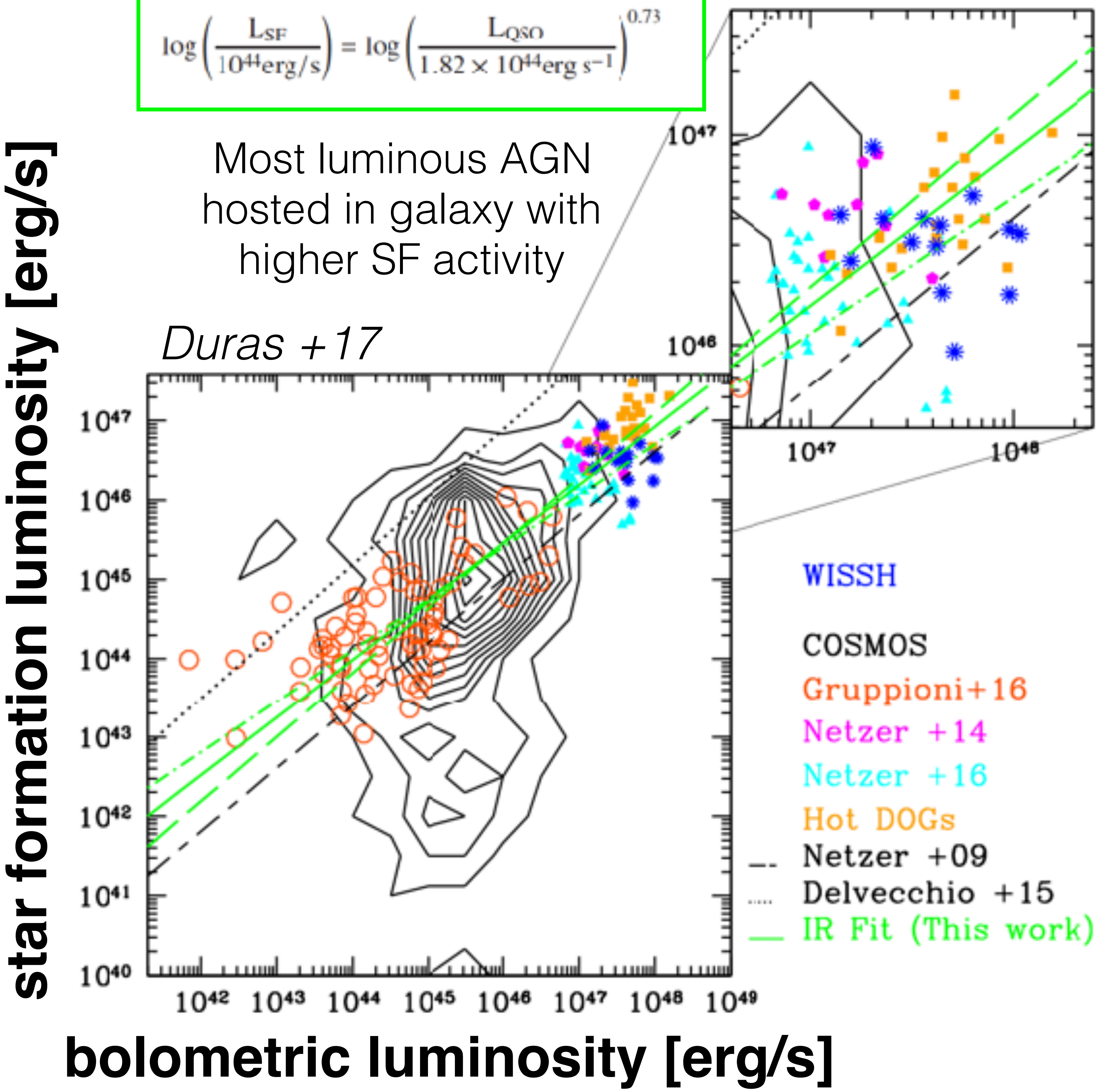

Really HIGH values of SFR (thousands Msun/yr) as usual in hyper-luminous AGN even accounting for the AGN contribution to the FIR (~50% NOT NEGLIGIBLE)!

see e.g., Symeonidis+16

Radiative transfer (TRADING) code

Schneider+15

applied to the **least** (40% of AGN contribution) and the **most** (60% of AGN contribution) **luminous** sources of the sample

Studying the monsters : the WISSH sample

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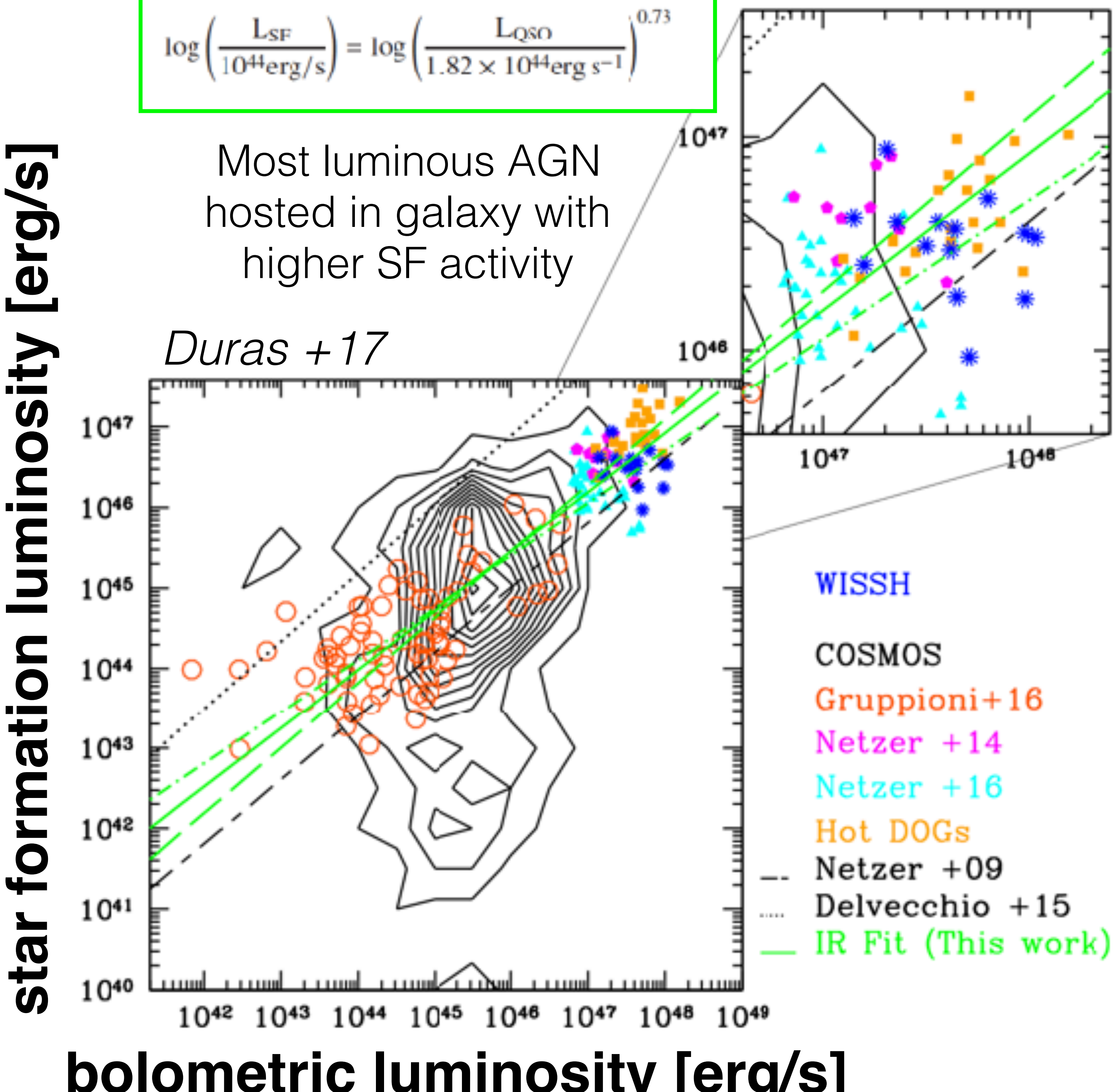

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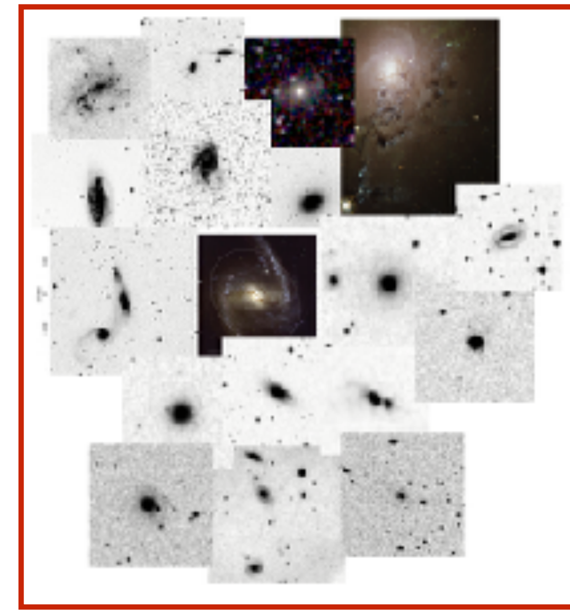
However :
we need to sample the FIR and sub-mm with higher angular resolution to avoid contamination not solved by Herschel (SPIRE PSF too big!)

see the recent Bischetti+18

Getting closer: the SWIFT / BAT sample

30 Seyfert2
20 Seyfert1
selected from the SWIFT/BAT 70-month catalog

see Baumgartner+13 for the entire catalog



Type 2 AGN :

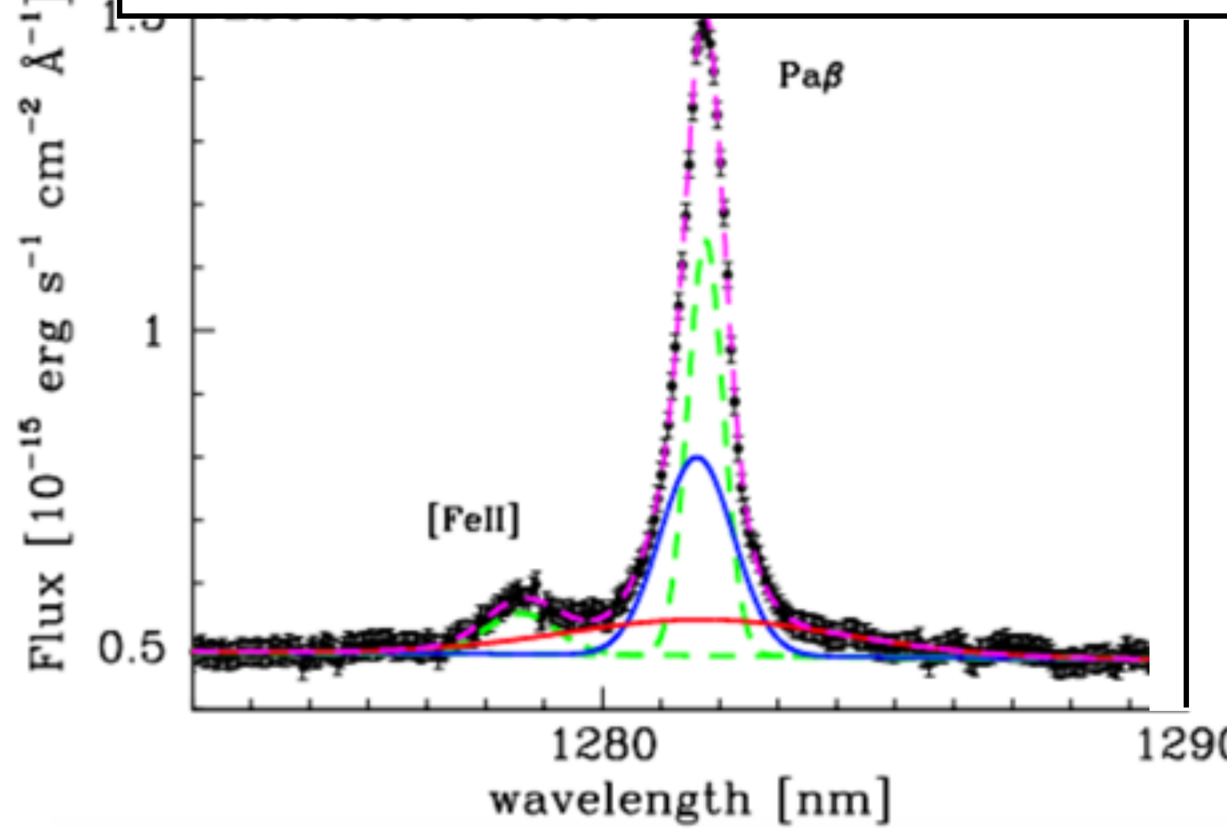
- no broad line component in the (rest-frame) optical
  AGN continuum obscured and/or contaminated by host galaxy

faint broad
(800 < FWHM < 3500 km/s)
components found in **15**
type2 AGN through deep
NIR spectroscopy

BH mass estimation

see Onori+17 and Ricci,F.+17

$$\log\left(\frac{M_{\rm BH}}{\rm M_\odot}\right) = 7.75 + \log\left[\left(\frac{\rm FWHM_{NIR}}{10^4\ \rm km\ s^{-1}}\right)^2 \left(\frac{L_{14-195\ \rm keV}}{10^{42}\ \rm erg\ s^{-1}}\right)^{0.5}\right]$$



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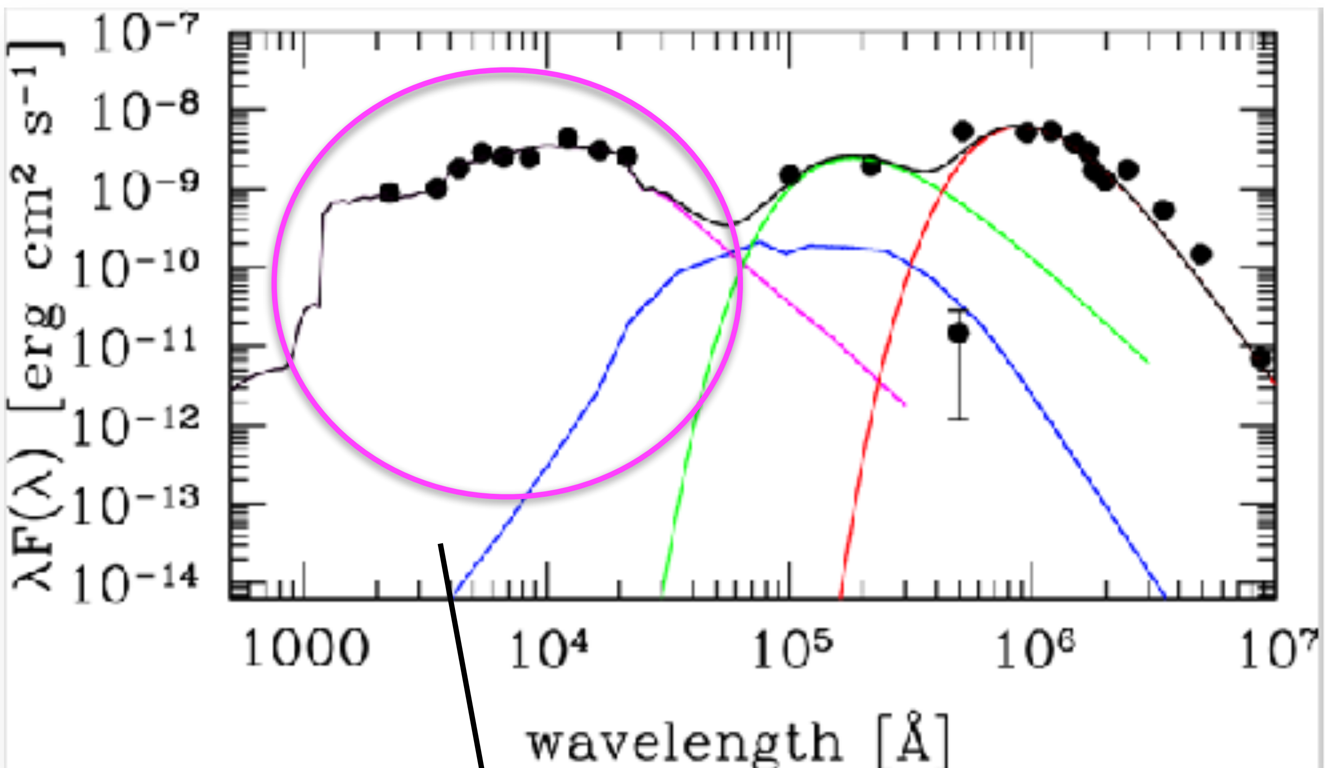
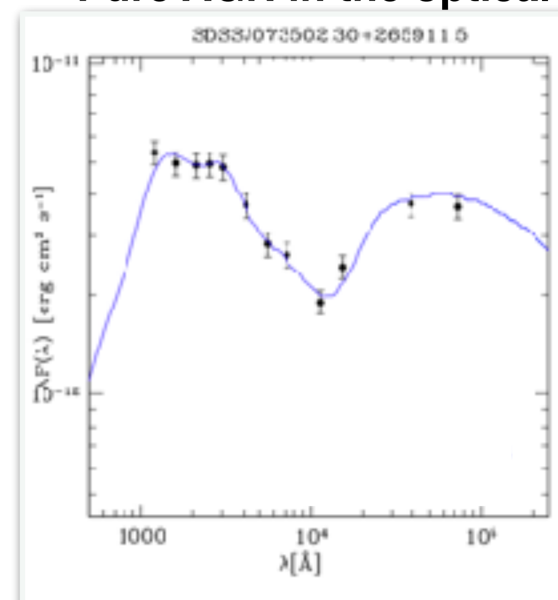


We can do more with the SWIFT/BAT AGN!

Strong presence of the emission from the galaxy, not hidden by the AGN emission as in the WISSH

Pure AGN in the optical



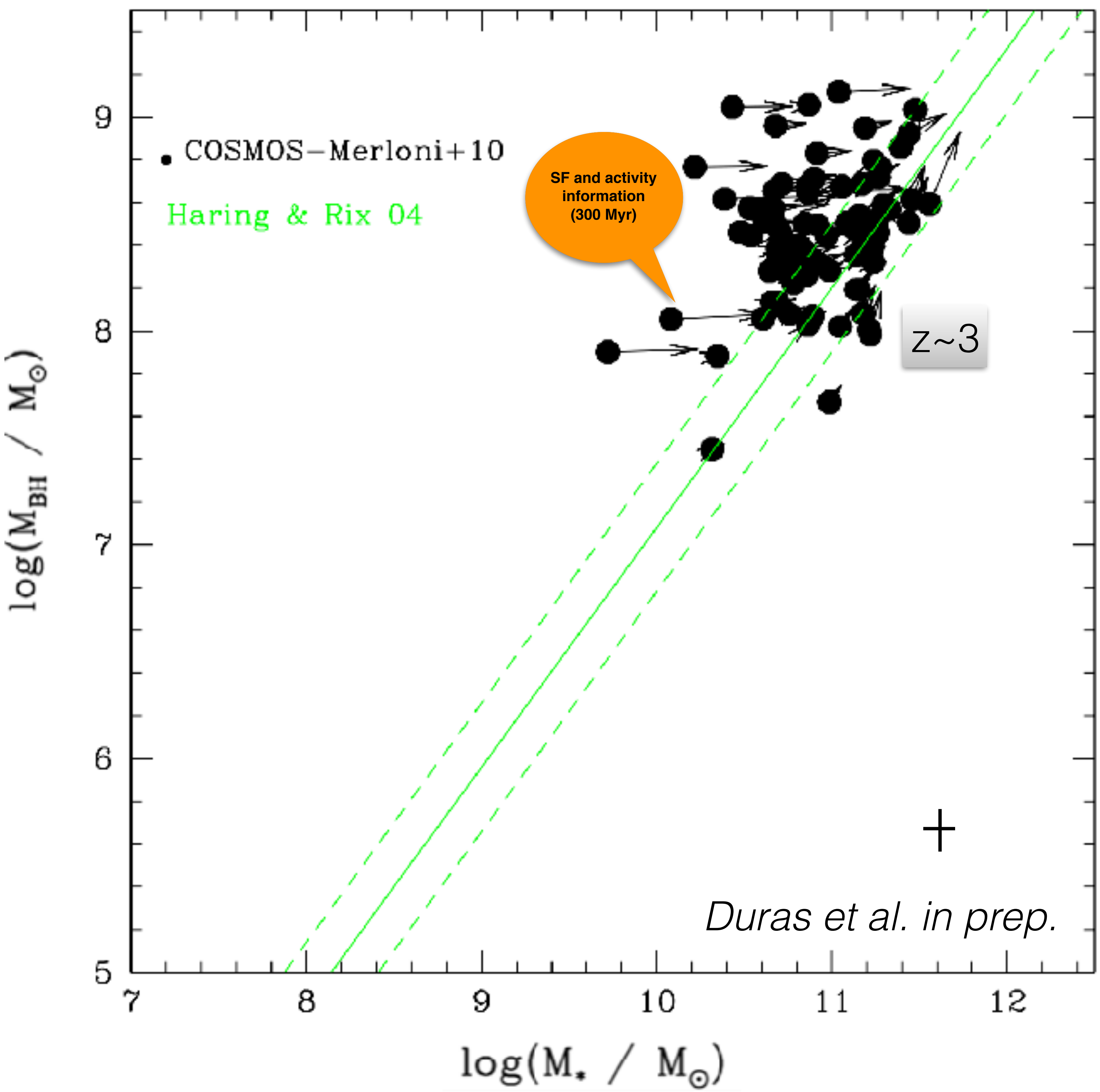
STELLAR MASS is here known from SED-fitting!

SFR is derived from the SED-fitting

BH Accretion Rate from LBOL (SED-fitting)

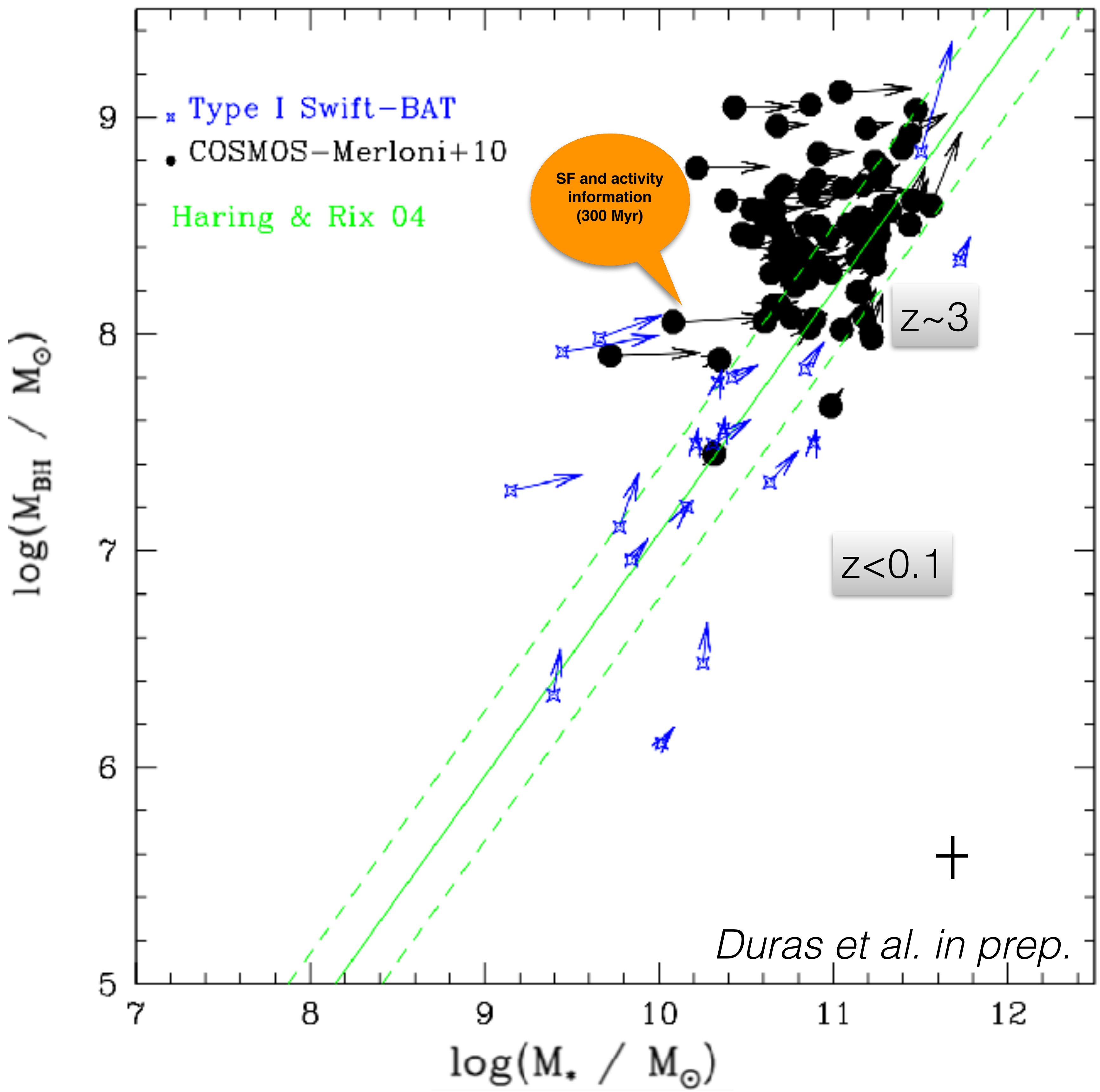
BH MASS known from RM & NIR spectroscopy

BH/Galaxy co - evolution from local to high redshift



BH/Galaxy co - evolution from local to high redshift

More massive type1 AGN populate the typical region of the observed M_{BH}-M_* relation



BH/Galaxy co - evolution from local to high redshift

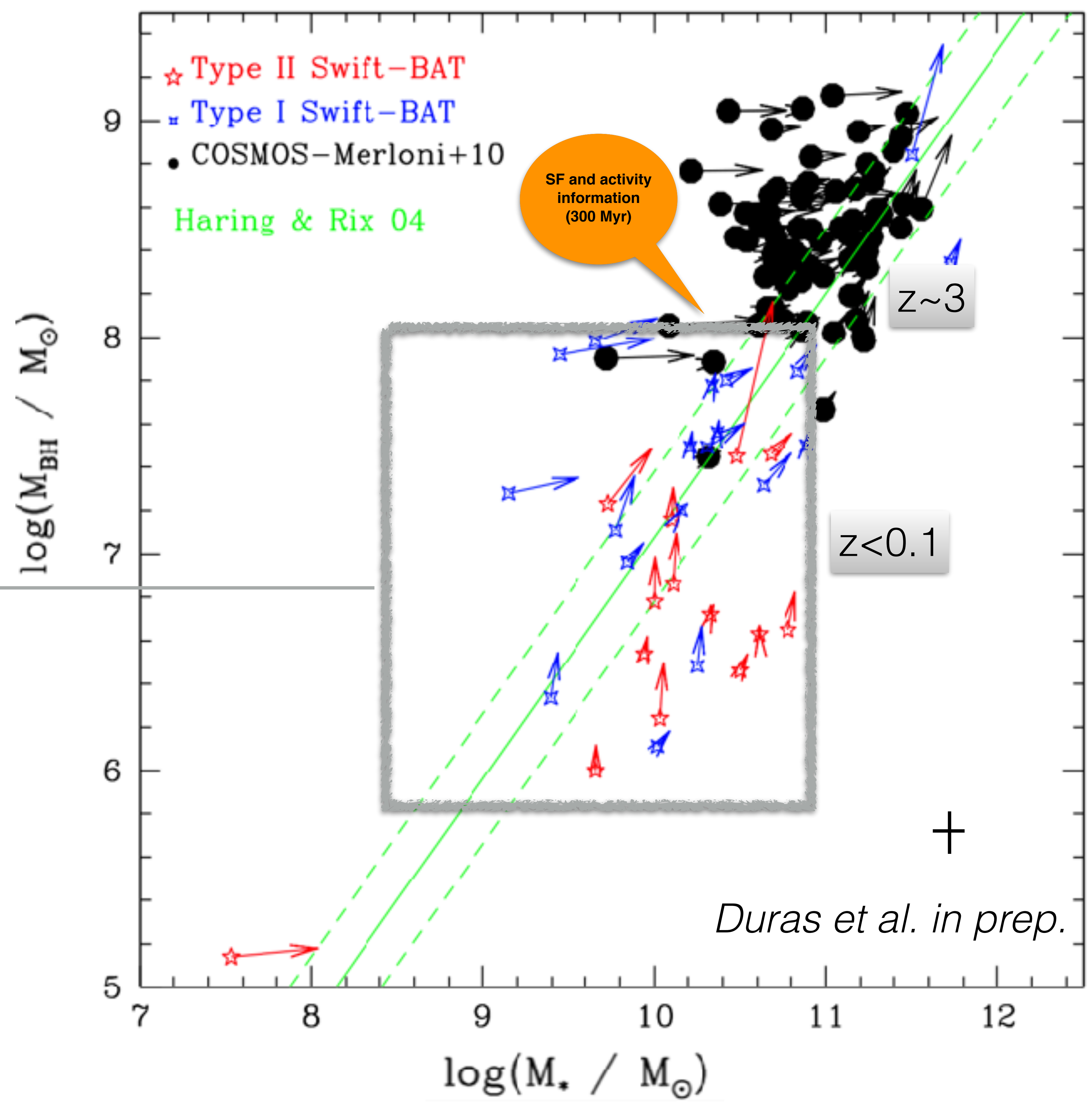
More massive type1 AGN populate the typical region of the observed M_{BH}-M_* relation

Less massive type 2 AGN still on their way to reach the M_{BH}-M_* locus;

obscured AGN host less massive BHs compared to unobscured ones, given the same stellar mass

low-mass low-z regime

Constraining
the BH-galaxy scaling relation over
three orders of magnitudes in mass
and following its evolution
from z~3 to z~0.



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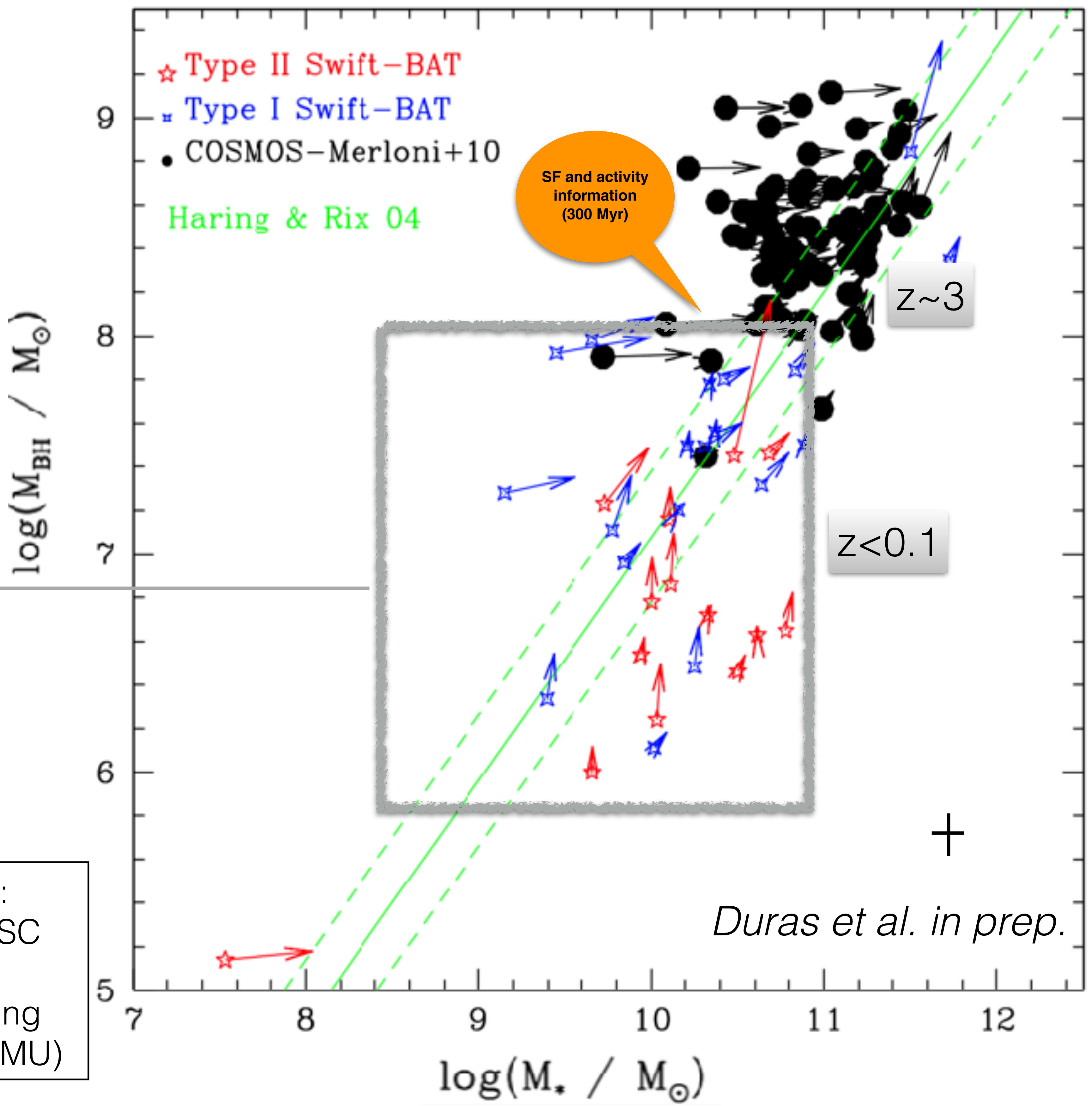
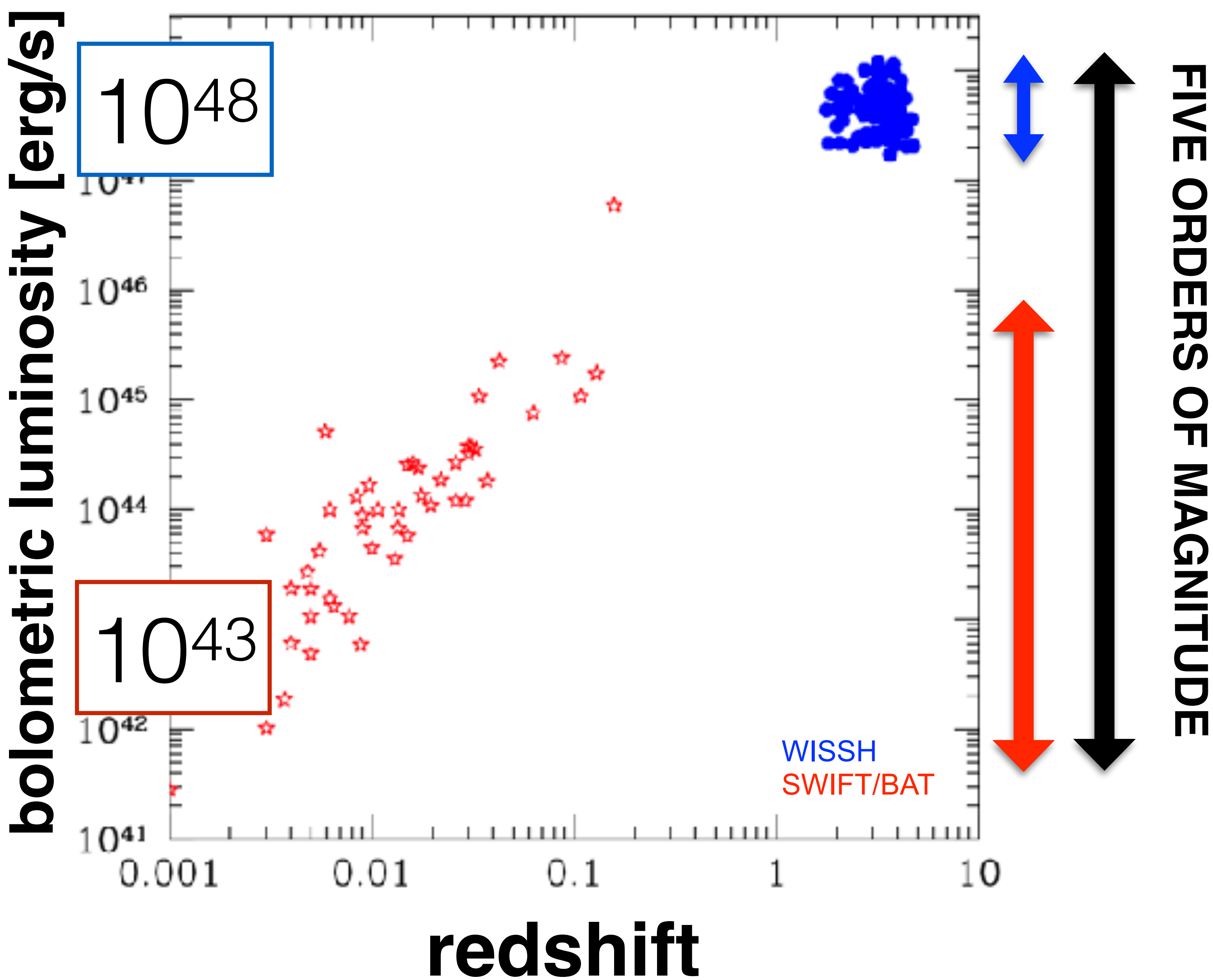


More information in the next future:
study of a sample of galaxies with HSC data, analysed both with imaging decomposition (GalFIT) and SED-fitting
(in collab. with J.Silverman @KAVLI IPMU)

A new hard X - ray bolometric correction for type1 and type2 QSOs

WIDE RANGE
OF BOLOMETRIC
LUMINOSITY

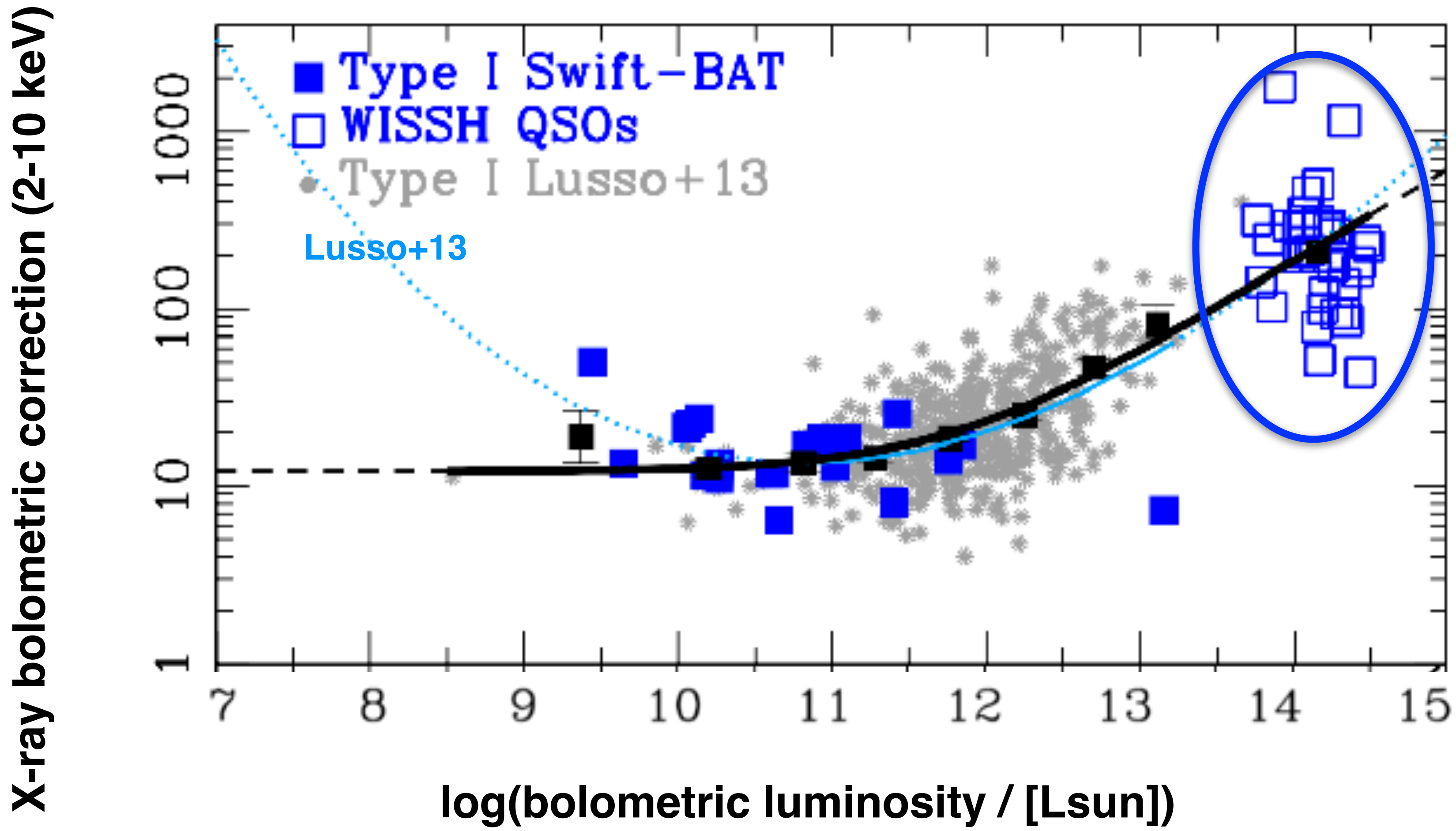


The perfect collection to build up a new bolometric correction

$$k_{band} = \frac{L_{bol}}{L_{band}}$$

… in the hard X-ray band

A new hard X - ray bolometric correction for type1 and type2 QSOs



see Martocchia+17

constraining the tail at high luminosities

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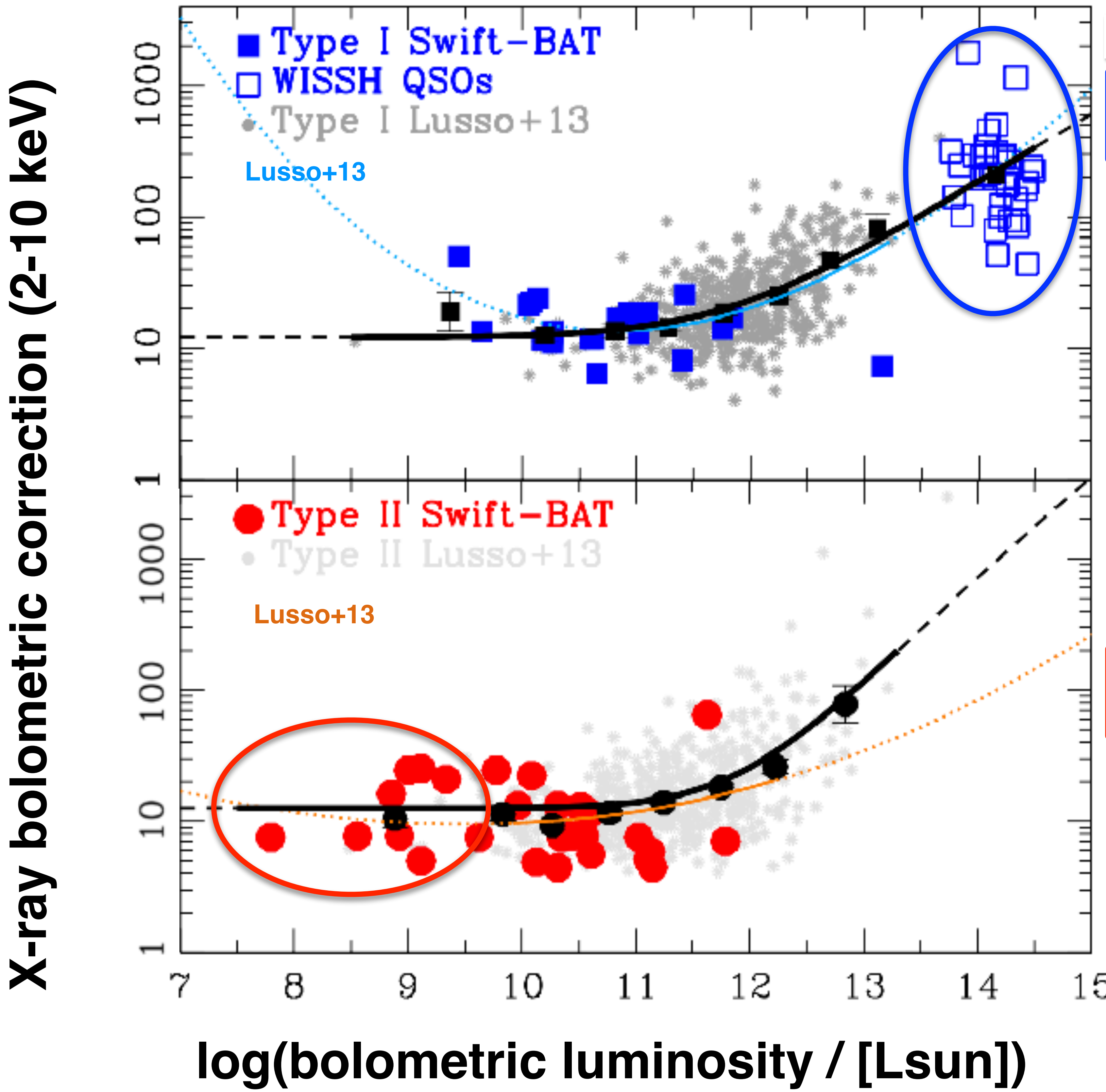
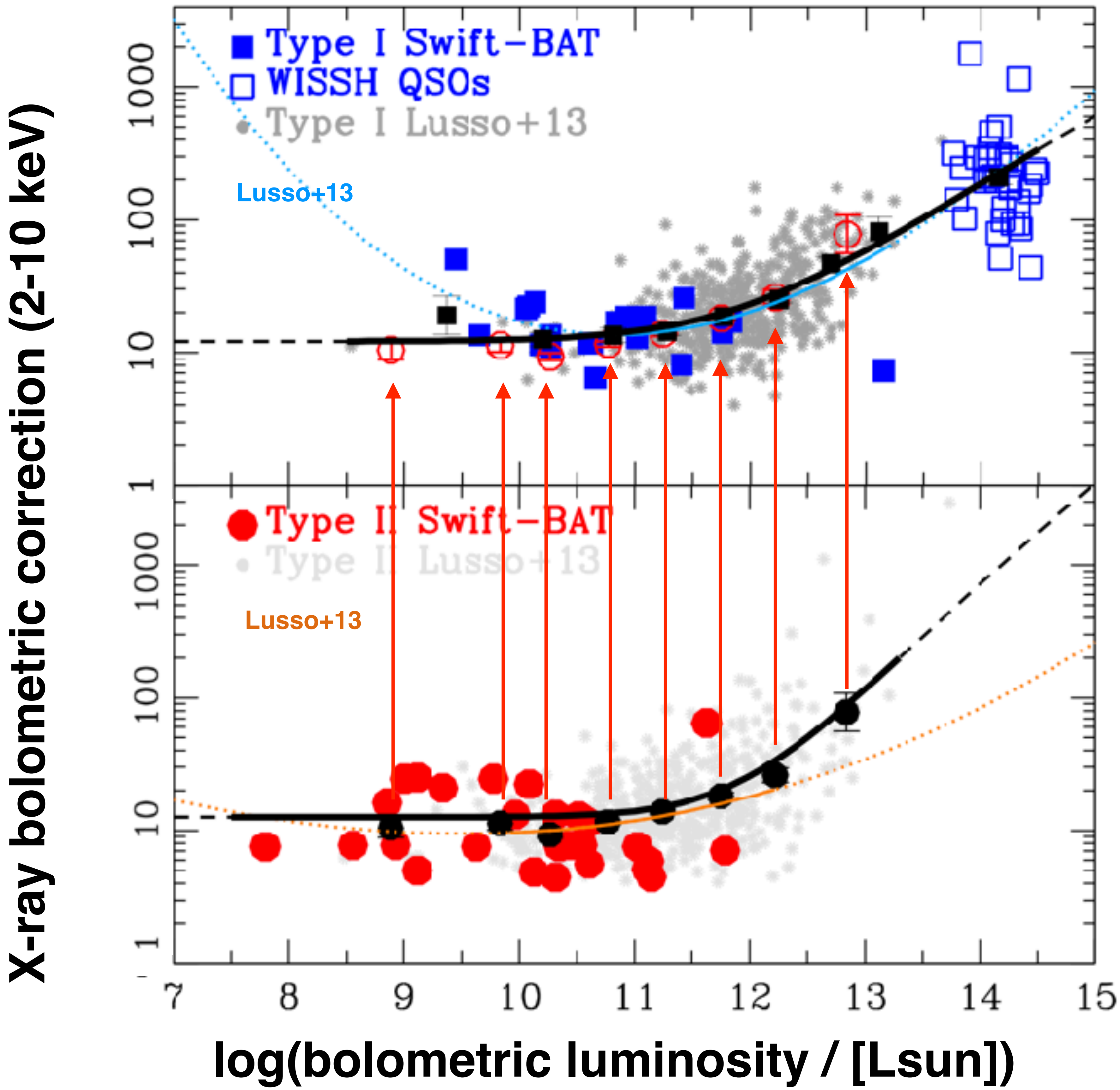


see Martocchia+17

constraining the tail at high luminosities

and at low luminosities

A new hard X - ray bolometric correction for type1 and type2 QSOs



<kbol> (in bin of LBOL) of type2 sources lie ON the fit for type1 sources

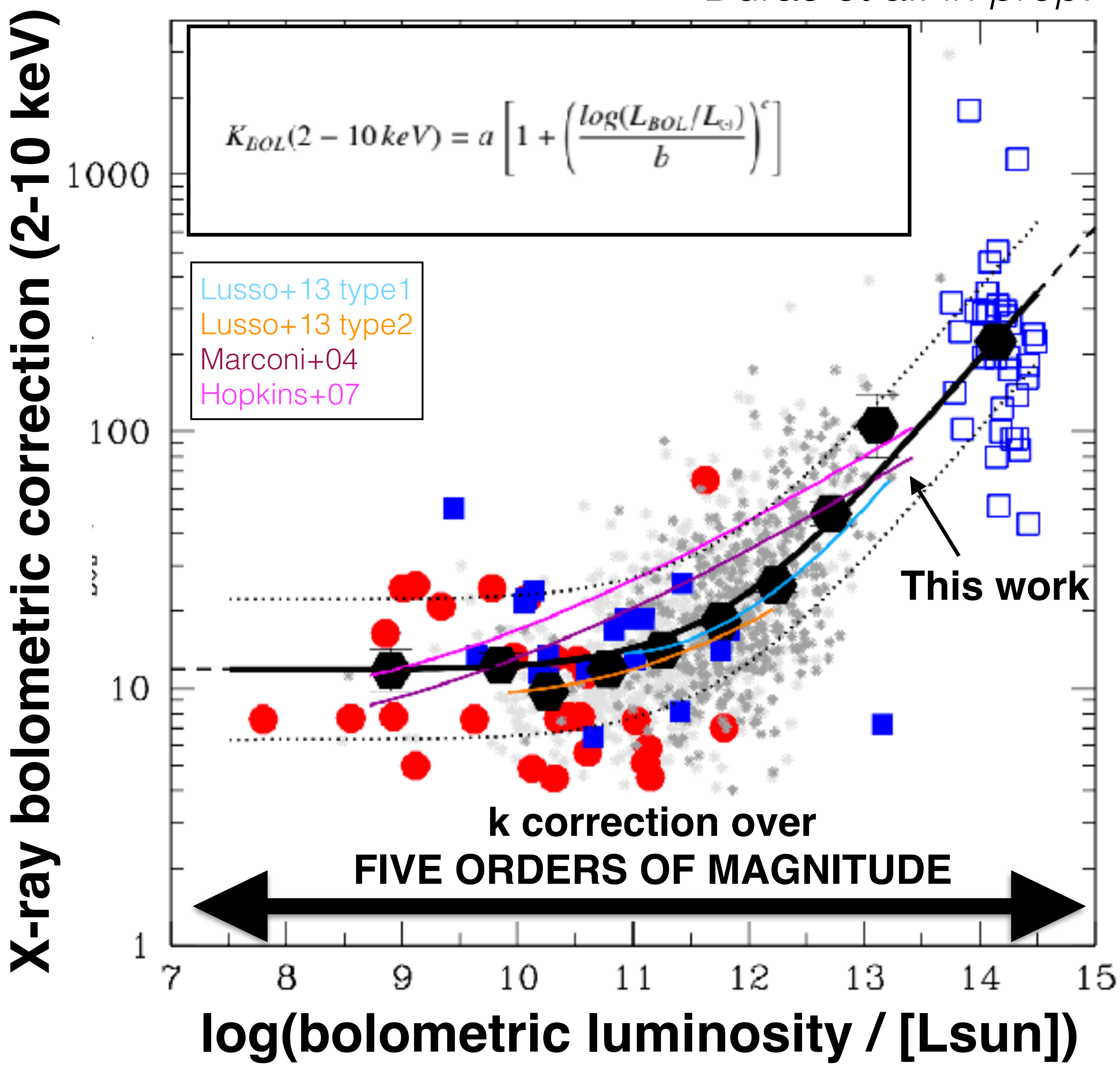
A new hard X - ray bolometric correction for type1 and type2 QSOs

General bolometric correction for the entire population of AGN

Duras et al. in prep.

STATISTICALLY REPRESENTATIVE (F-test confirmed)

OF BOTH TYPE1 AND TYPE2 POPULATIONS



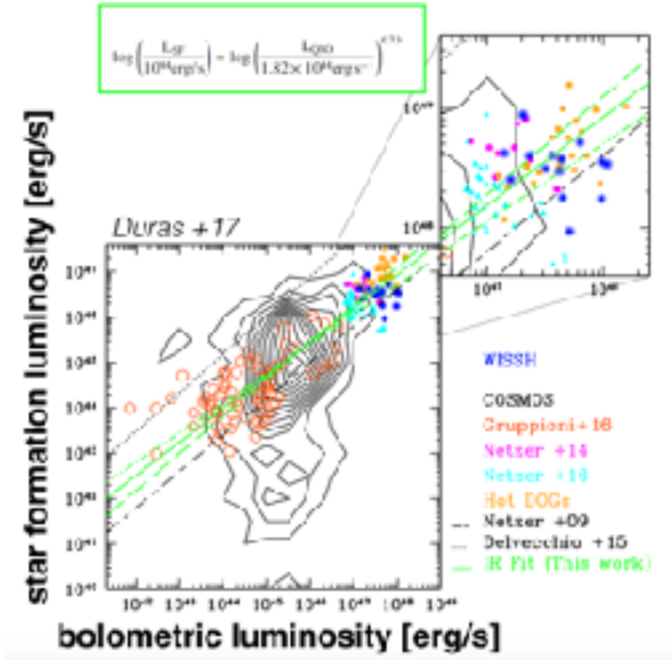
Summary

TWO complementary samples of sources at the bright and the faint end of the AGN mass and luminosity function

WISSH QSOs

Type 1
2<z<4
High luminous and massive

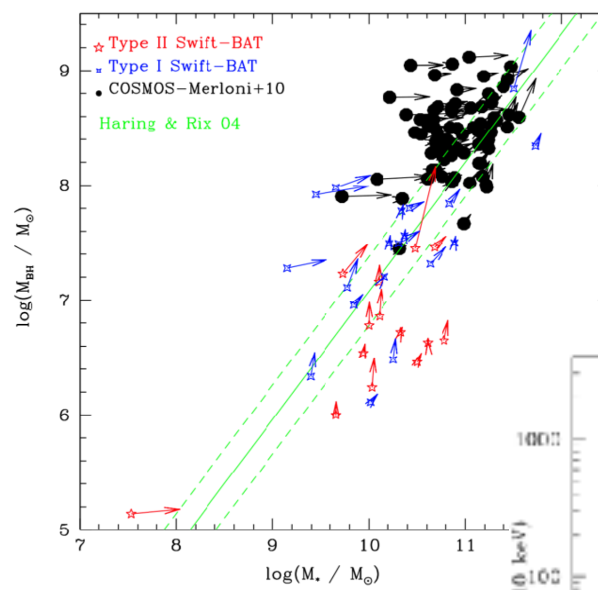
16 sources with Herschel coverage

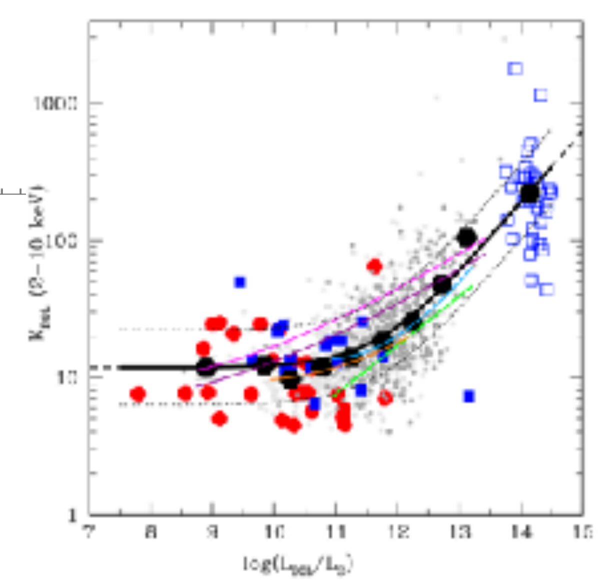


★ Extremely high SFR (**500 - 4000 M_{sun}/year)** even counting for the AGN contribution to the FIR (~50%) - **BUT** - need for high-resolution IR and sub-mm data!

SWIFT/BAT

Local (z<0.1)
Low luminous and low massive
Mass estimation from IR spectroscopy





★ Populating the low region of the MBH-M* plane: **obscured AGN** with **less massive BHs** than the **unobscured ones**, are moving towards the local scaling relation

★ NEW general hard X-ray bolometric correction over five order of magnitude for both type1 and type2 sources

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Stay tuned for news and ...

THANK YOU !

ROMA TRE UNIVERSITÀ DEGLI STUDI

DMF DIPARTIMENTO DI MATEMATICA E FISICA

OSSERVATORIO ASTRONOMICO DI ROMA INAF ISTITUTO NAZIONALE DI ASTROFISICA

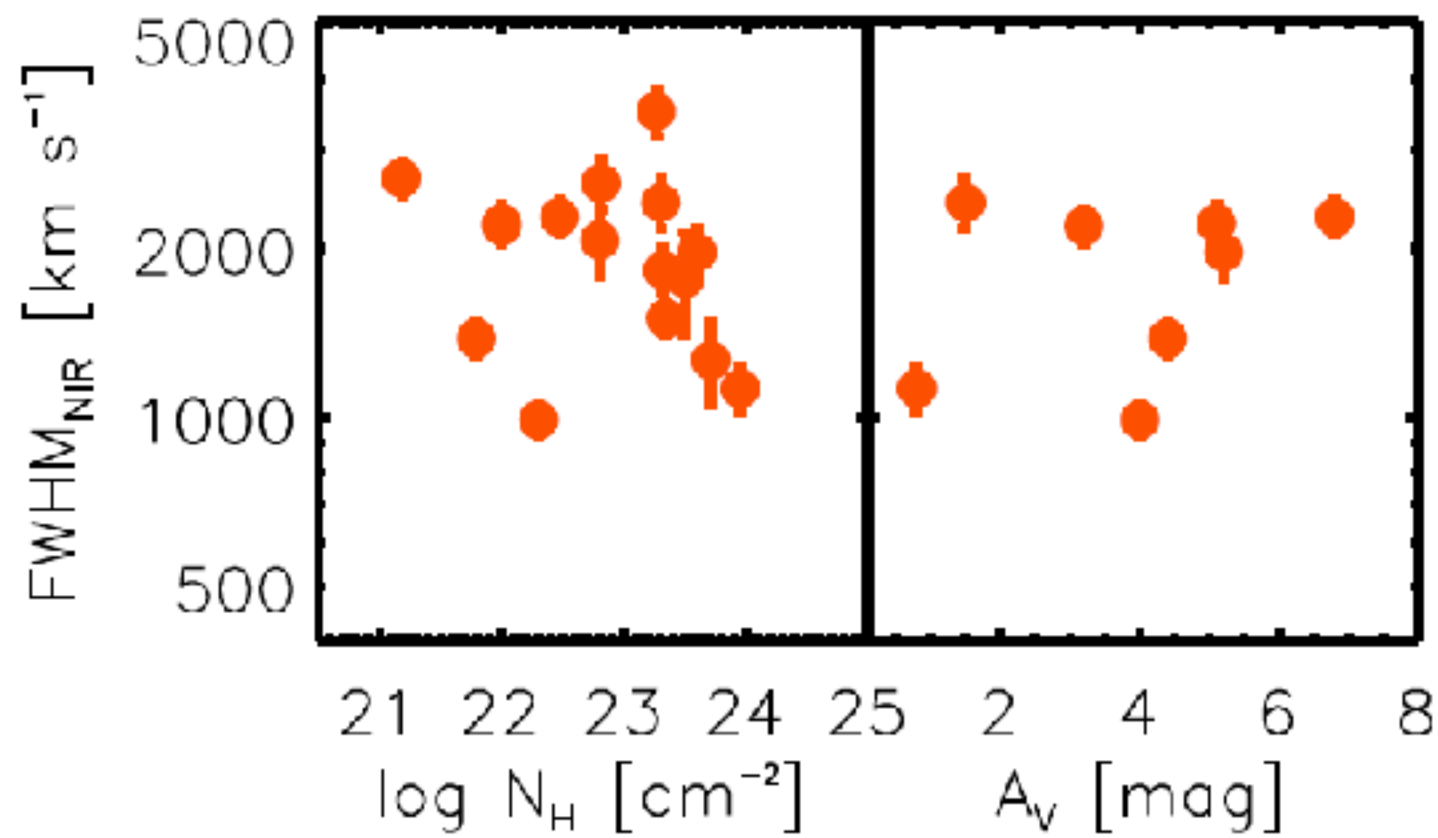
WISSH

KAVLI IPMU

POSSIBLE BIASES ON THE BH MASS ESTIMATION

REDDENING / EXTINCTION

Are the broad lines we see from an outer part of the BLR in which there's less dust?



We should see the largest values of FWHM in the less absorbed sources

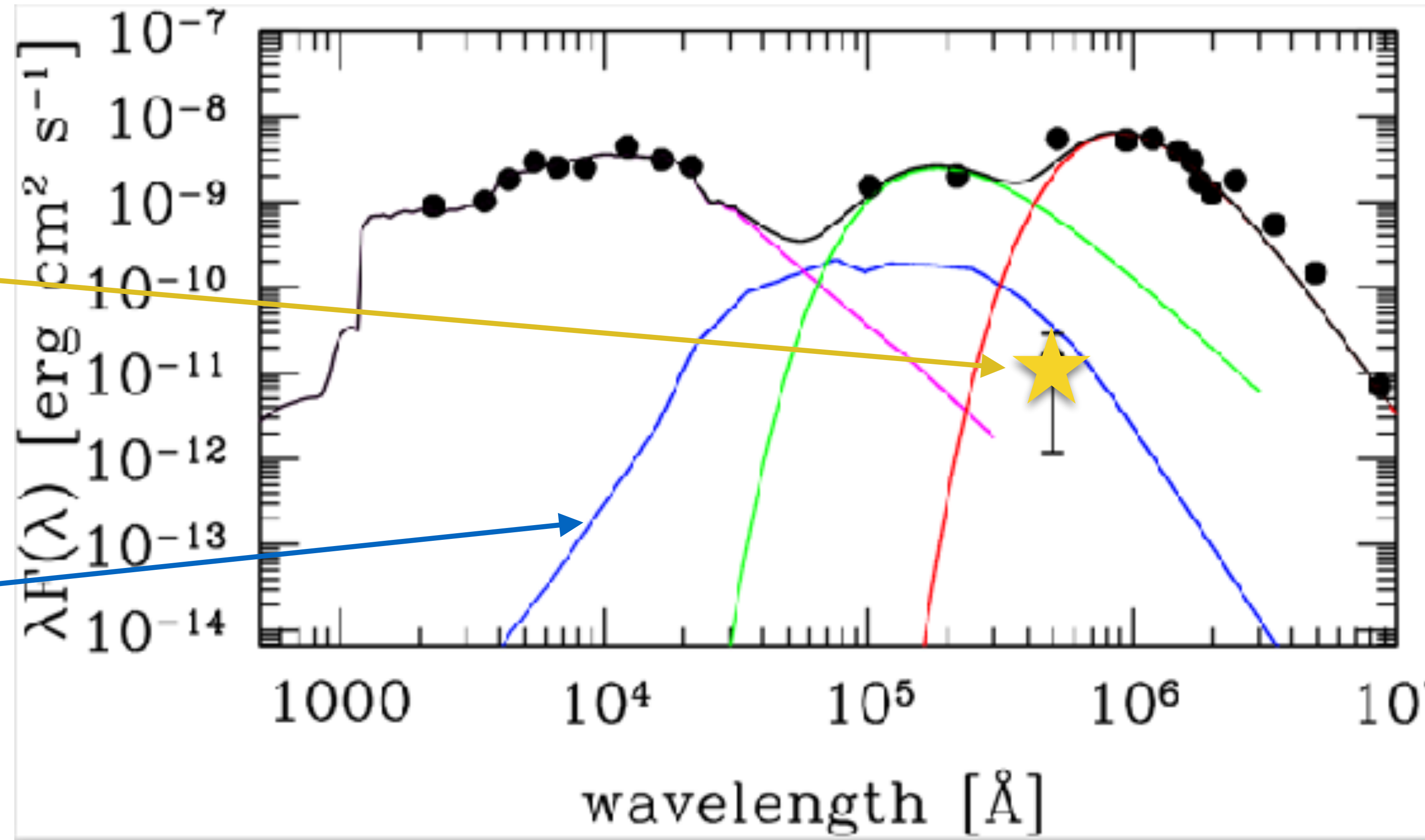
NO TREND BETWEEN FWHM and THE EXTINCTION!

see Onori+17

X-RAY INFORMATION CONVERTED INTO A VIRTUAL PHOTOMETRIC POINT

PREDICTION
from the X-ray
Luminosity

Silva+04 SEDs for the description of the AGN emission



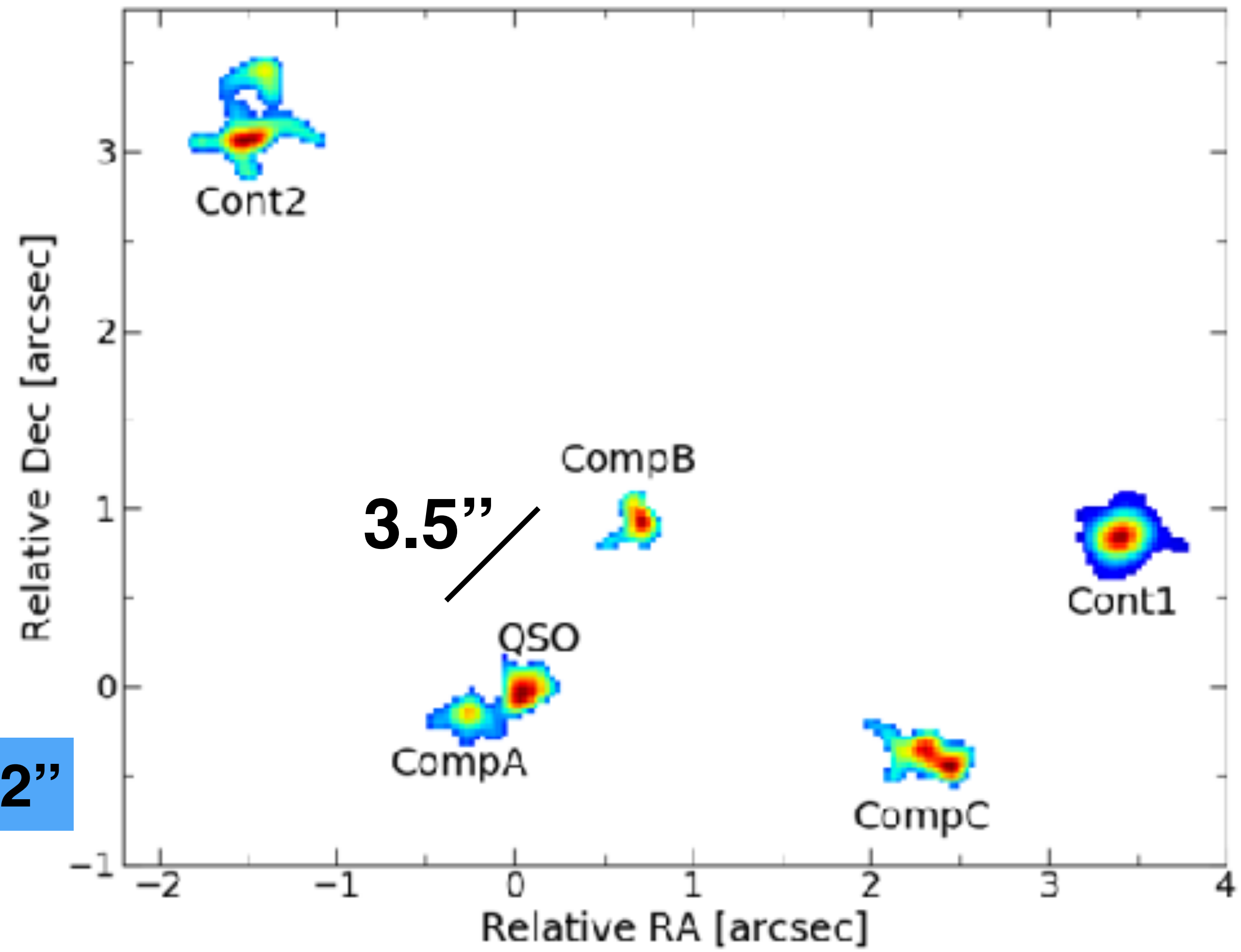
14-195 keV
X-ray luminosity

Baumgartner+13

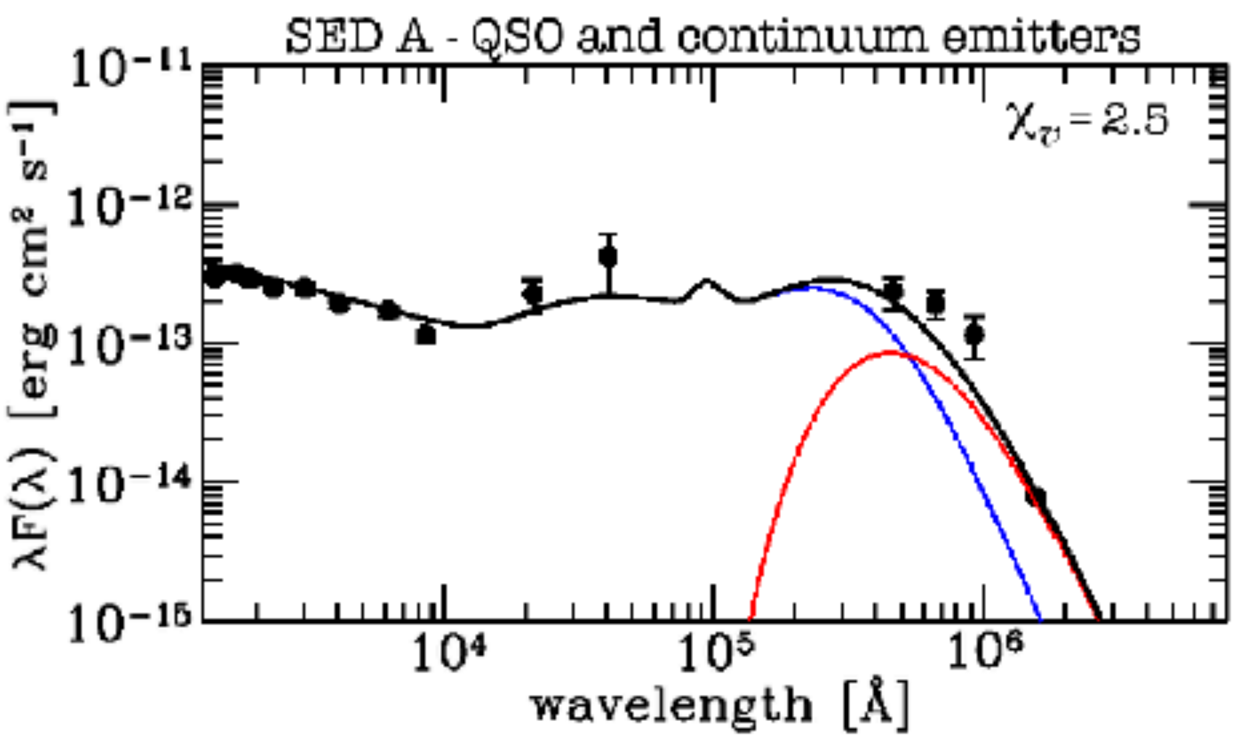
converted in a
virtual photometric point
connected to the sole AGN

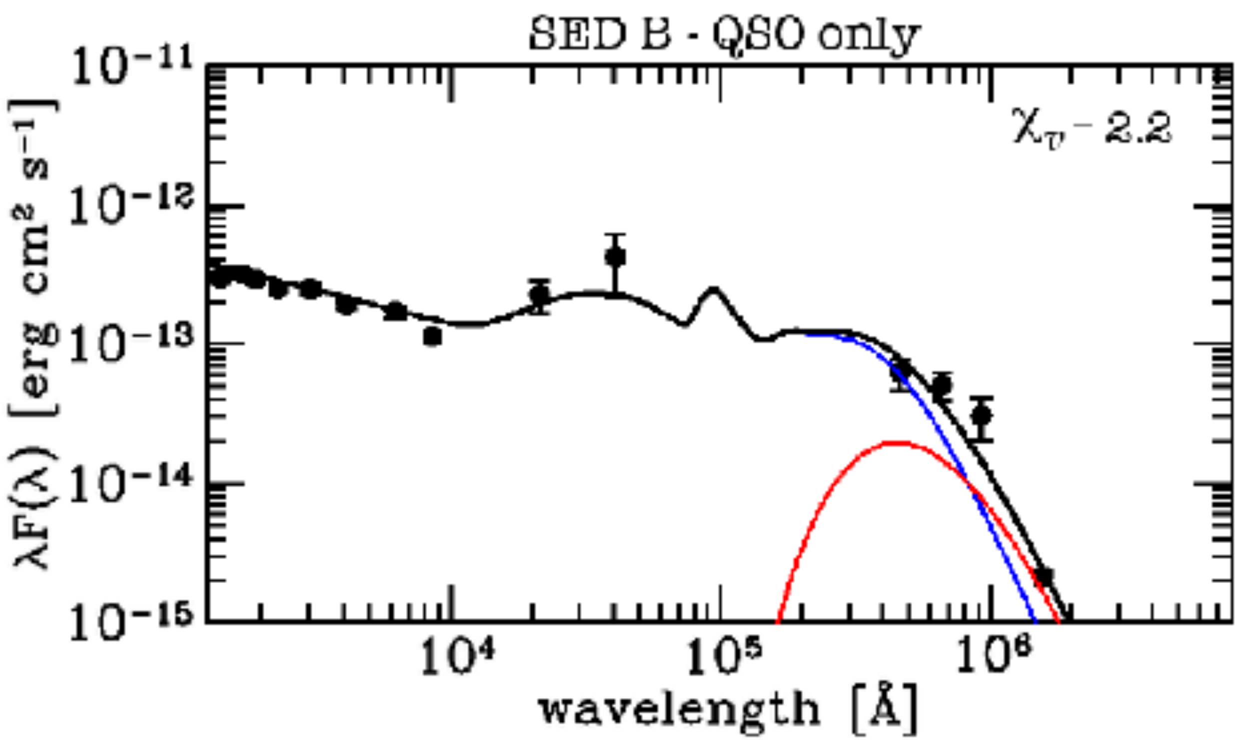
The hard X-ray is NOT contaminated by the host. It represents a **PURE INFORMATION** of the AGN emission

Bischetti+18

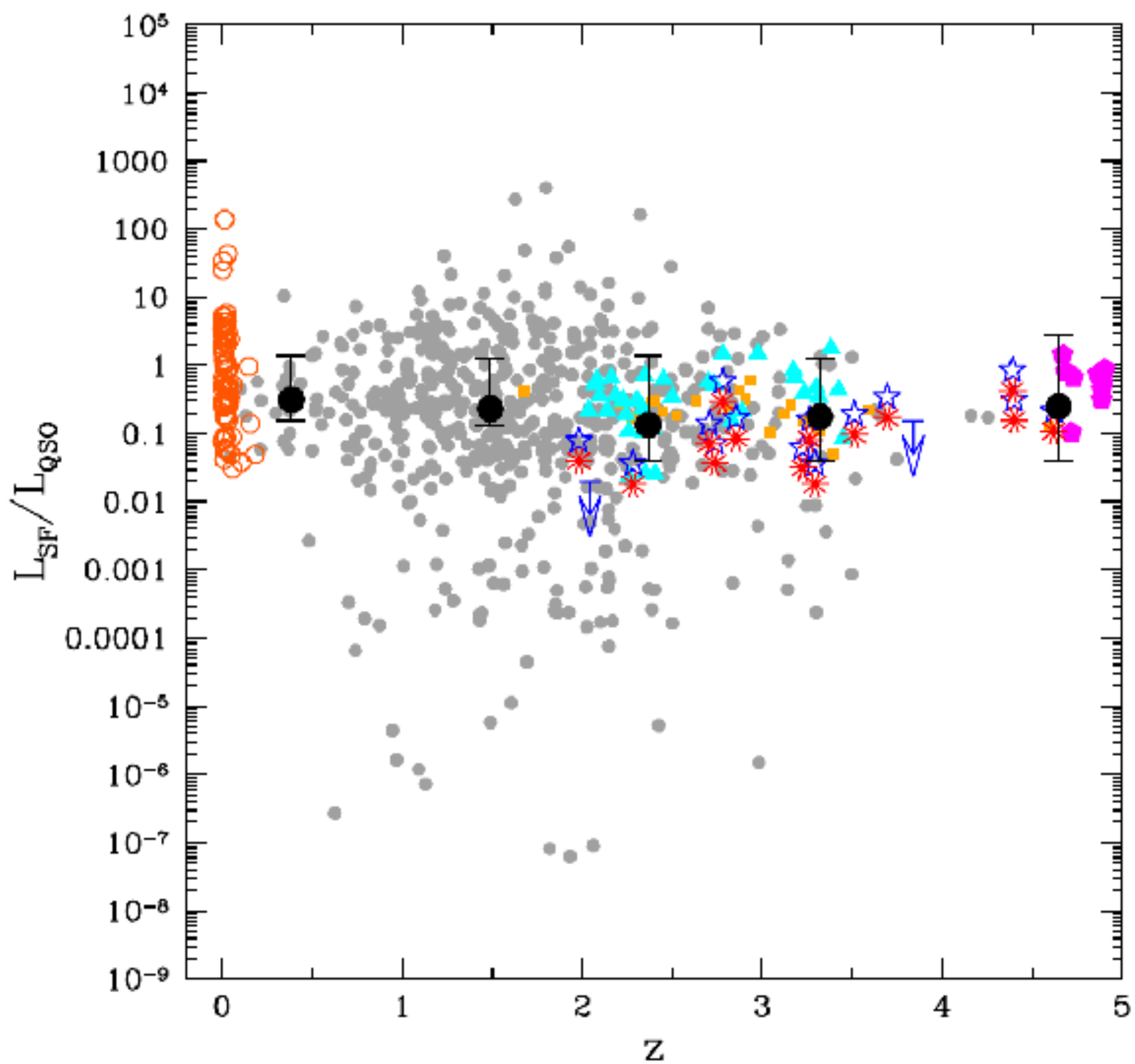


SPIRE PSF 17.5'' - 35.2''



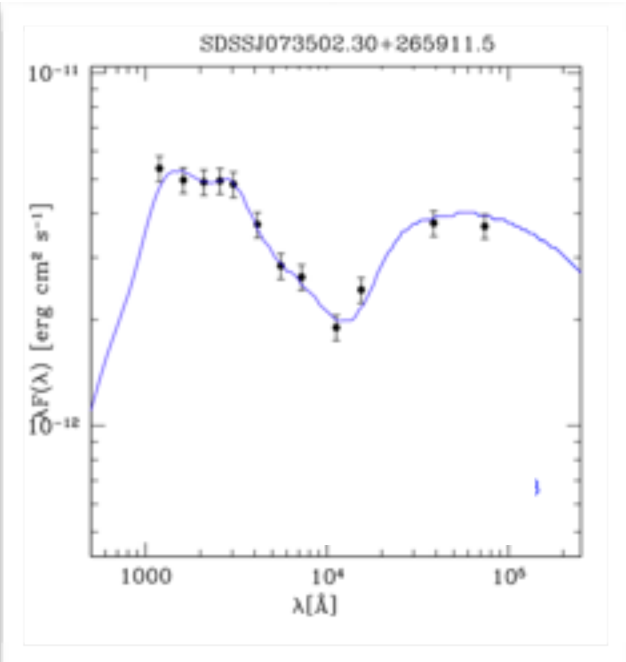


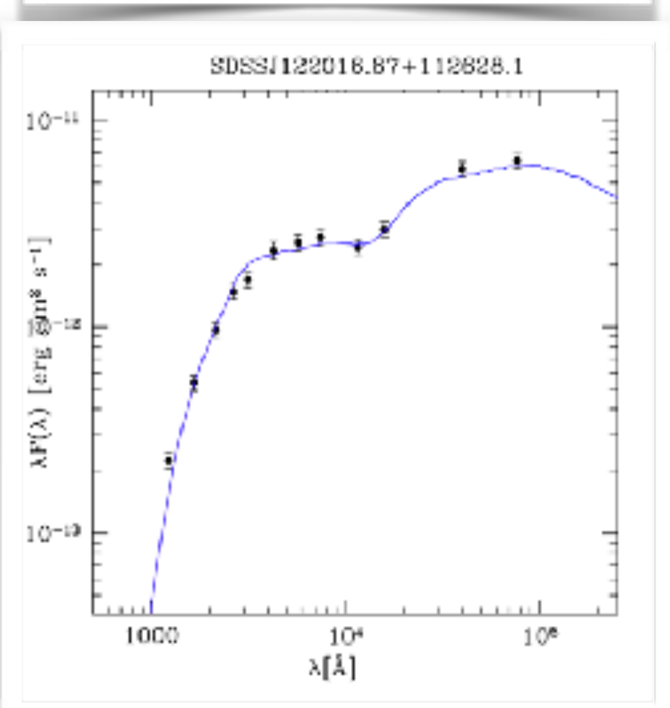
LSF vs LBOL :
no redshift dependence



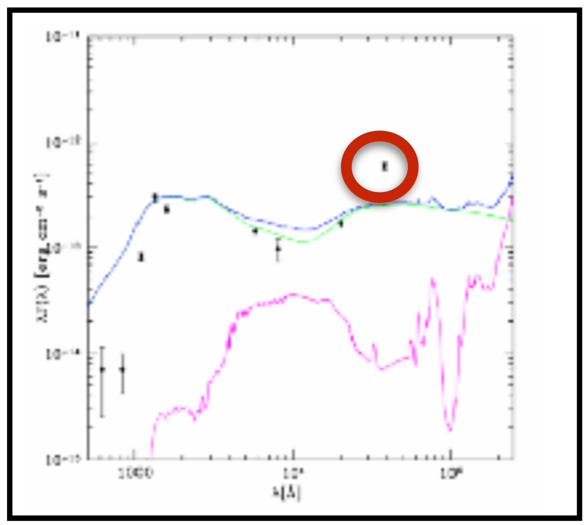
EXCESS IN THE MIR : WHAT IS IT?

Examples of perfect matches between templates and photometric points



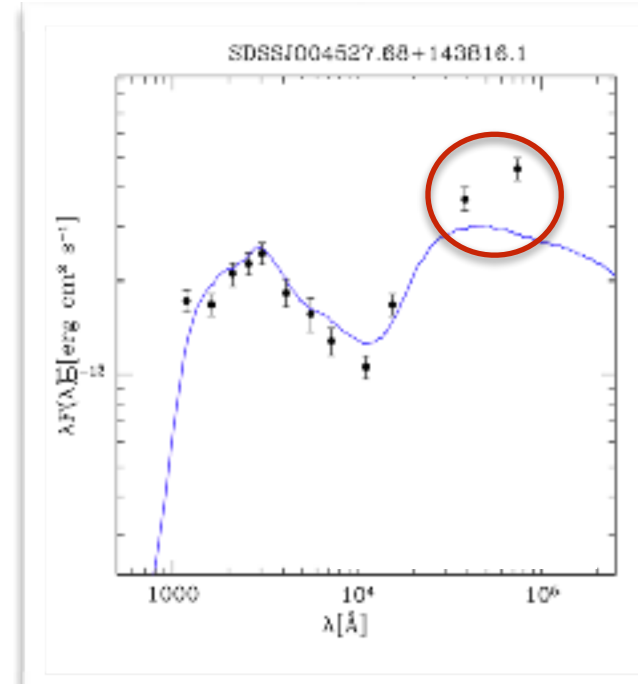


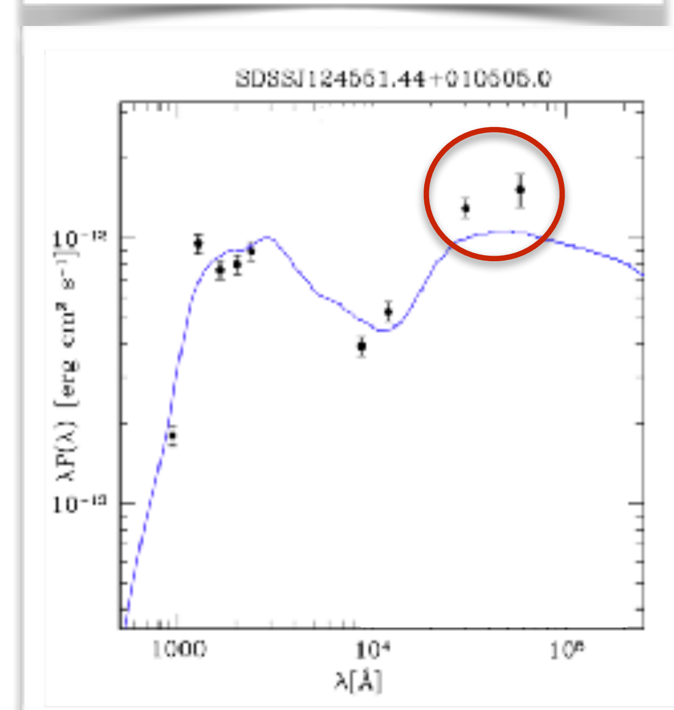
- NOT due to the lack of a PAH component in the fitting code



- NOT due to unreliable images in the WISE catalog (only 5%)

Examples of MIR excess of the photometric point with respect to the template





$\lambda L(\lambda) \propto \lambda^{0} \quad 0.01 < \lambda \leq 0.1 \quad (\mu m)$

Stalevski et al. 2012

Overestimation of the bolometric luminosities of a factor of ~ 2 using Stalevski's AD model

Feltre et al 2012

$\lambda L(\lambda) \propto \lambda^{0.8} \quad 0.05 < \lambda \leq 0.125 \quad (\mu m)$