Meeting "*Supermassive Black Holes: Environment and Evolution*"
@Corfù Island
June 21 2019

Expanding our knowledge of the AGN/galaxy coevolution with the widest dynamical range ever used

Federica Duras

F. La Franca, A.Bongiorno, F.Ricci, E.Piconcelli, L. Zappacosta and all the WISSH Team

ROMA TRE UNIVERSITÀ DEGLI STUDI
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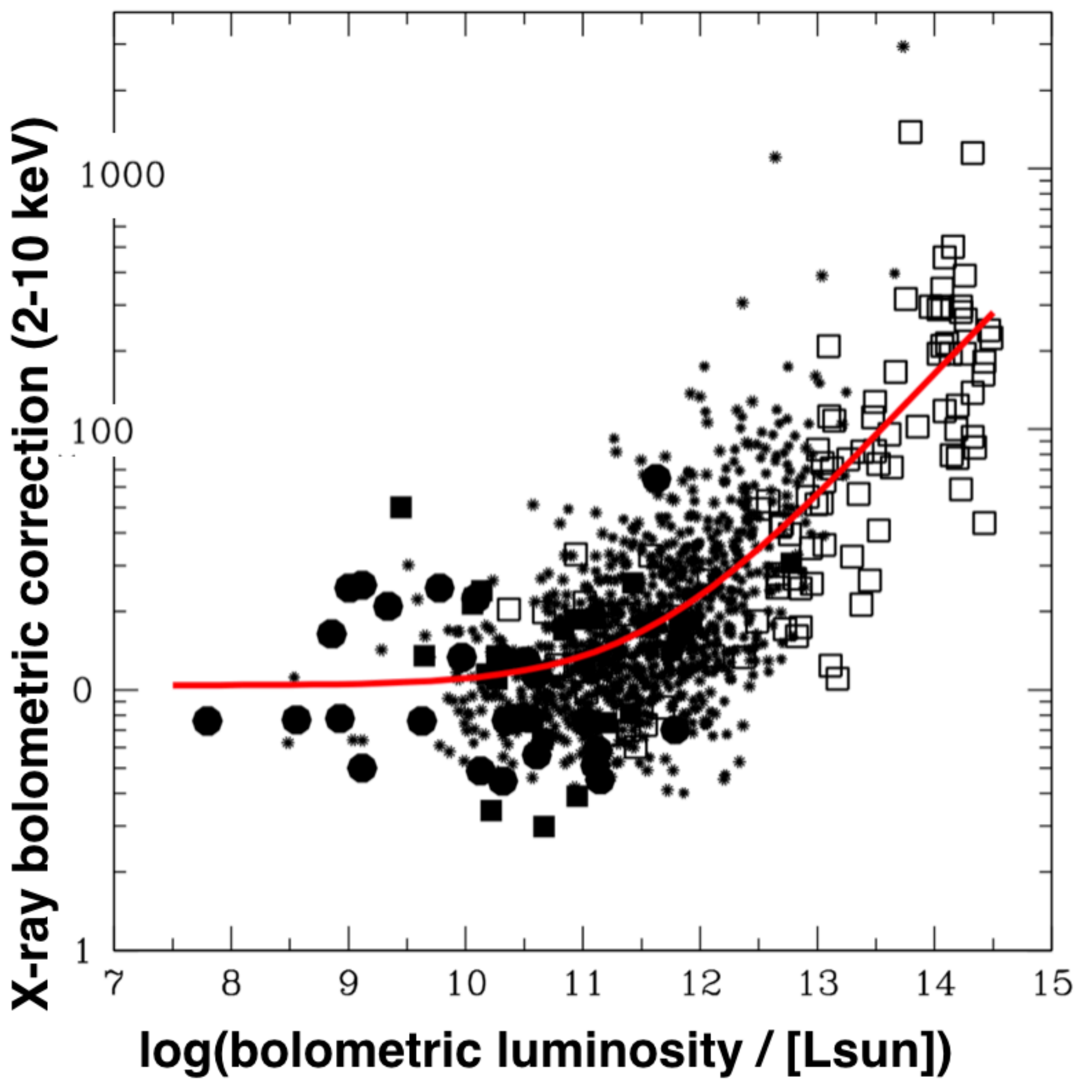
OSSERVATORIO ASTRONOMICO DI ROMA INAF ISTITUTO NAZIONALE DI ASTROFISICA
WISSH

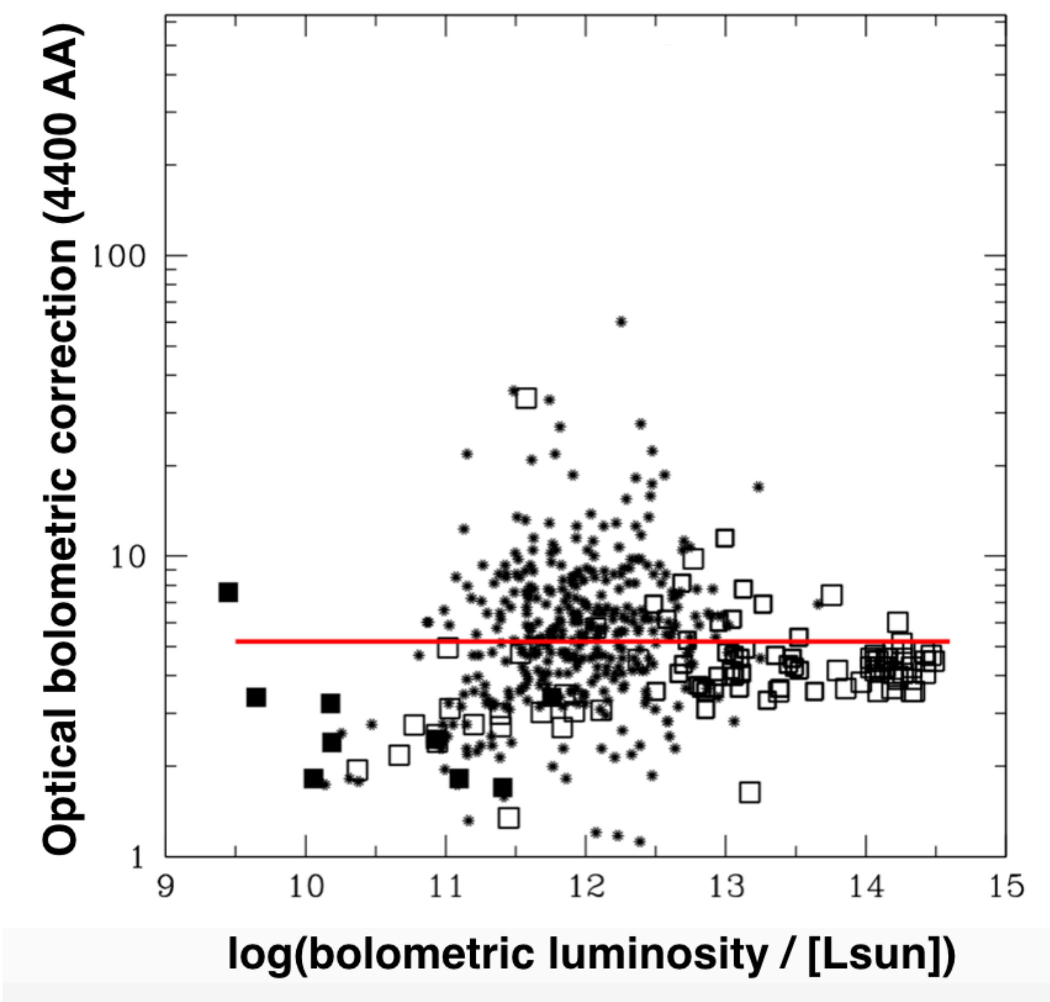
HOW COULD WE SURVIVE WITHOUT THAT COOL UNIVERSAL BOLOMETRIC CORRECTION ?

Adapted from Mars Explorers Wanted poster

BACKWARDS, STARTING FROM THE MAIN RESULT

A new, general, bolometric correction for the entire AGN population in the widest luminosity range ever





THE MOTIVATION

The **BOLOMETRIC LUMINOSITY** is one of the MOST IMPORTANT physical properties of an AGN. Used in plenty of theoretical and observational works, together with simulations.

$$\int_0^\infty M n_M(M, t_0) dM = \int_0^{t_0} dt \int_0^\infty dL \frac{(1-\varepsilon) L_{bol}}{\varepsilon c^2} \psi(L, t);$$

local accreted

$n_M(M, t_0)$: local BH mass function,

$\psi(L, t)$: QSO luminosity function,

ε : efficiency

Soltan argument, just as example

Not always possible to be measured, because it requires a full modelling of the SED (multi-walength data from different telescopes) and a good treatment of the contamination by the galaxy

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

Bolometric correction: not just a convenient formula

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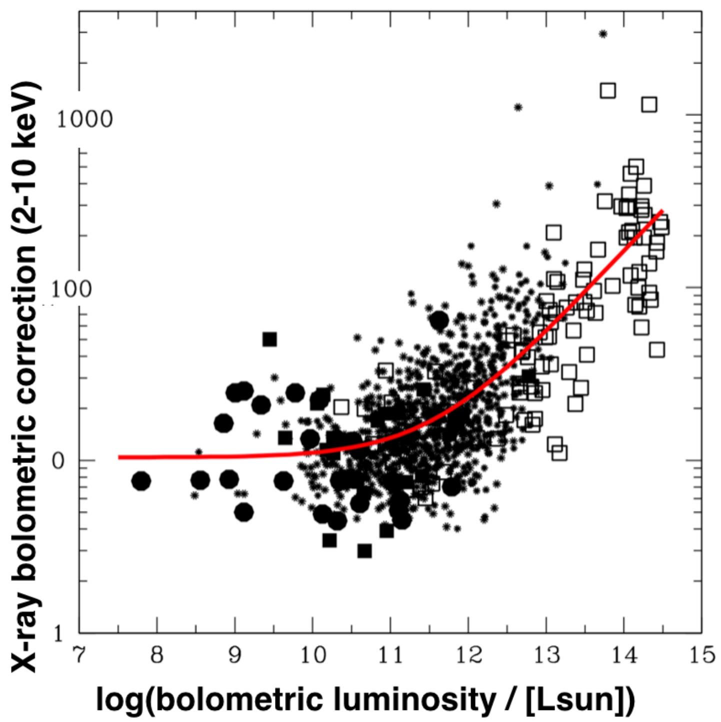
Up to now :

-validity in a **narrow range of luminosity**
-**NOT** a **common** correction for the entire AGN population

STEP BY STEP : THE SAMPLE(S)

Five AGN (both type 1 and type 2) samples selected to cover a wide range of luminosity



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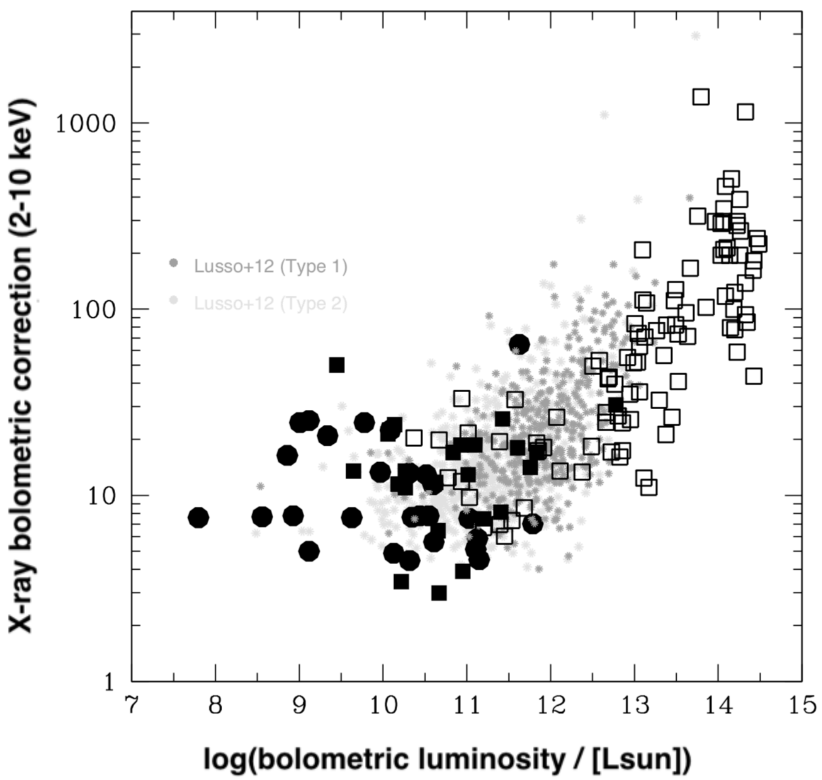
from the COSMOS sample by *Lusso+12*
0.1 < z < 4



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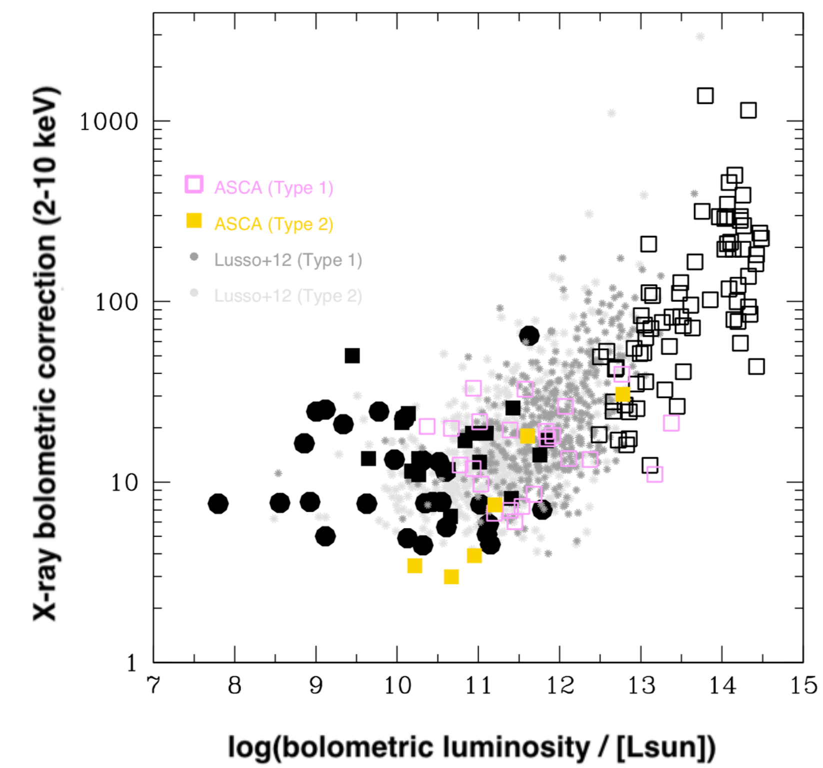

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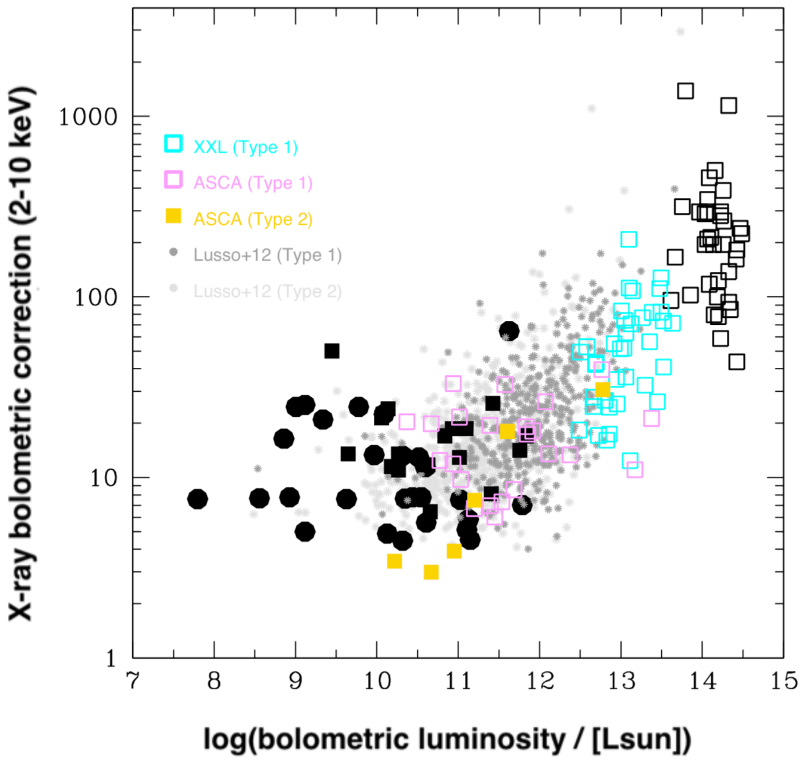

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Starting from the paper by *Liu+16*, selection of the objects with the highest L_{BOL} (>46.5)

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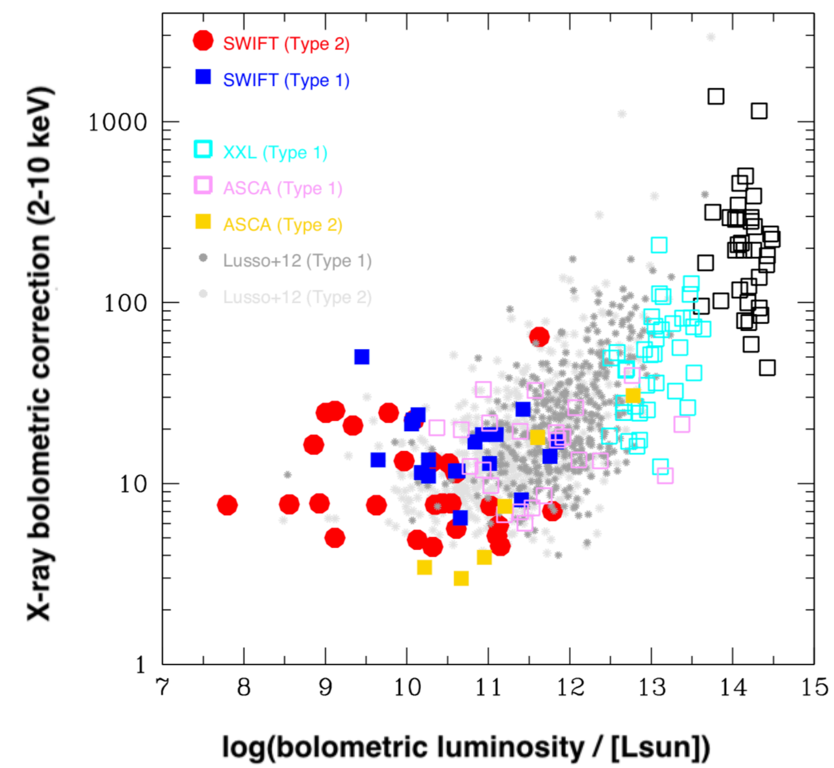

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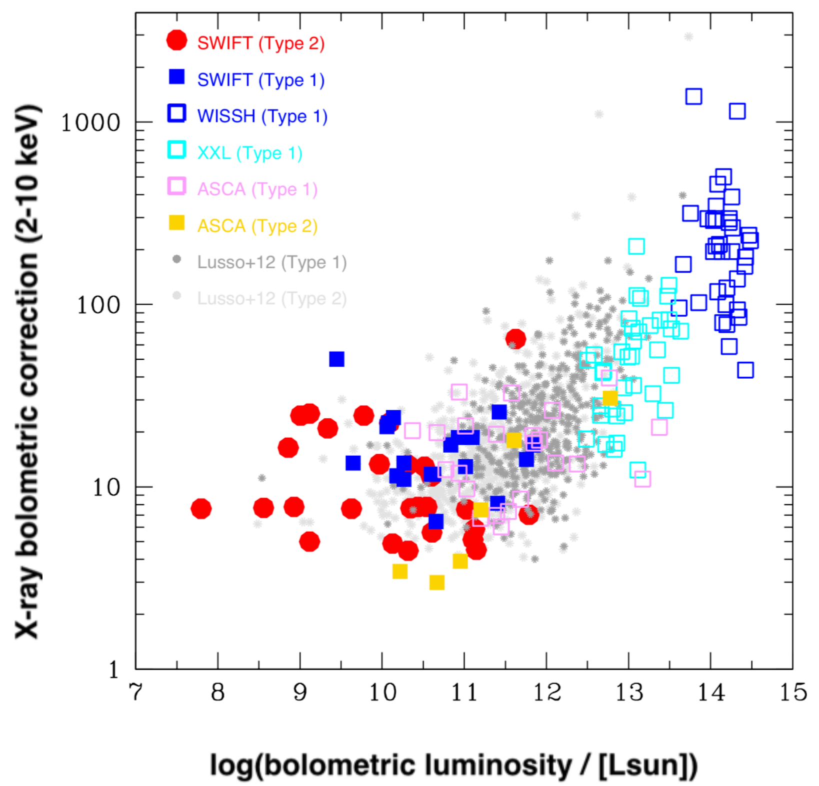

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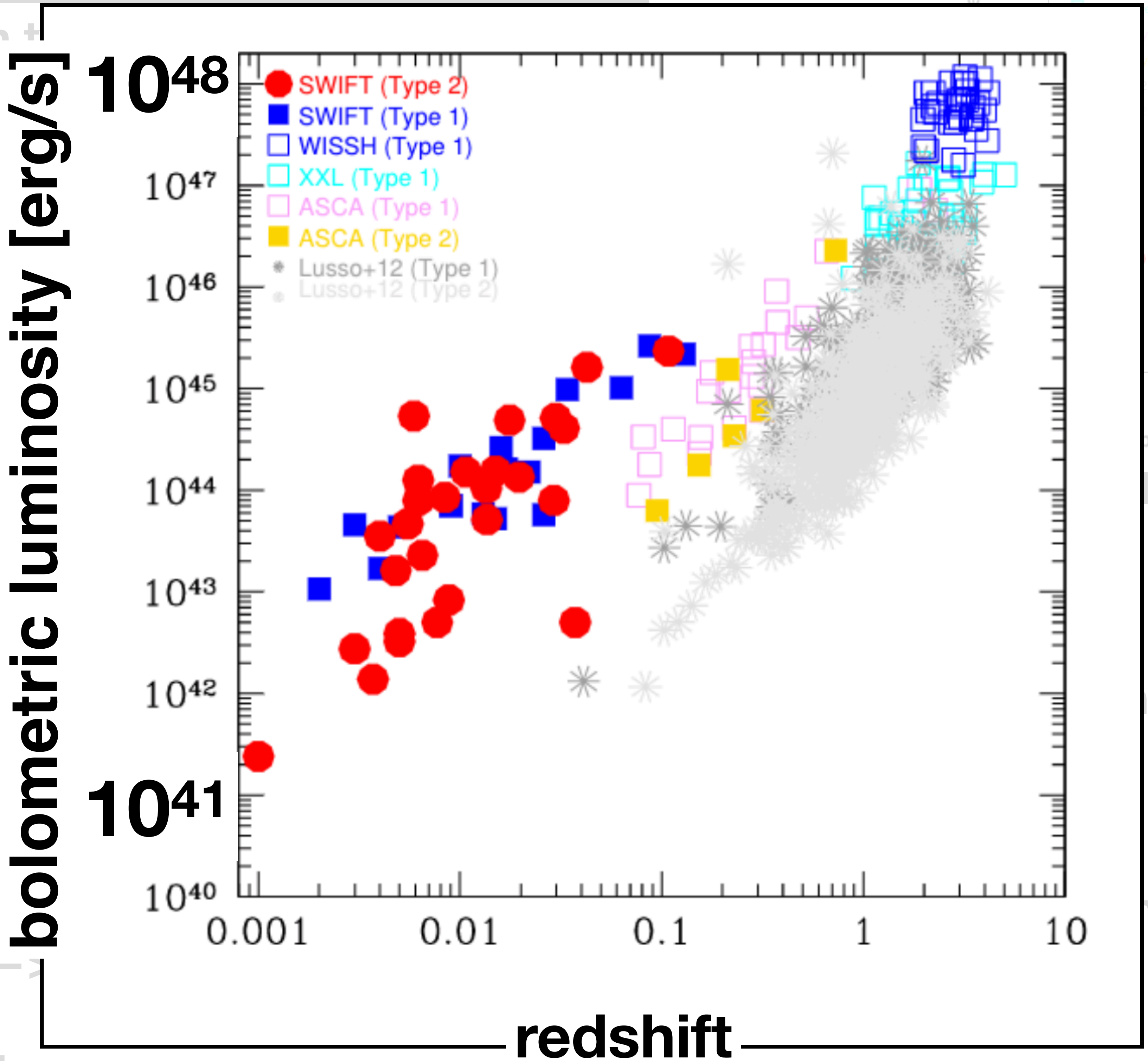

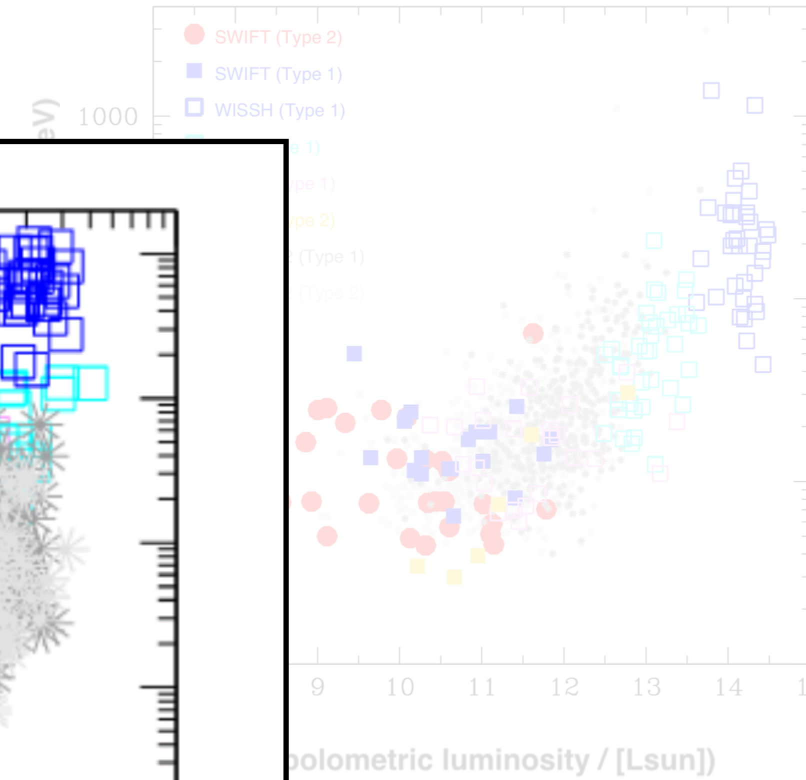

ISE

ighest LBOL (>46.5)

rough deep NIR

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WHERE DOES THE BOLOMETRIC LUMINOSITY COME FROM?

The method in very brief

Dedicated SED-fitting procedure for all the samples but COSMOS (in Lusso+12 similar approach than the one adopted by us)

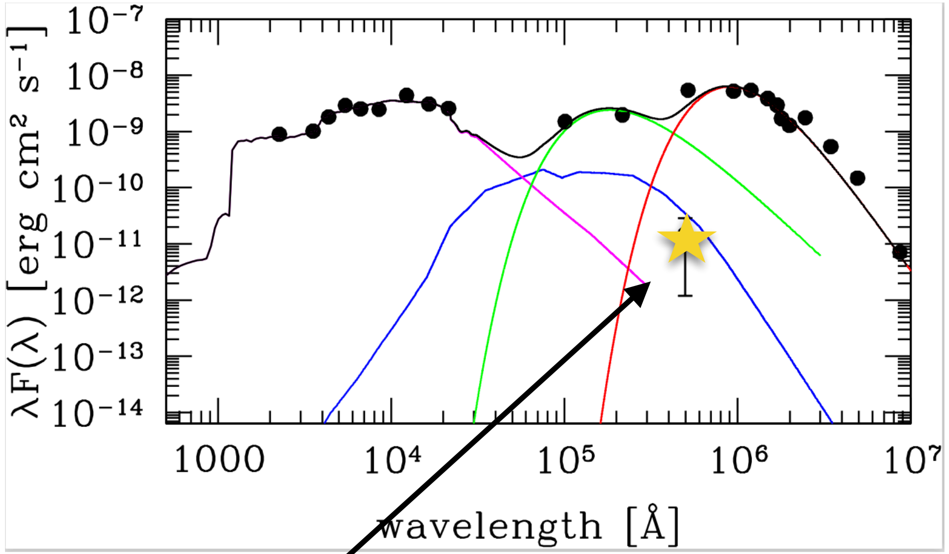
Four fitting components
to describe the emission:

Accretion disk + Torus

Galactic stellar light

Cold dust in the FIR
due to the reprocessed emission of the UV photons by the dust in the torus (tracer of star formation)

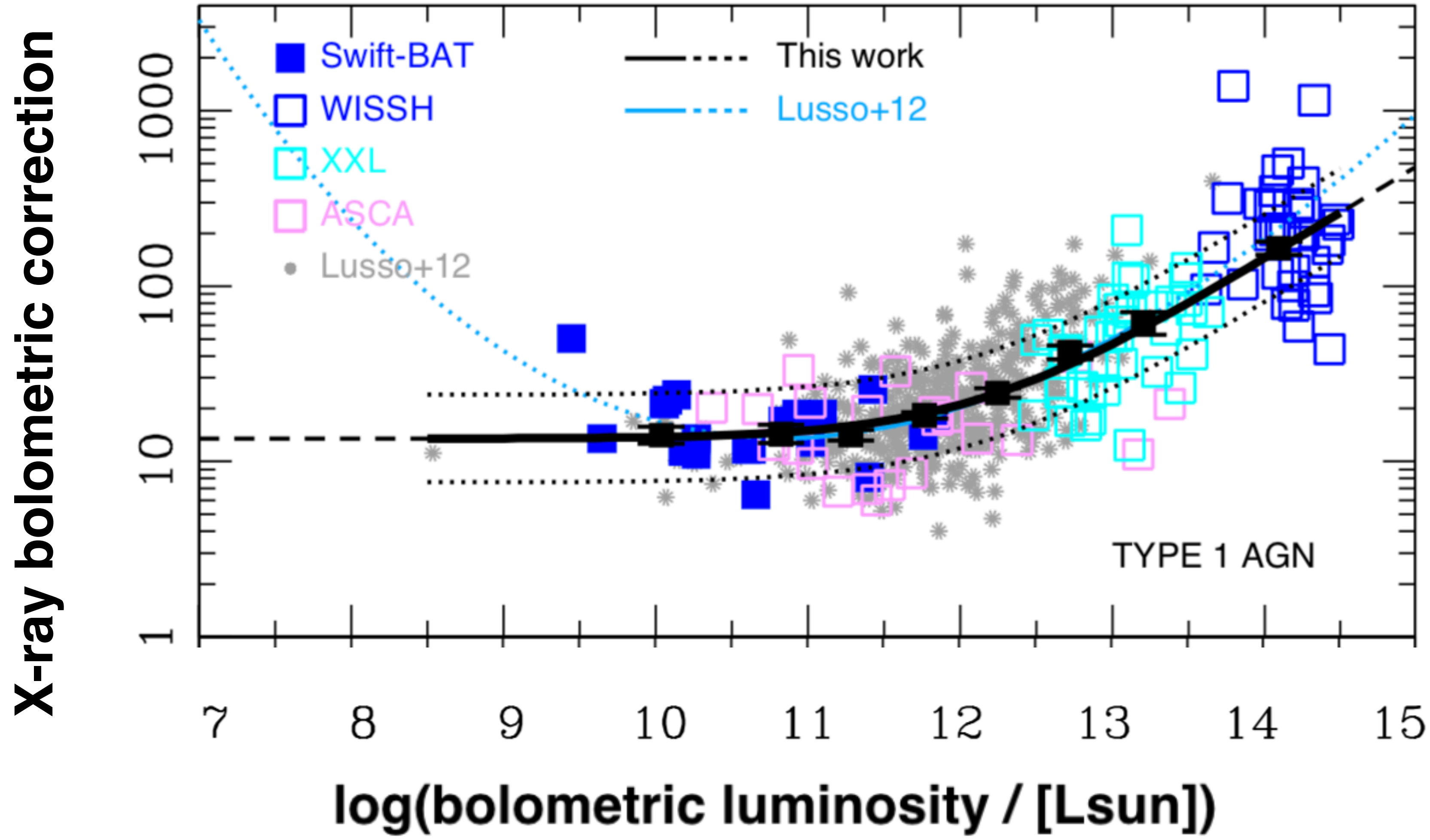
eventual **excess** in the MIR
(it has been found in several works on luminous AGN)



X-ray information used to constrain the AGN template

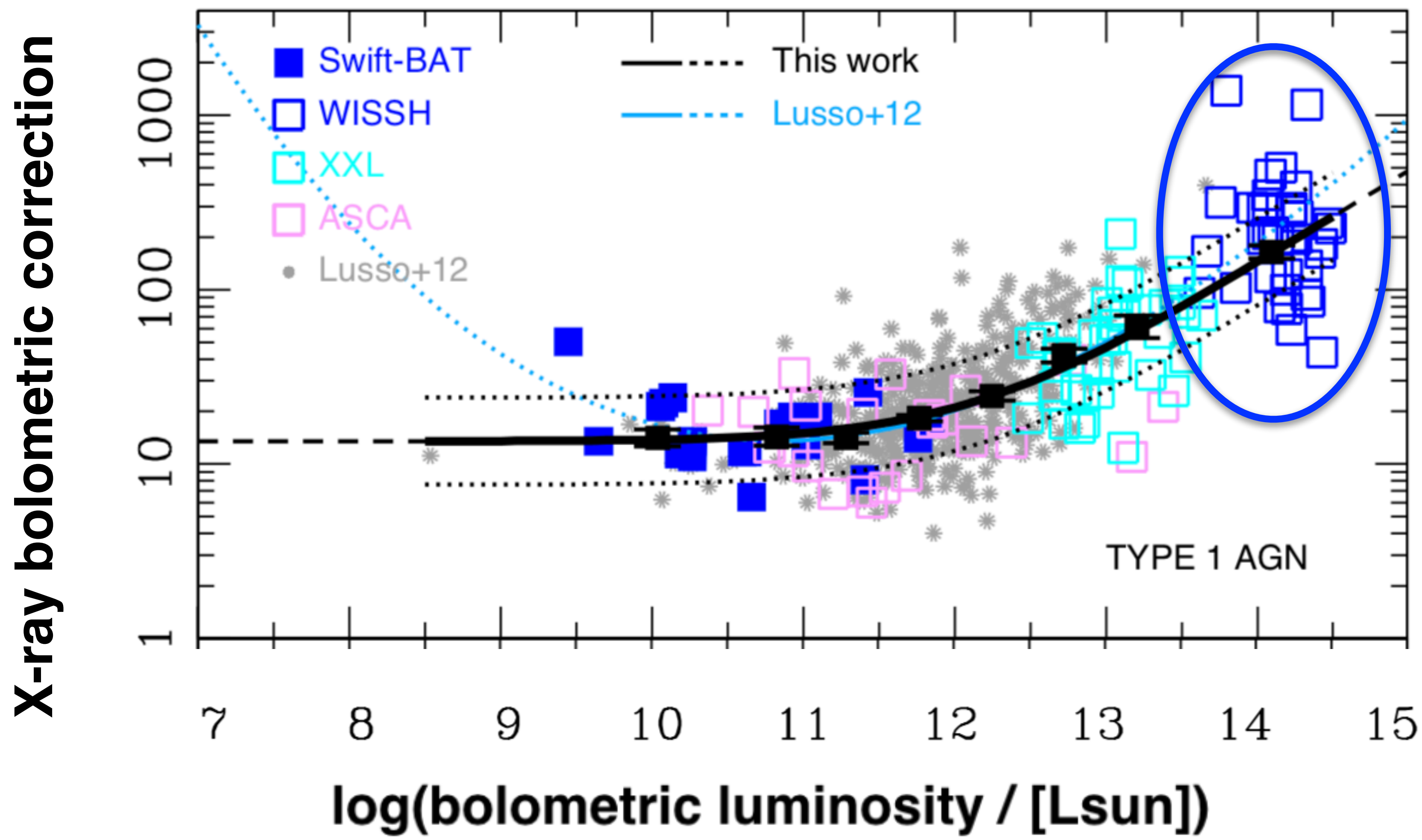
BOLOMETRIC LUMINOSITY AS OUTPUT PARAMETER

TYPE 1 FIRST



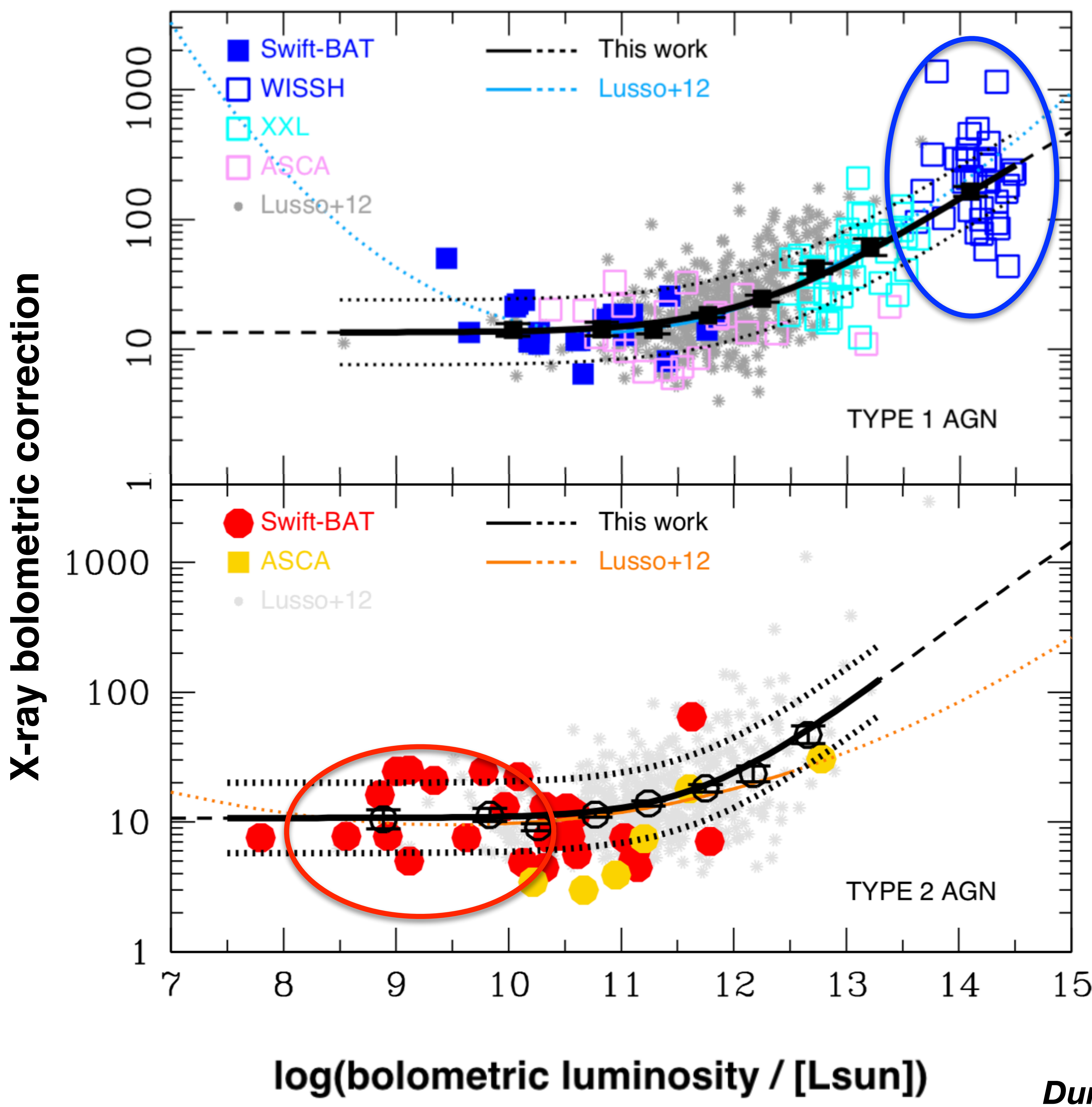
Swift-BAT
WISSH
XXL
ASCA
Lusso+12
This work
Lusso+12
TYPE 1 AGN
X-ray bolometric correction
1
10
100
1000
7
8
9
10
11
12
13
14
15
log(bolometric luminosity / [Lsun])

TYPE 1 FIRST



constraining the tail at high luminosities

THEN TYPE 2

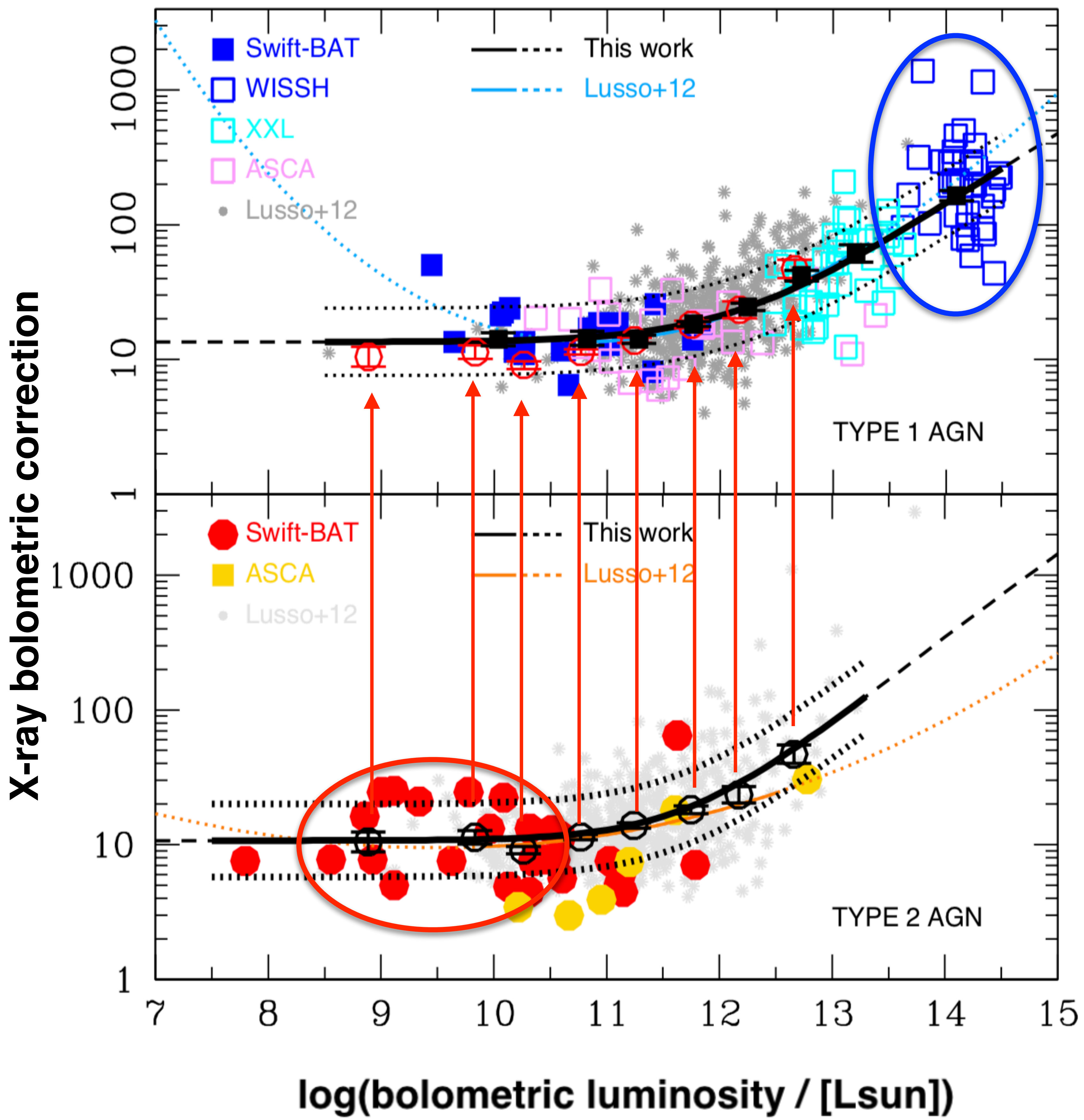


constraining the tail at high luminosities

and at low luminosities

Duras+19, to be submitted

MATCHING ALL TOGETHER : DO THEY TALK EACH OTHER ?



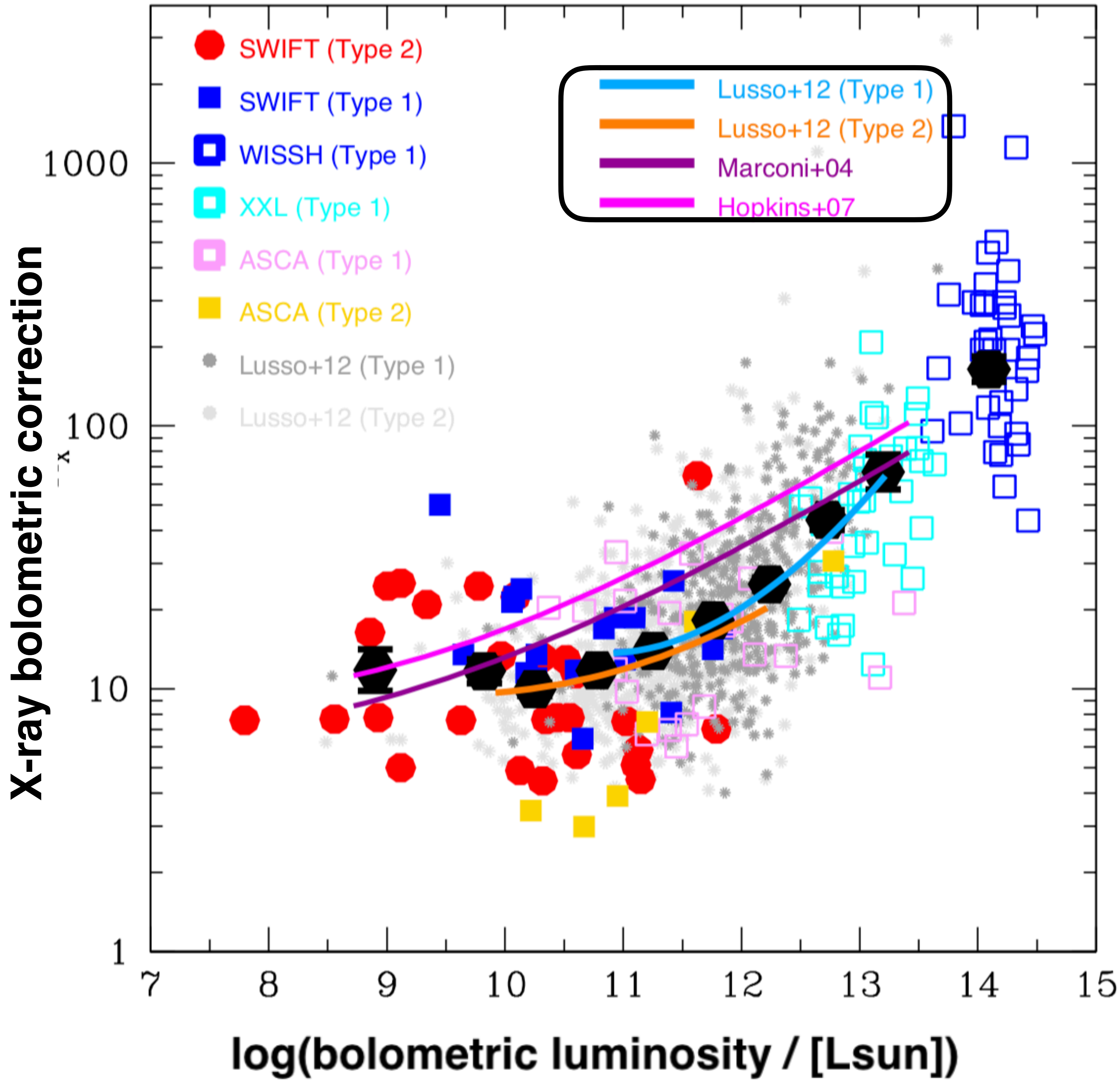
constraining the tail at high luminosities

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

and at low luminosities

YES! FINALLY …

Current knowledge of the bolometric corrections



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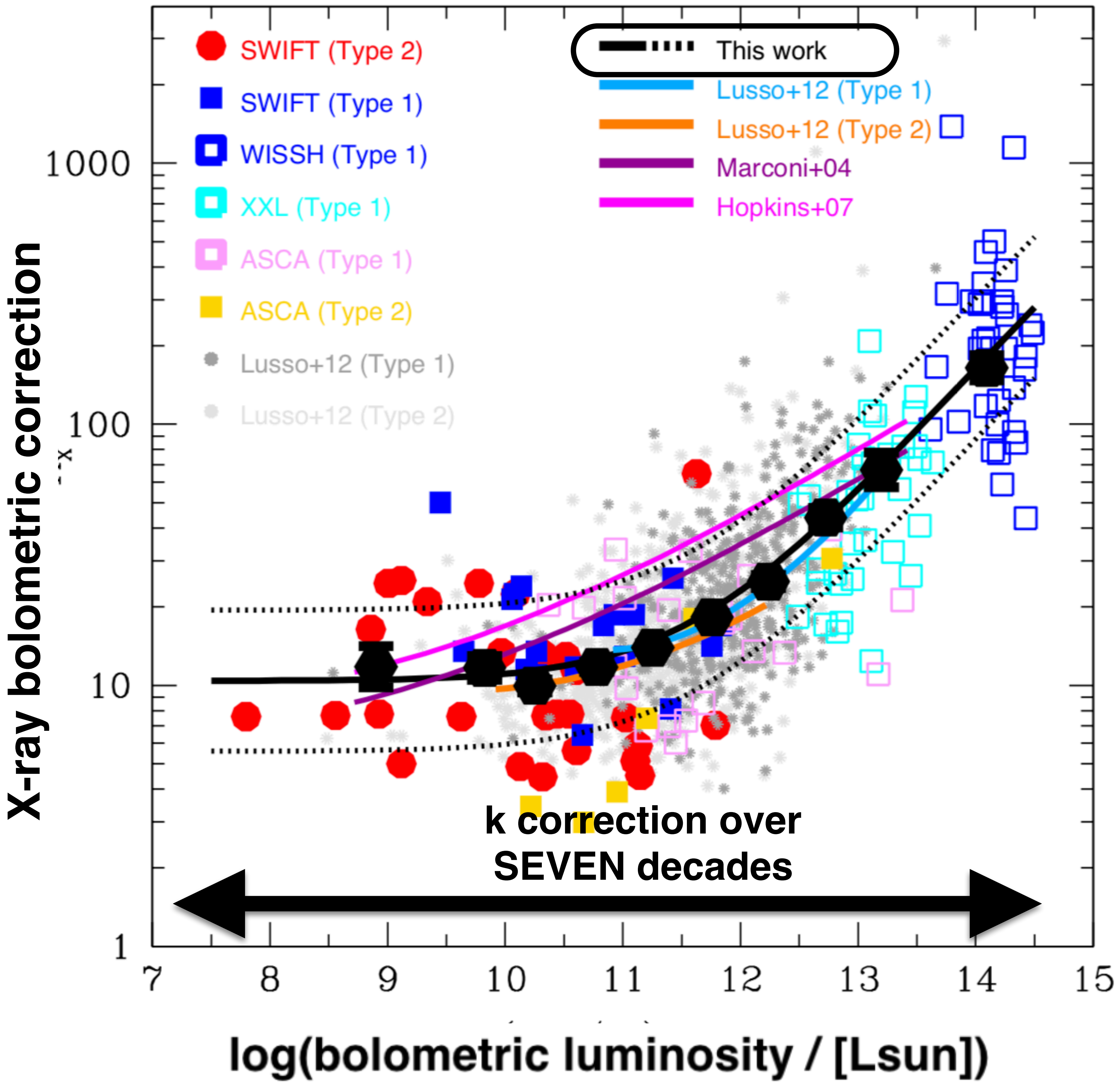
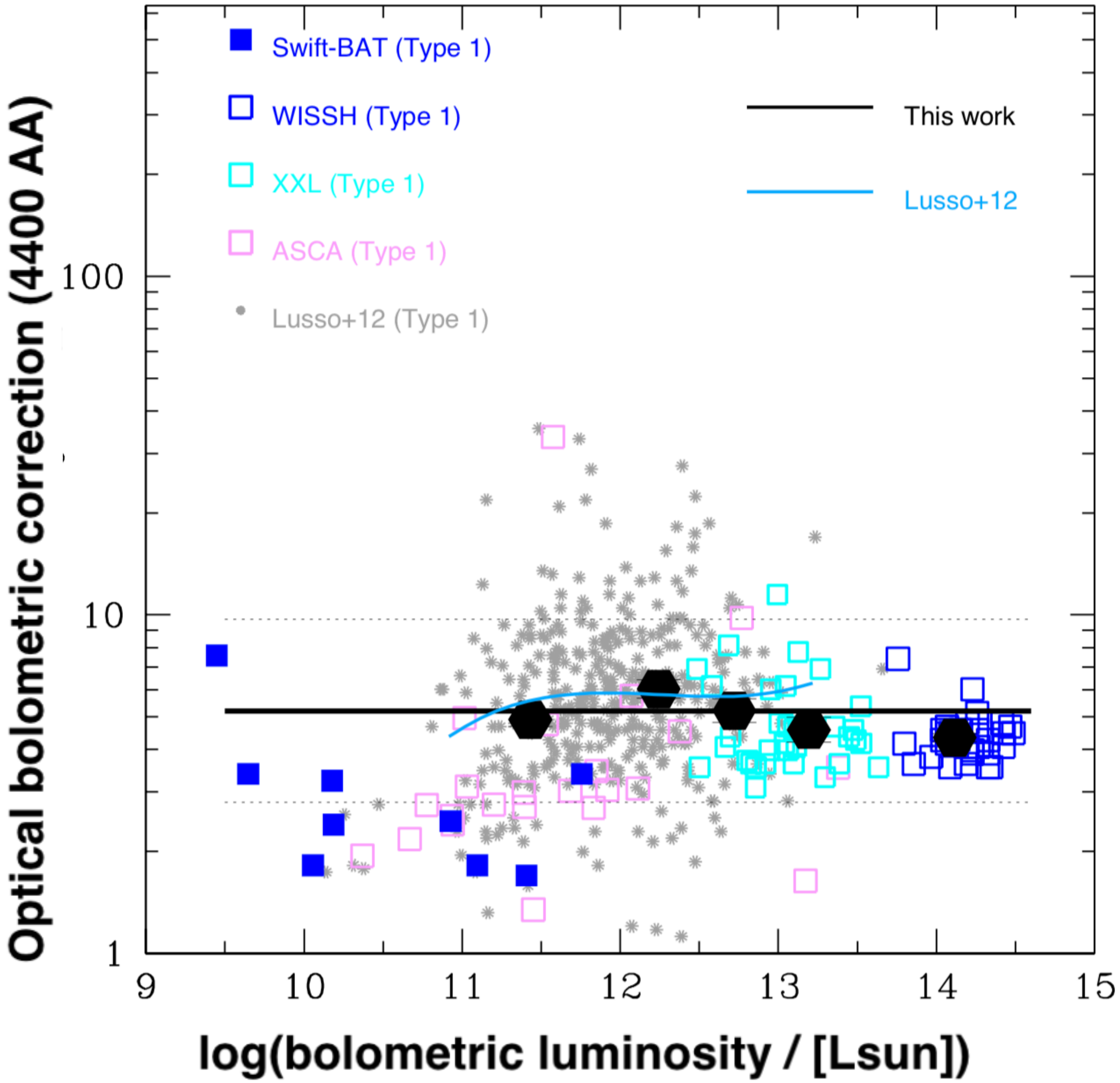

SWIFT (Type 2)
SWIFT (Type 1)
WISSH (Type 1)
XXL (Type 1)
ASCA (Type 1)
ASCA (Type 2)
Lusso+12 (Type 1)
Lusso+12 (Type 2)
This work
Lusso+12 (Type 1)
Lusso+12 (Type 2)
Marconi+04
Hopkins+07
X-ray bolometric correction
log(bolometric luminosity / [Lsun])
k correction over
SEVEN decades

THE OPTICAL BOLOMETRIC CORRECTION

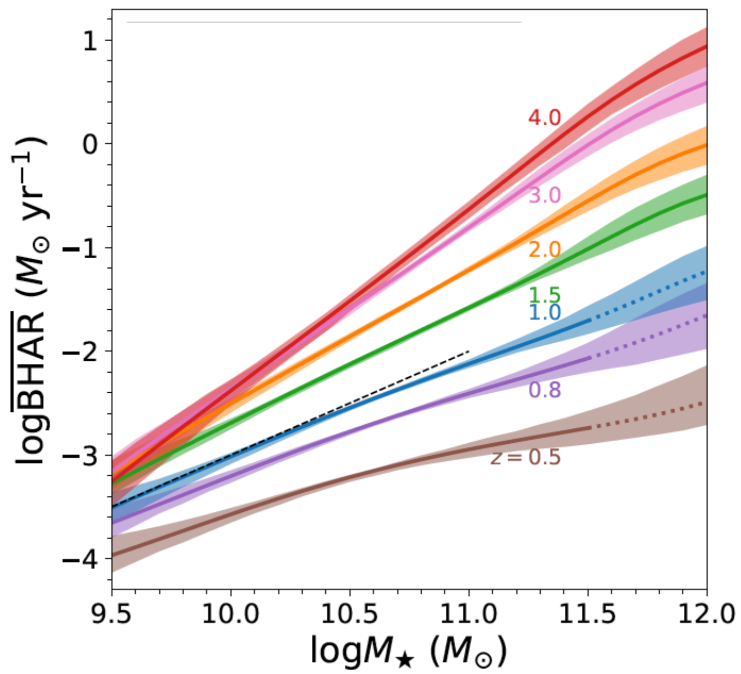


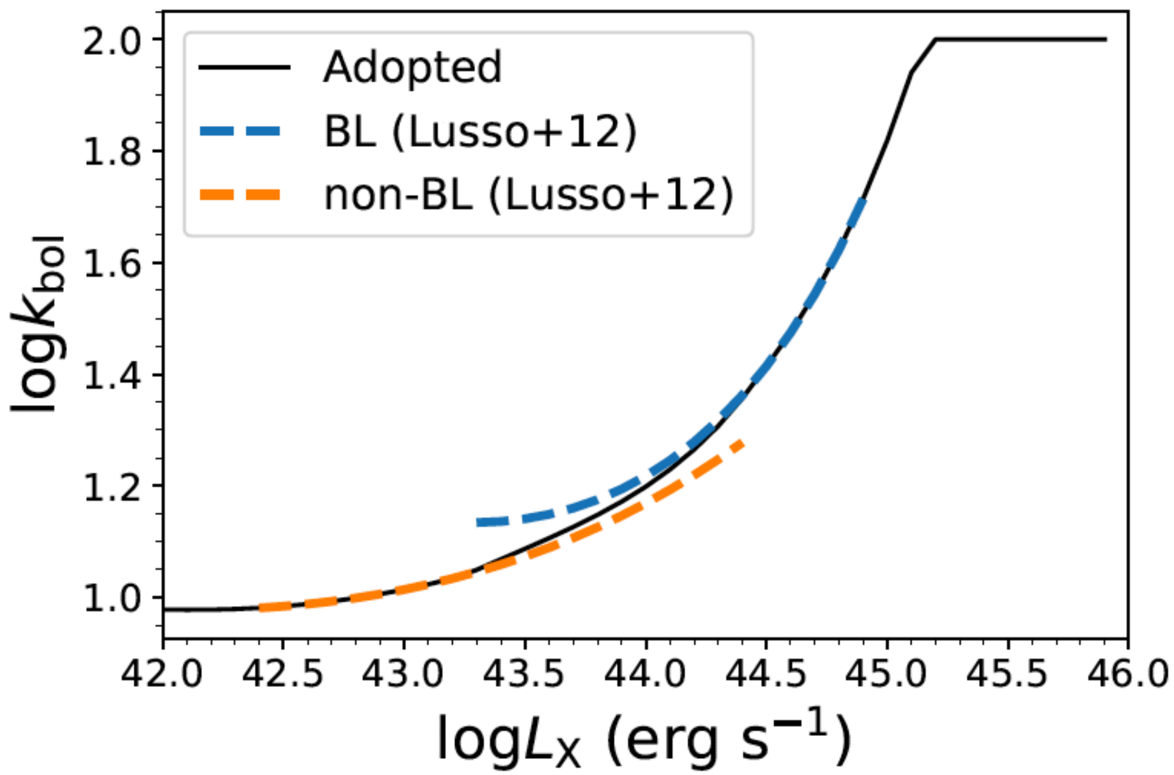
Consistent to be **flat** ($K_O \sim 5$) in agreement with previous findings (e.g. Lusso+12, same value of the K_O)

LET'S REMEMBER THE MOTIVATIONAL AIM, AGAIN.

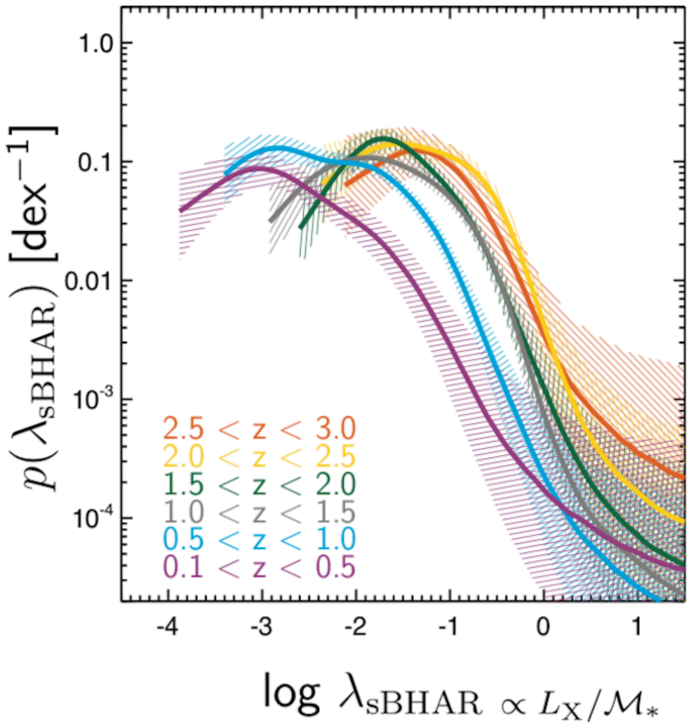
Two recent examples of K_{BOL} application …

Yang+17





Aird+18



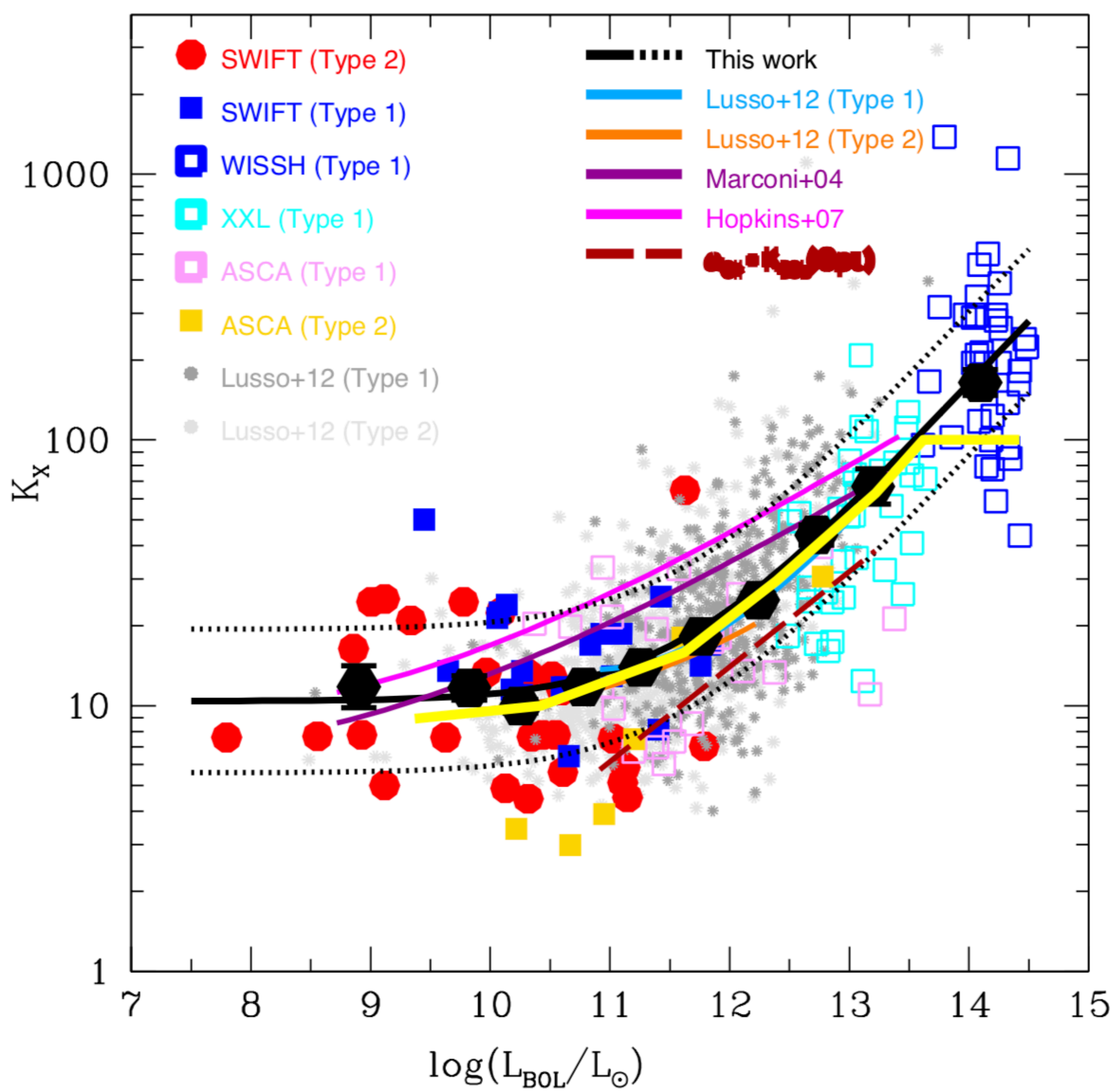
$$\mathrm{BHAR} = \frac{\eta k_{\rm bol}}{c^2} L_X$$

=25

LET'S REMEMBER THE MOTIVATIONAL AIM, AGAIN.

… What do they mean?

Yang+17



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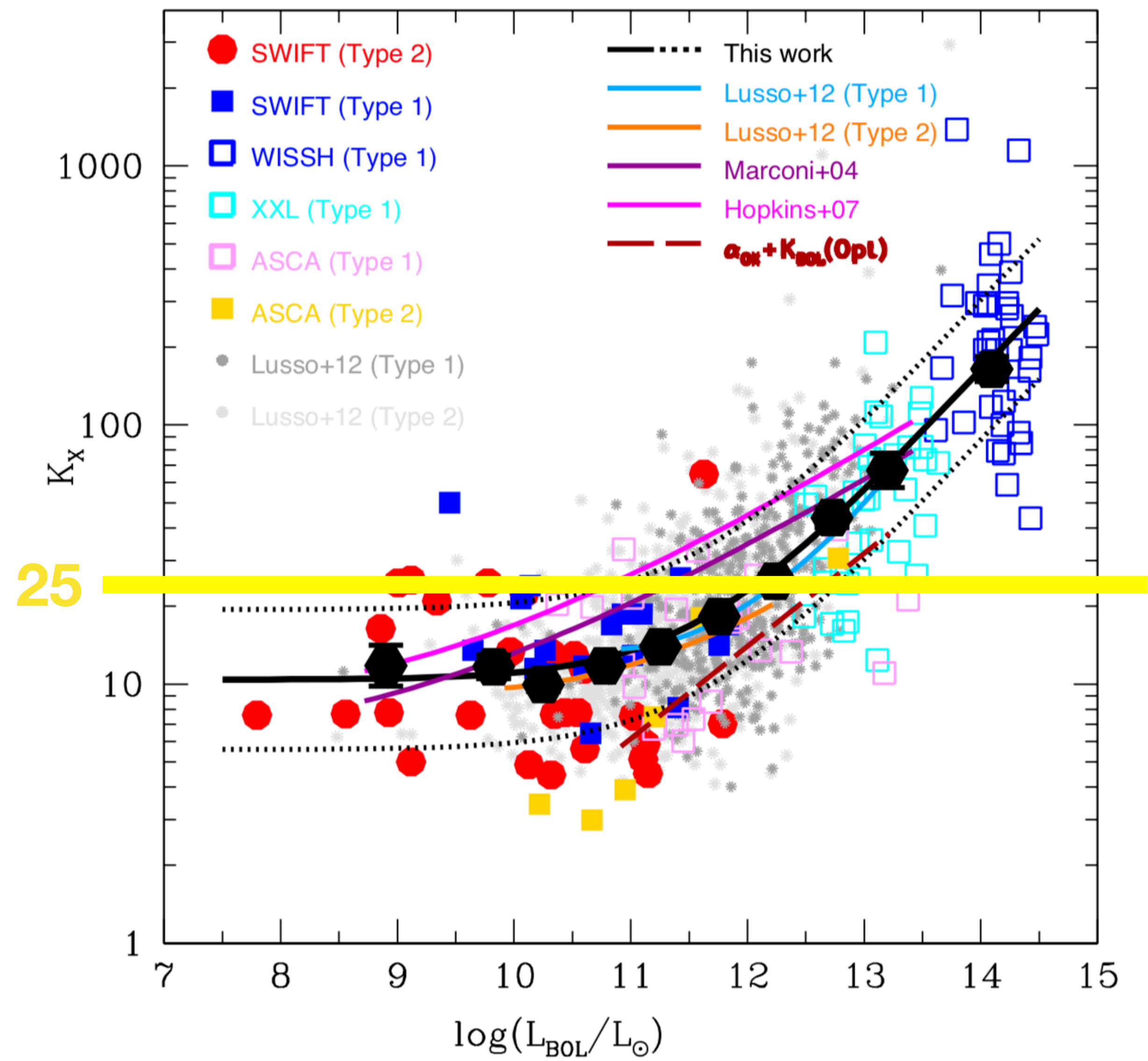
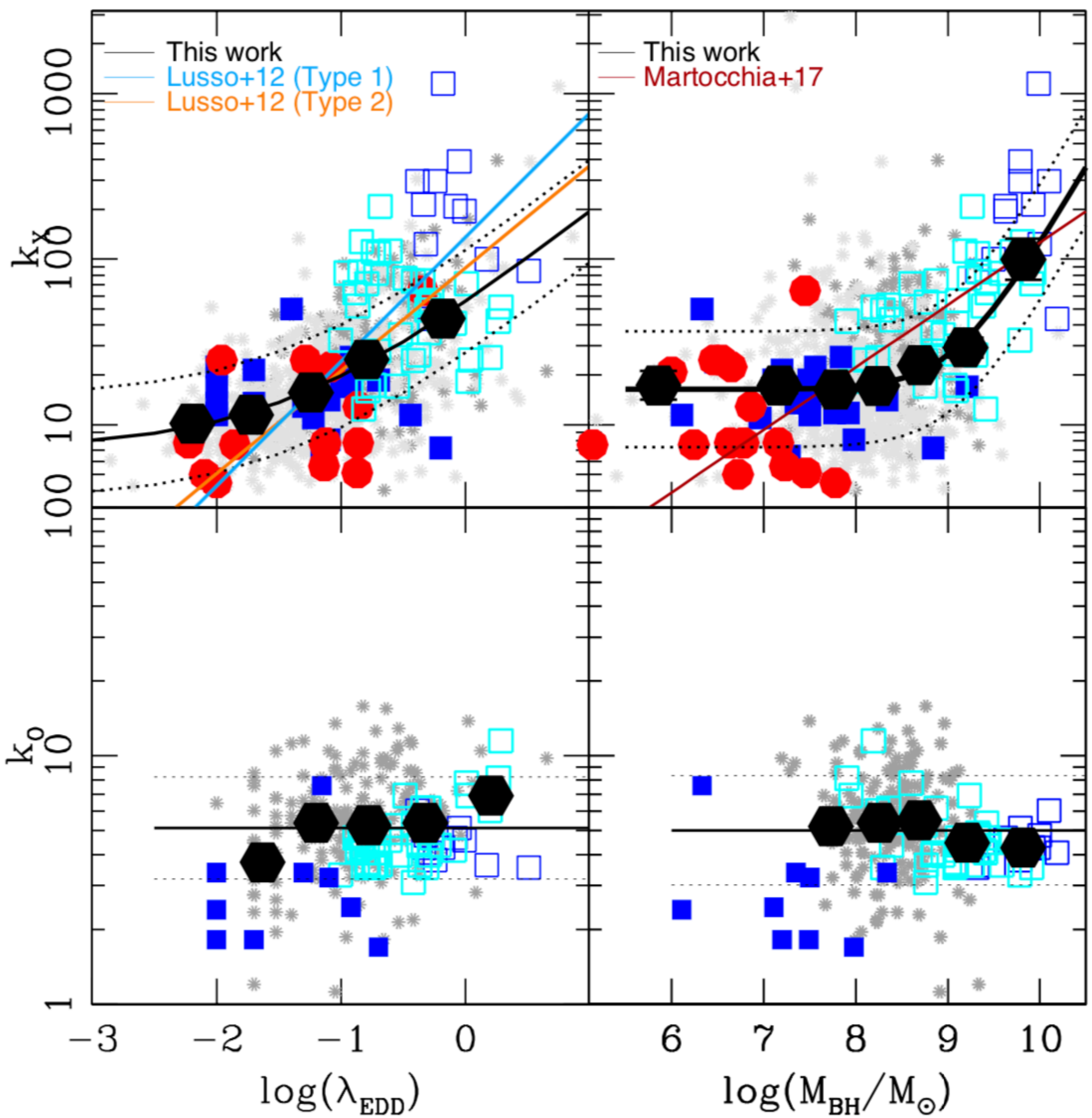


A good estimate of the bolometric correction (keeping into account the difference with luminosity) is mandatory to obtain information about the accretion and evolution properties of AGN

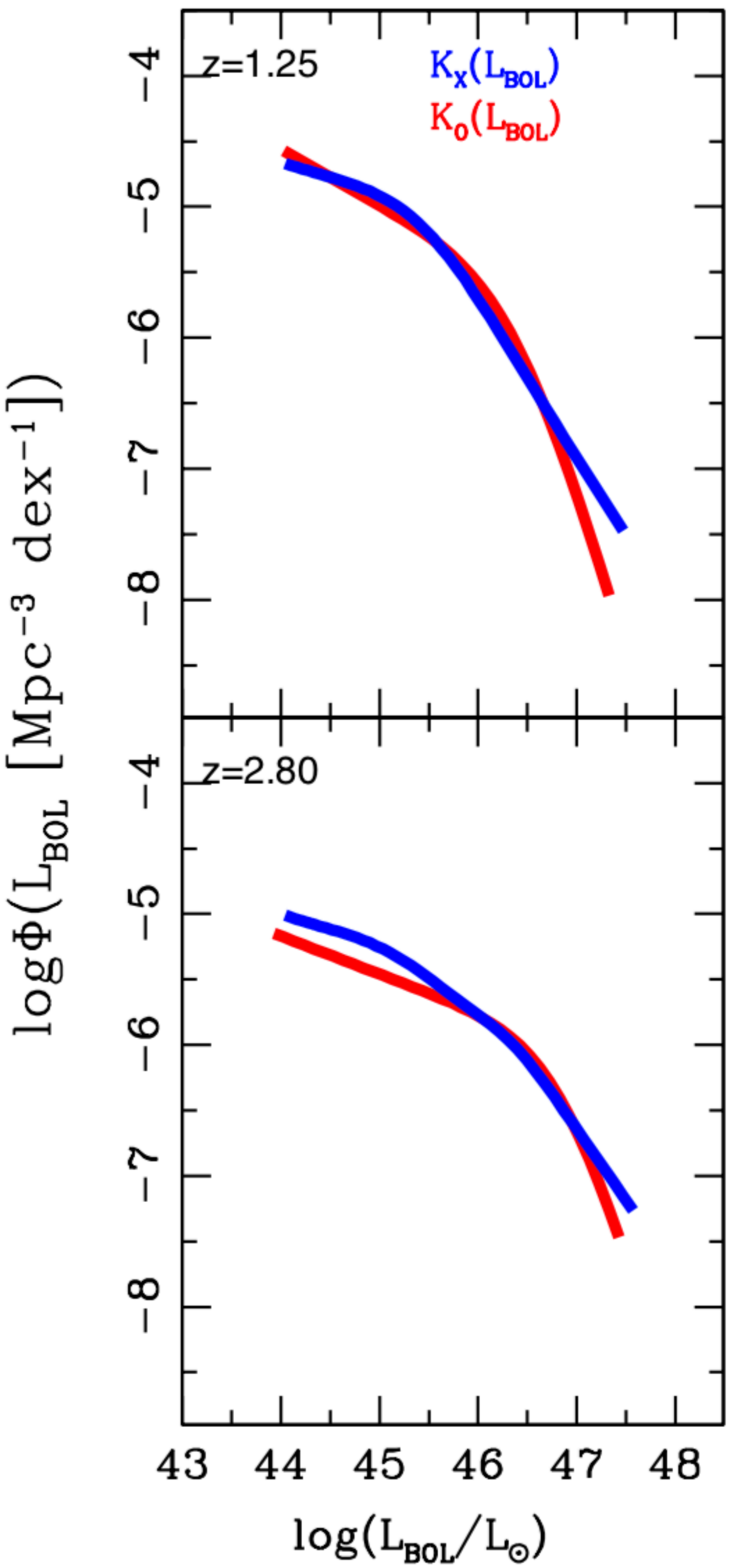
DEPENDENCE OF THE K_{BOL} ON EDDINGTON RATIO AND BH MASS



The two K_{BOL} follow, separately, the same analytical behaviour whatever the independent variable is chosen

Duras+19, to be submitted

A SANITY CHECK : THE AGN BOLOMETRIC LUMINOSITY FUNCTION



In the work by Ricci+17, the XLF and the type 1 OLF are in agreement when unabsorbed sources are consider and when a proper observational scatter (which was about 0.4 dex) is assumed

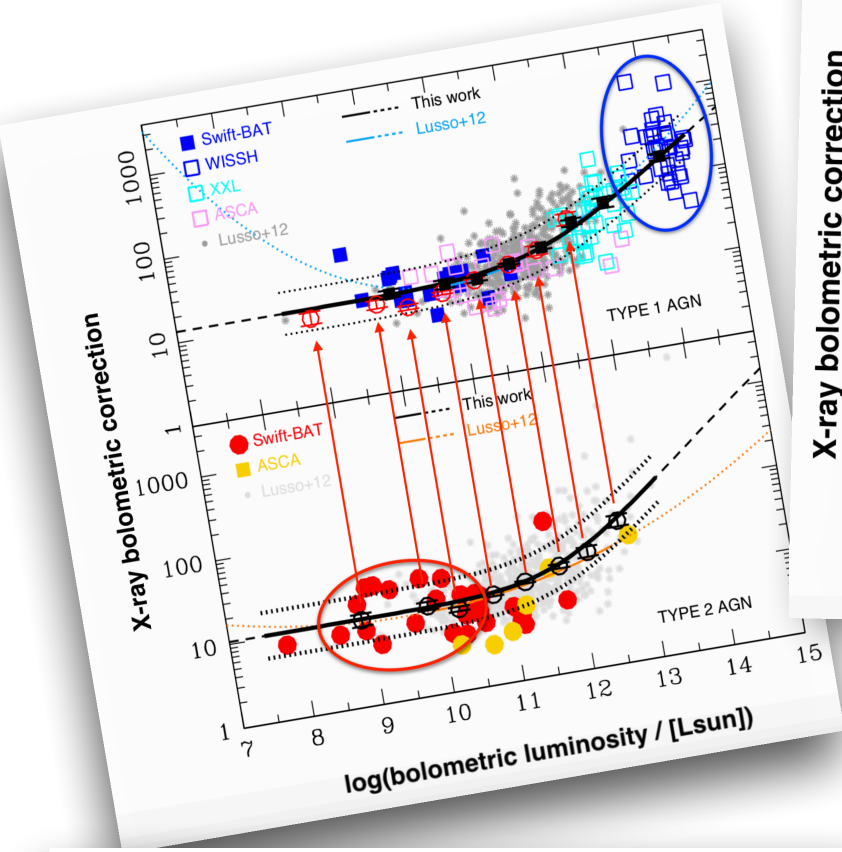
Palanque-Delabrouille+13
Ross+13

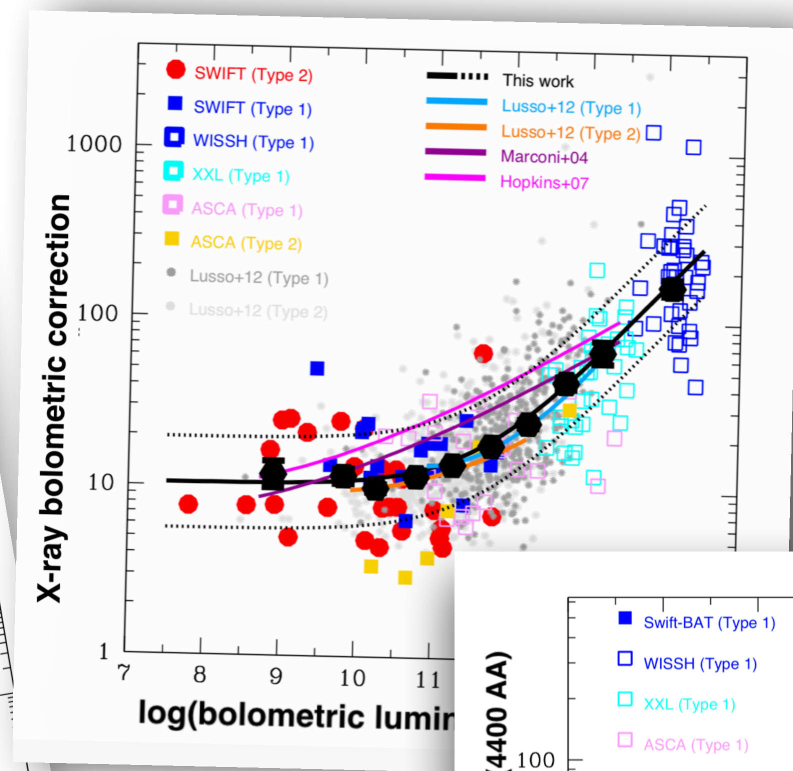
Ueda+14

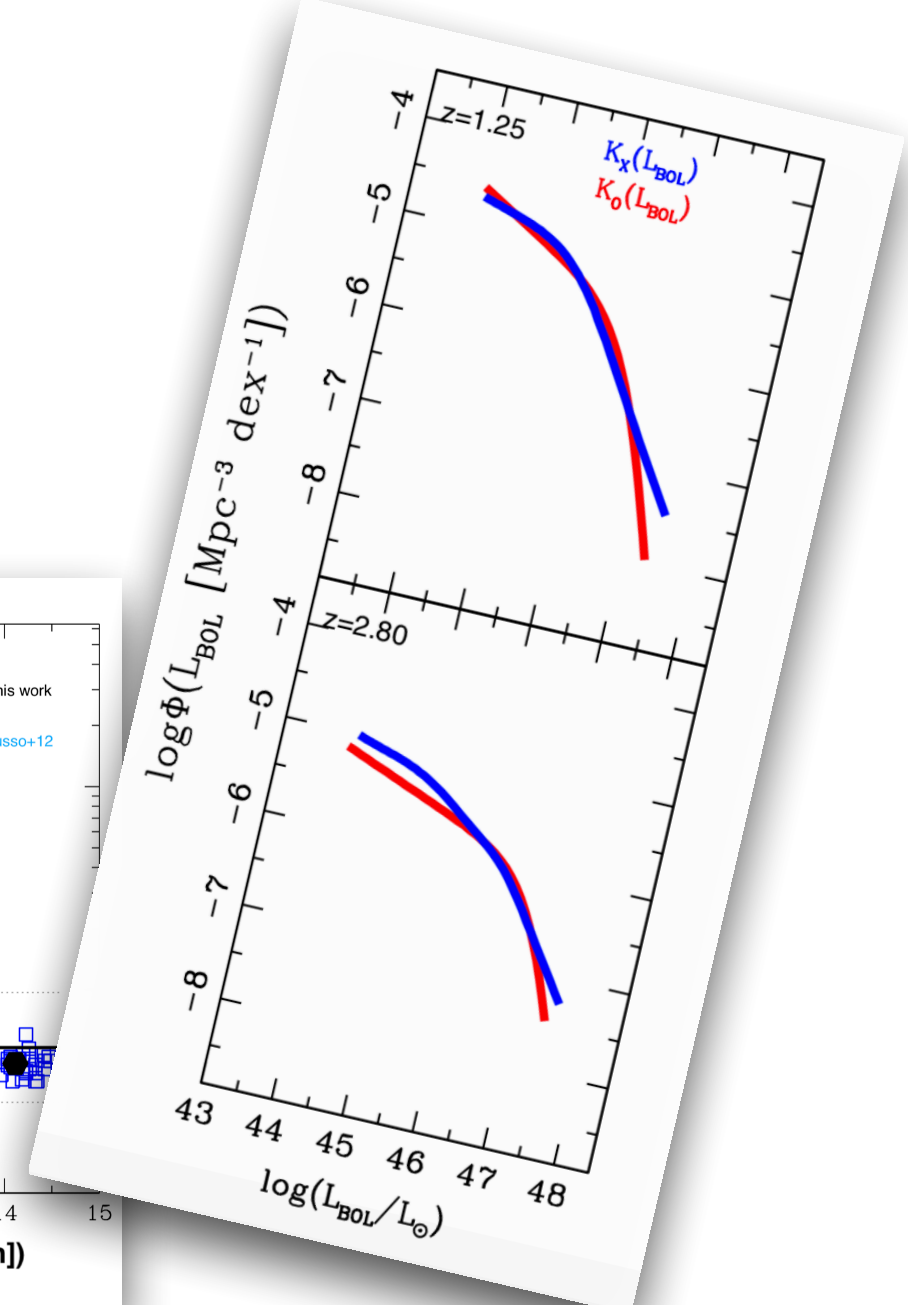
The derivation of the LFs beyond the aim of this work
BUT
Good agreement, within ~0.25 dex!

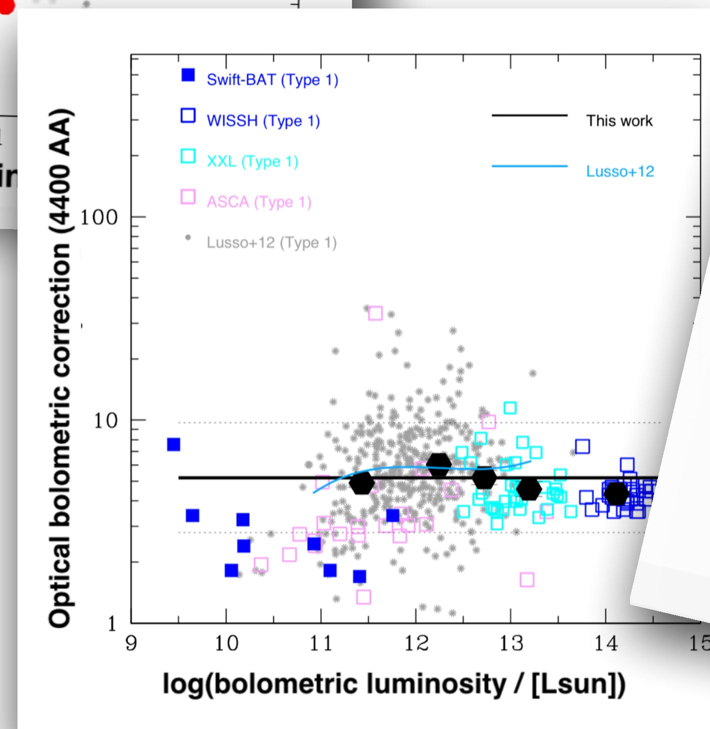
Duras+19, to be submitted

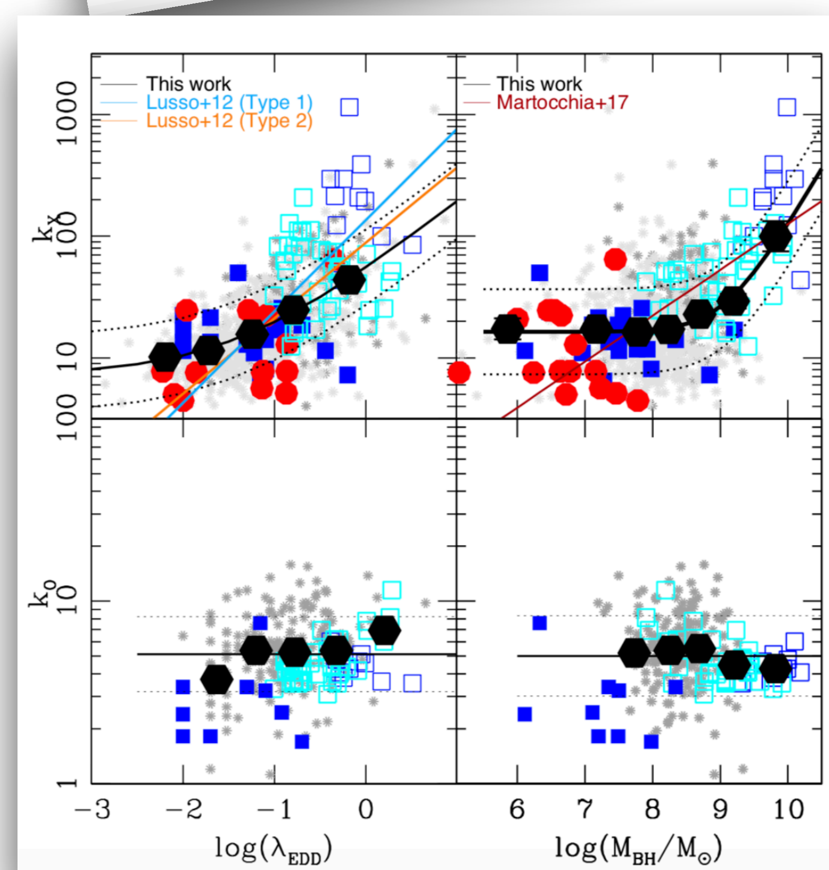
TAKE HOME FIGURES

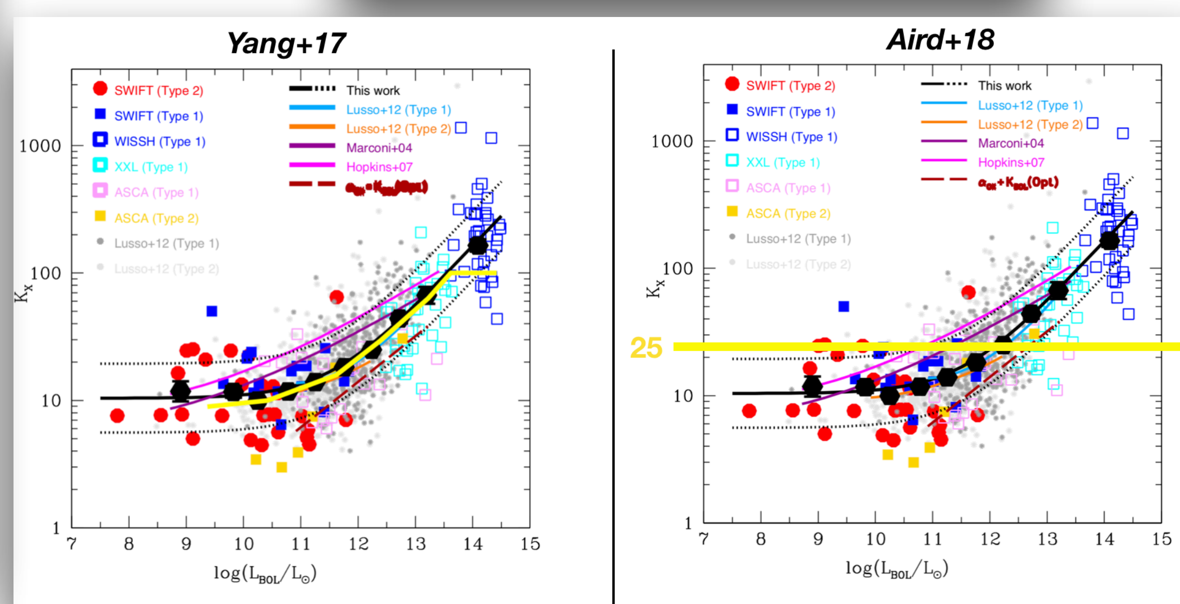












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