The WISSH Quasars Project: X-raying the most luminous quasars at cosmic noon

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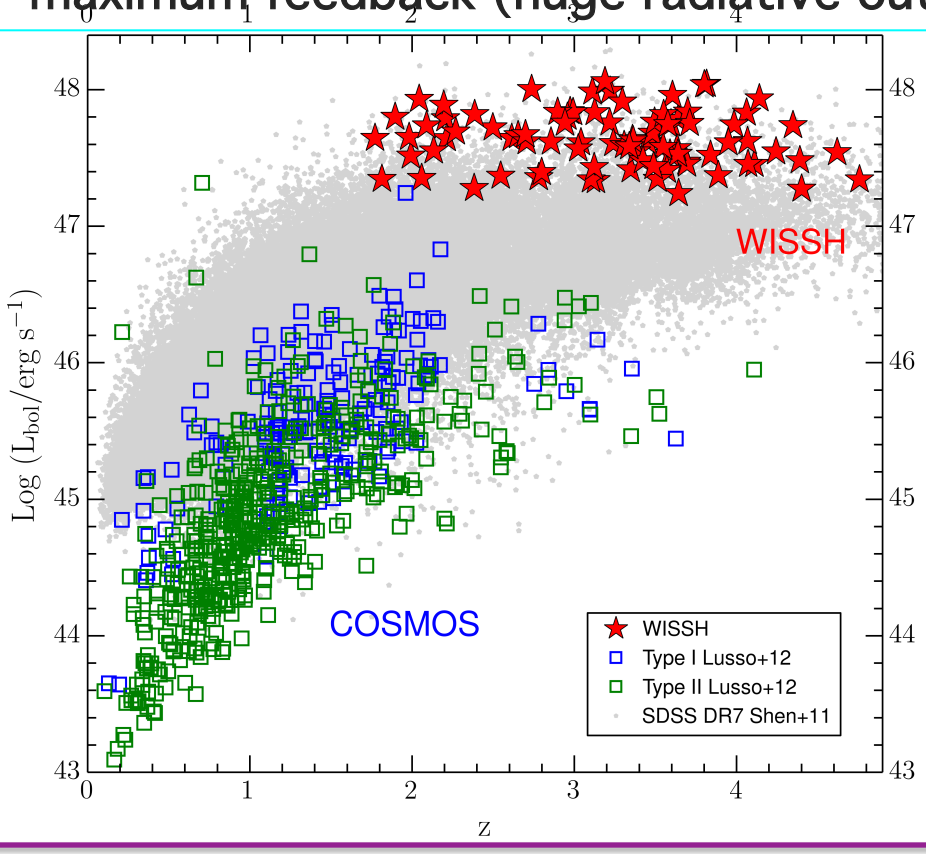
THE WISSH QUASARS PROJECT

Sample of ~90 WISE/SDSS Selected Hyper-luminous (WISSH) Quasars

- SDSS DR7 broad-line quasars at $z > 1.5$ with WISE(22μm) > 3 mJy
- Bolometric Luminosity log(Lbol/erg/s) > 47.2

GOAL: Observing the AGN-driven feedback at its extreme

Models & Obs. → the most luminous QSOs are the best targets to hunt for maximum feedback (huge radiative output, powerful AGN-driven outflows)



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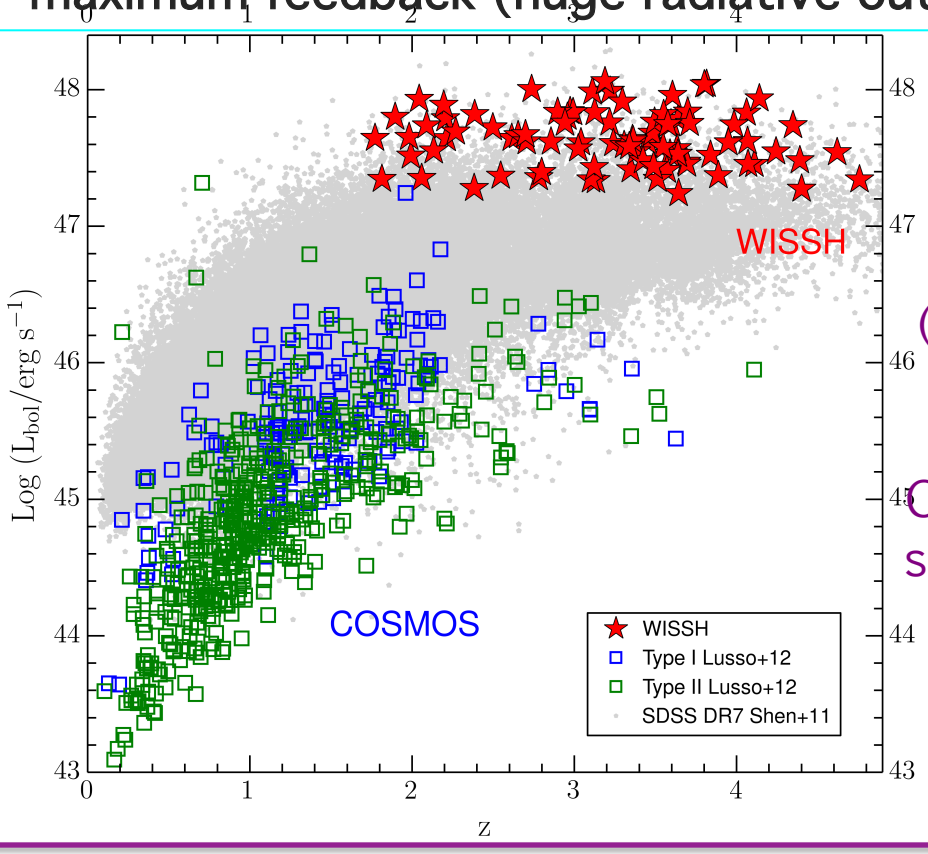

Extensive multi-band coverage from sub-mm to X-ray based on proprietary & archival data (i.e. ALMA, HERSCHEL, ESO/VLT, LBT/LUCI, SDSS, CHANDRA, XMM)

On-going follow-up: NOEMA, MUSE, X-shooter, HST .. ..

MULTIBAND FOLLOW-UP OF WISSH

WISSH Tasks:

- ✓ Probing widespread presence of outflows from different gas phases/distances
- ✓ Constraining the properties of the central engine
- ✓ Studying the ISM and SFR of quasars host galaxies

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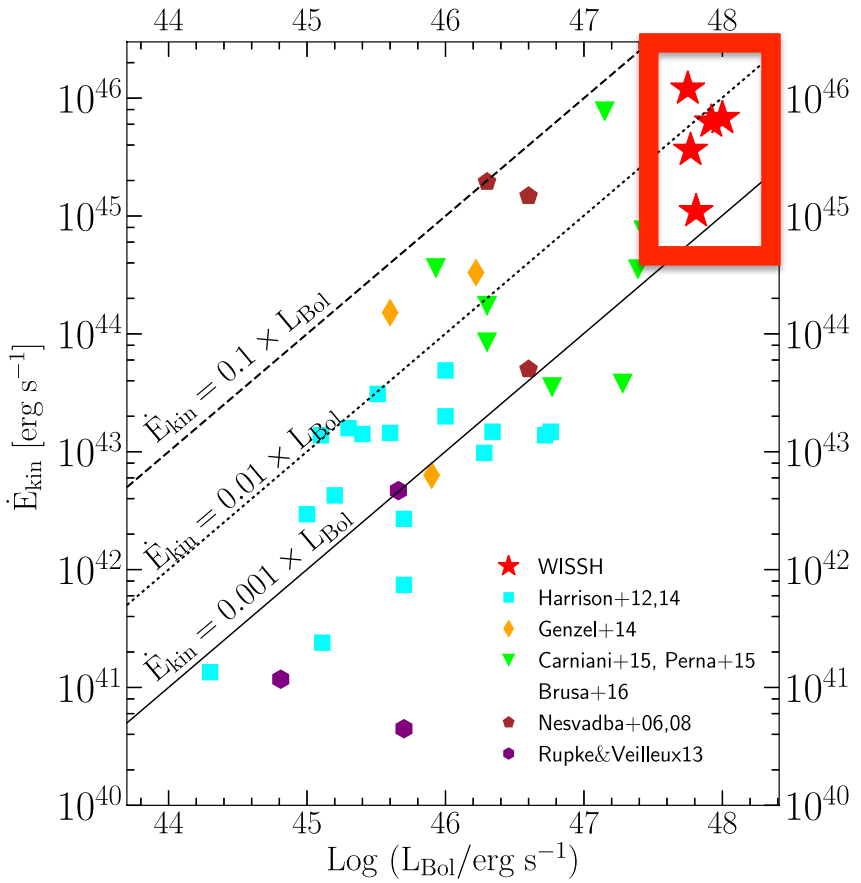
A taste of WISSH...

- Largest ever luminosity of Broad [OIII] lines
- Powerful (~1% Lbol) kpc-scale outflows

Bischetti et al. 2017, A&A 598, A122



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- High-velocity BLR winds
- BLR (CIV) – kpc-scale [OIII] winds dichotomy
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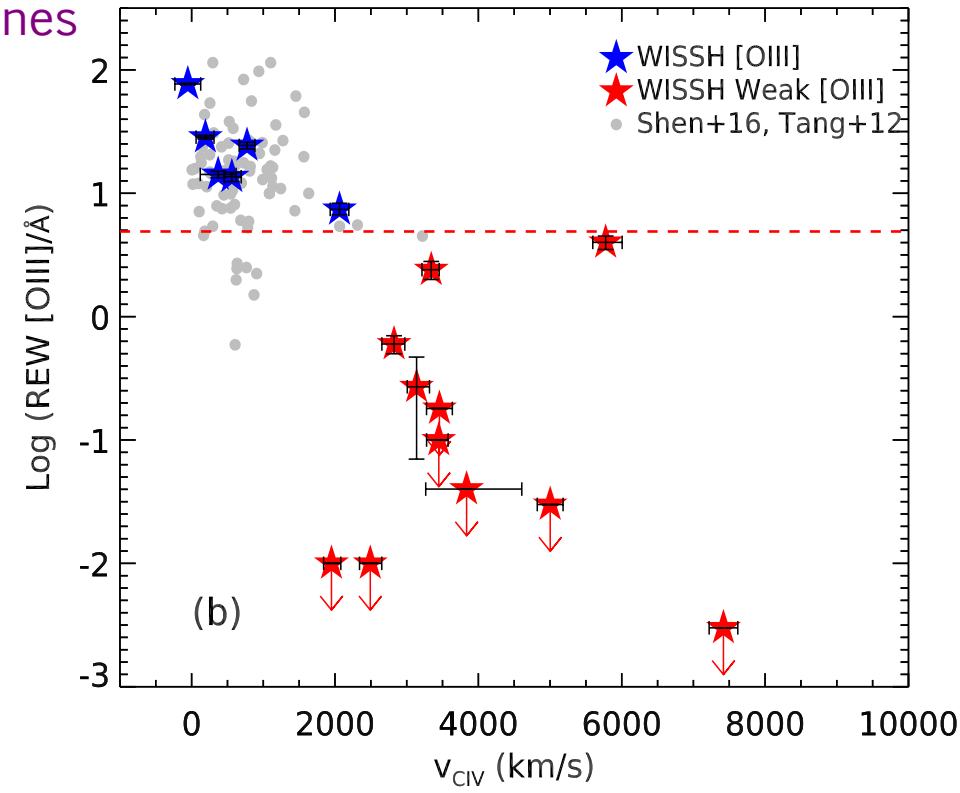

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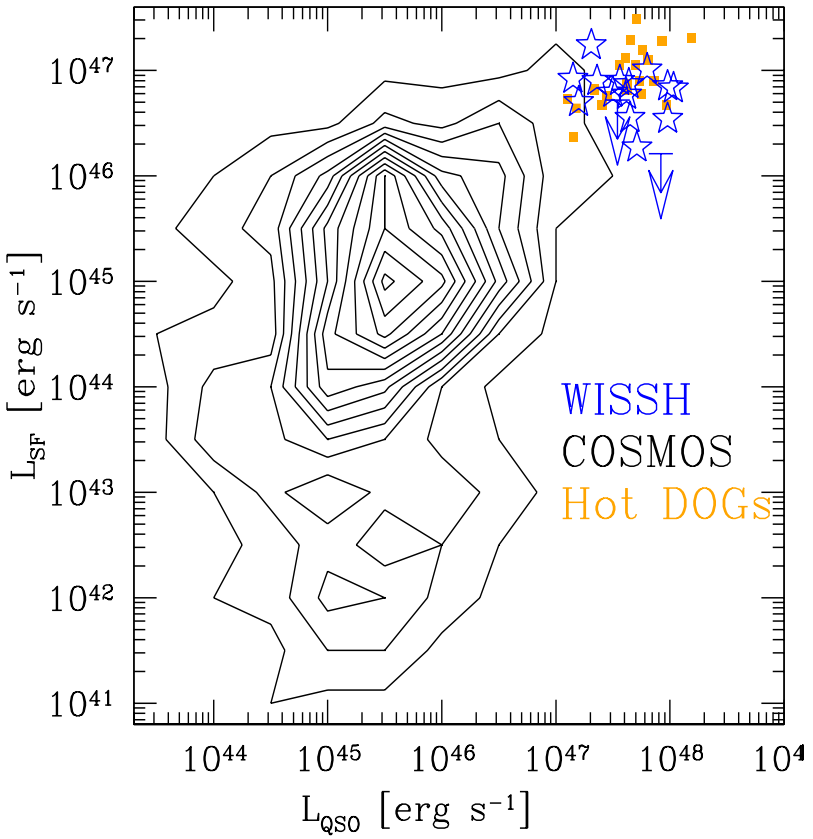
- Broad-band SED (UV-FIR)
- Giant star nurseries with SFR >1000 $M_\odot$/yr
  Duras et al. 2017, A&A accepted



X-RAY VIEW OF WISSH QUASARS

X-WISSH: X-raying the poorly explored bright end of the AGN LF

- X-ray coverage for 41 quasars (~50% of WISSH)
- Bulk of quasars (70%) with Nh < 1e22 cm^{-2} (as expected for Type 1)
- X-ray Luminosities log (Lum[2-10]/erg/s) ~ 45-46

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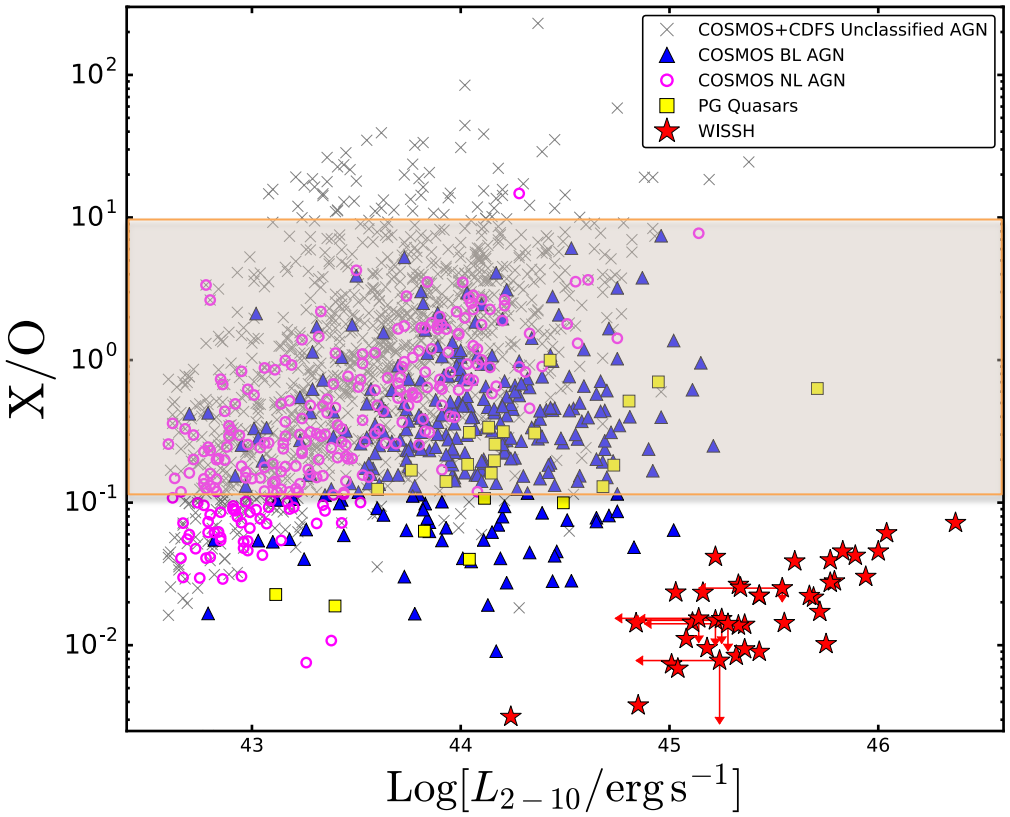


Martocchia, EP et al. 2017, submitted

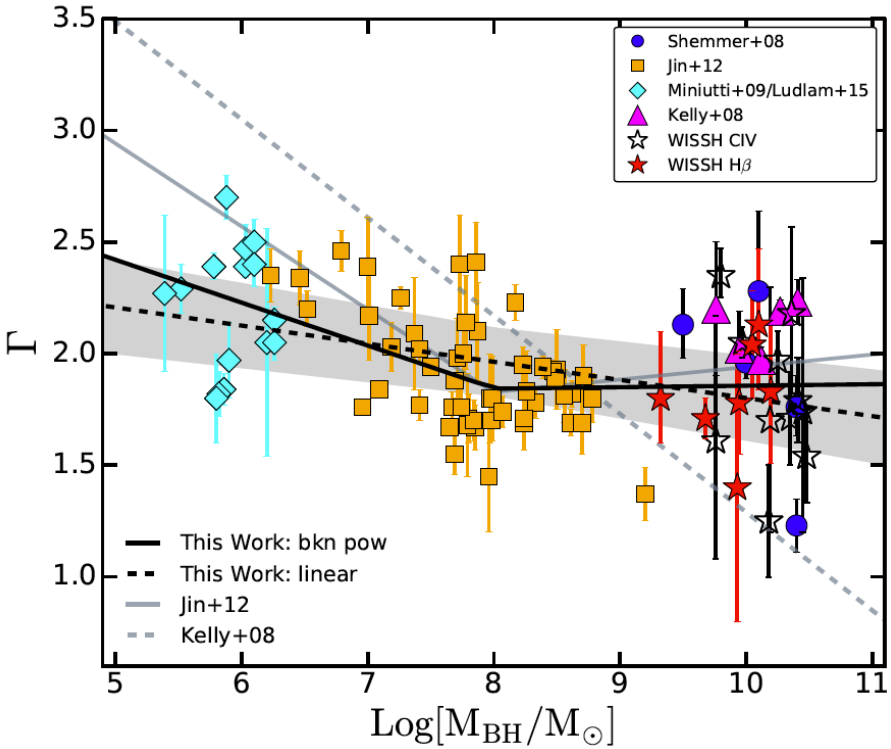
Typical AGN region
(COSMOS, CDFS, PG)
0.1 < Flux ratio X/O < 10

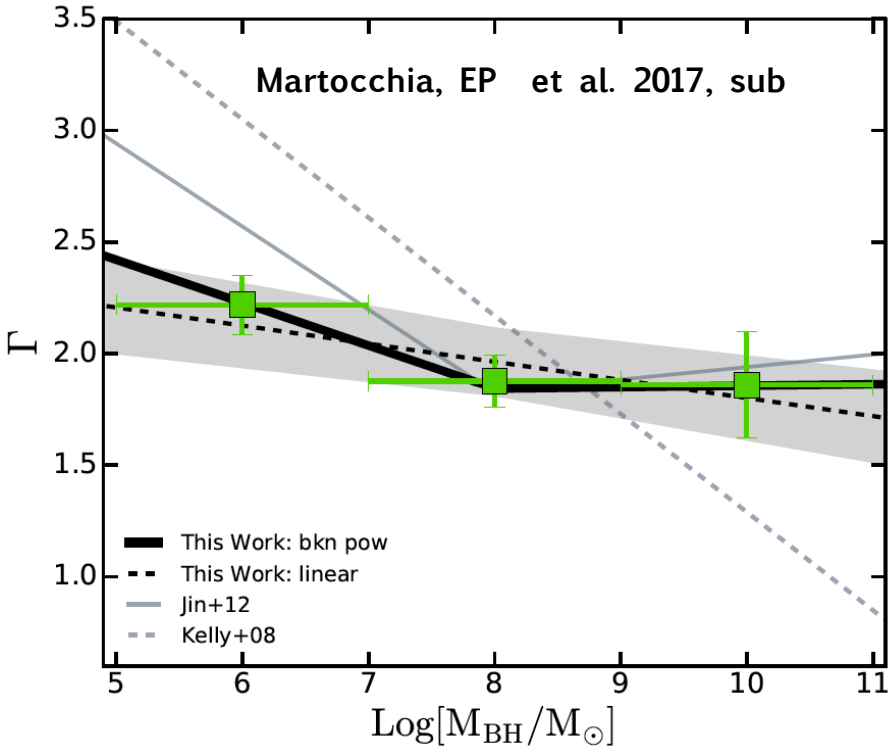
WISSH QSOs show X/O < 0.1
Unexplored region of the
X/O vs Lx plane

X-ray spectral slope vs. SMBH Mass

From the Jin+12 sample of nearby Type1 with SDSS+OM+XMM data

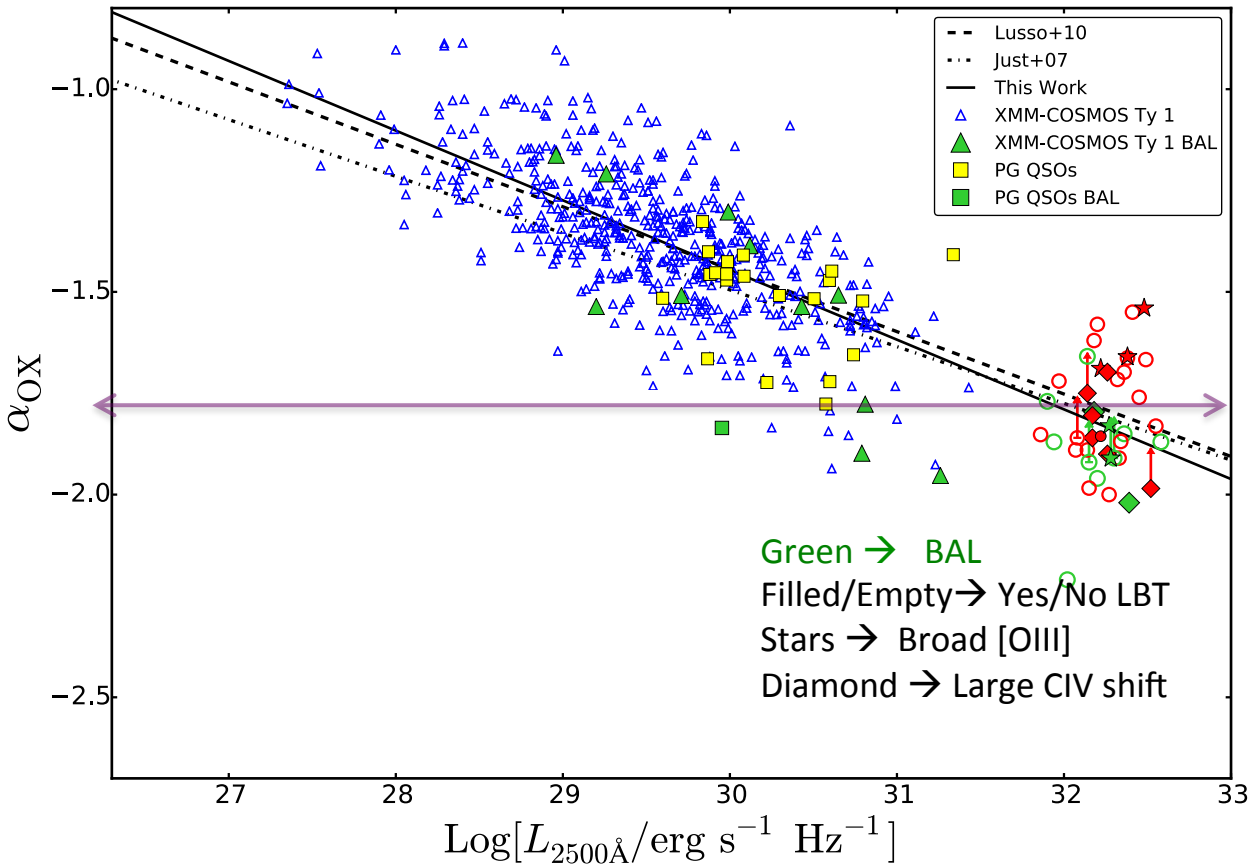
- Improved the sampling at the largest $M_{BH} \gg 10^9\ M_\odot$ thanks to WISSH
- Added two samples of AGN with $M_{BH} < 10^6\ M_\odot$ Ludlam+15 Miniutti+09
- Fits accounting for the soft excess or limited to the hard X-ray band





Flatter dependence than previously found over the broad $5 < \log M/M_\odot < 11$ range

WISSH QSOs: VERY STEEP AlphaOX



Steep ionizing continuum

→ Weak UV lines

→NO overionization

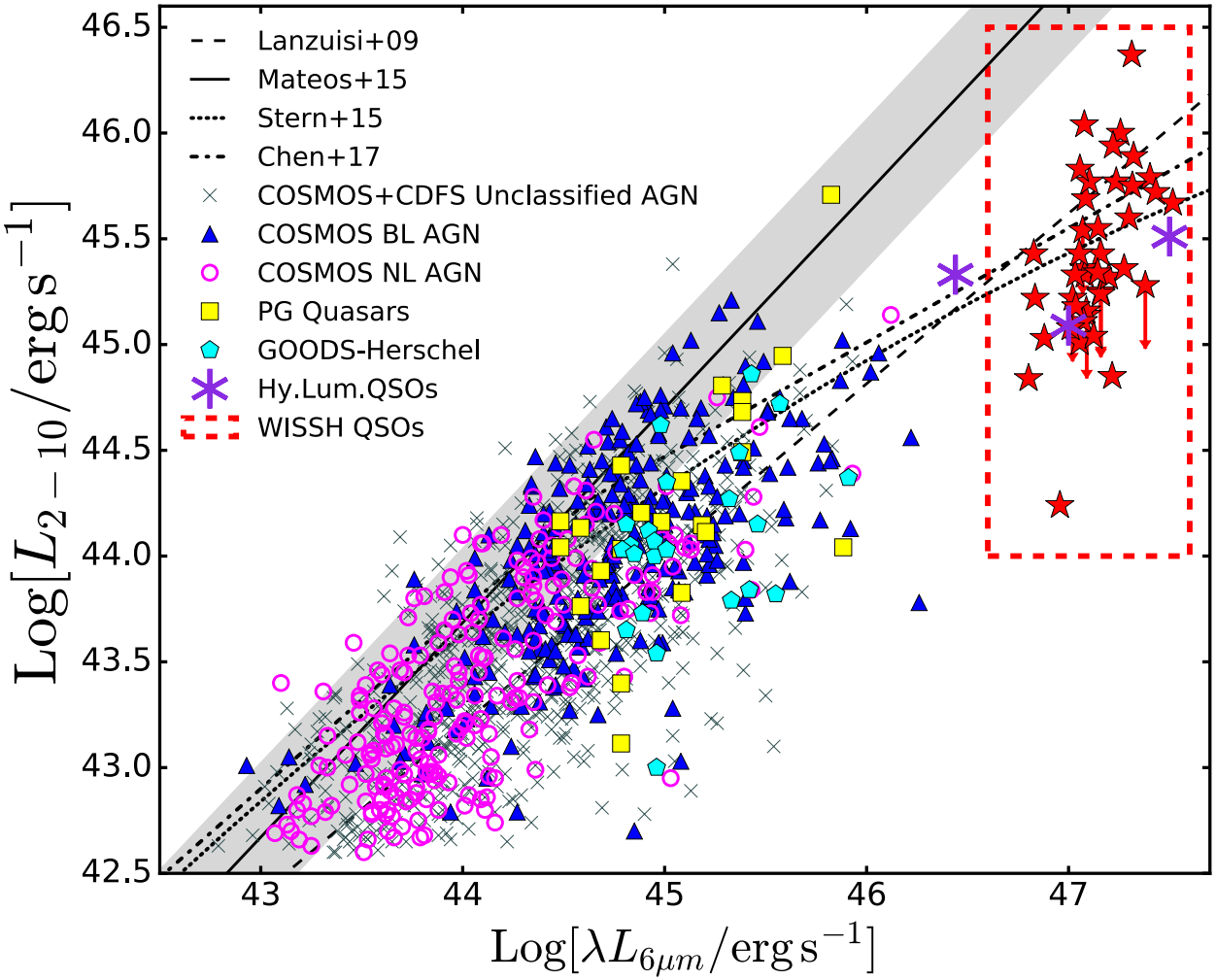
→OK for radiation line driving force

→ Hi-ionization CIV Winds

$\alpha_{OX} < 1.8$
typical threshold of "X-ray weakness" for typical AGN

WISSH QSOs are "intrinsically" X-ray weak
Ideal sources for driving high-ionization broad-line winds

X-RAY vs MID-IR LUMINOSITY



Combination of AGN samples selected by different criteria:

- better sampling of the plane
- mitigate bias

OFFSET from LOCAL RELATION

LARGE SCATTER

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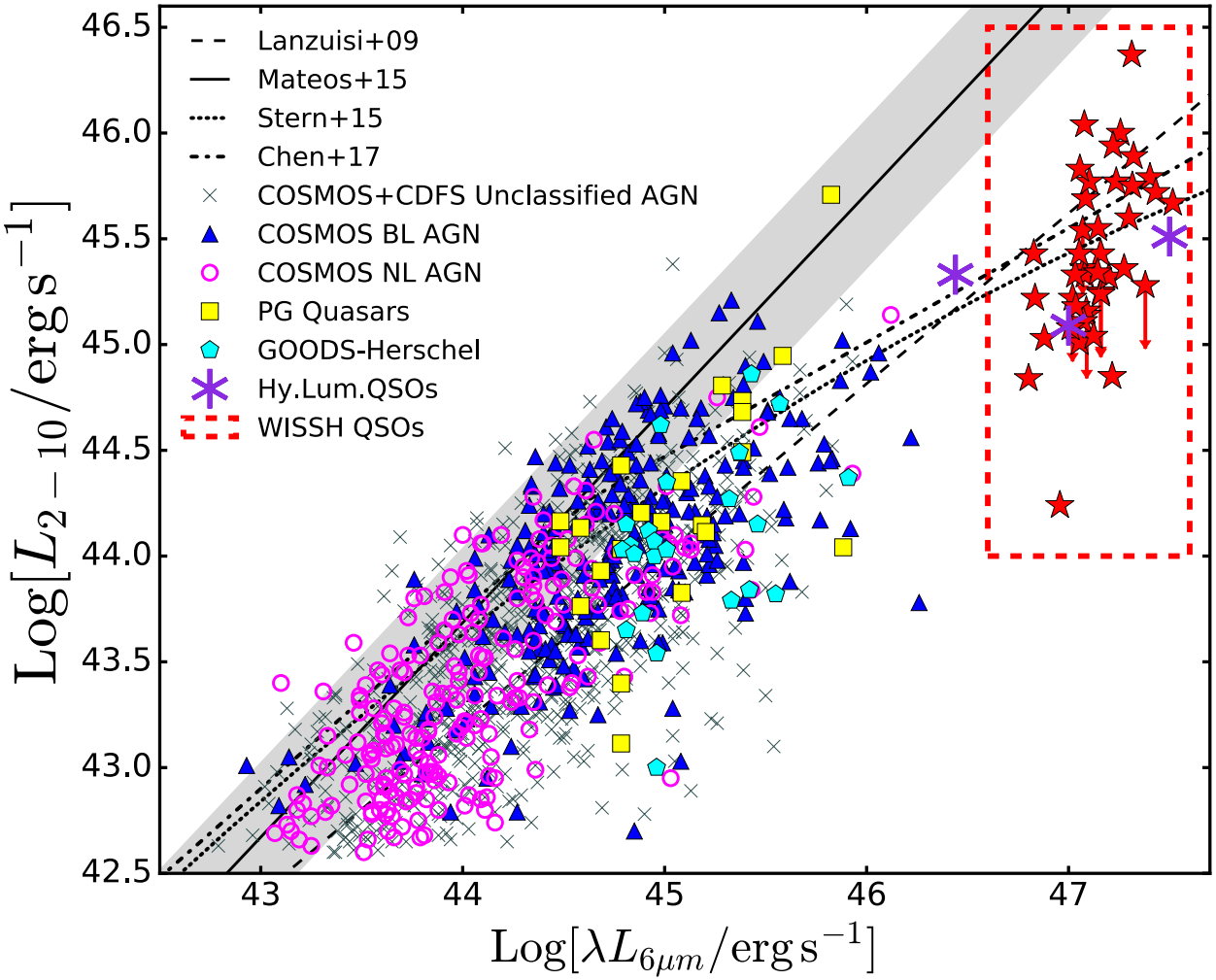

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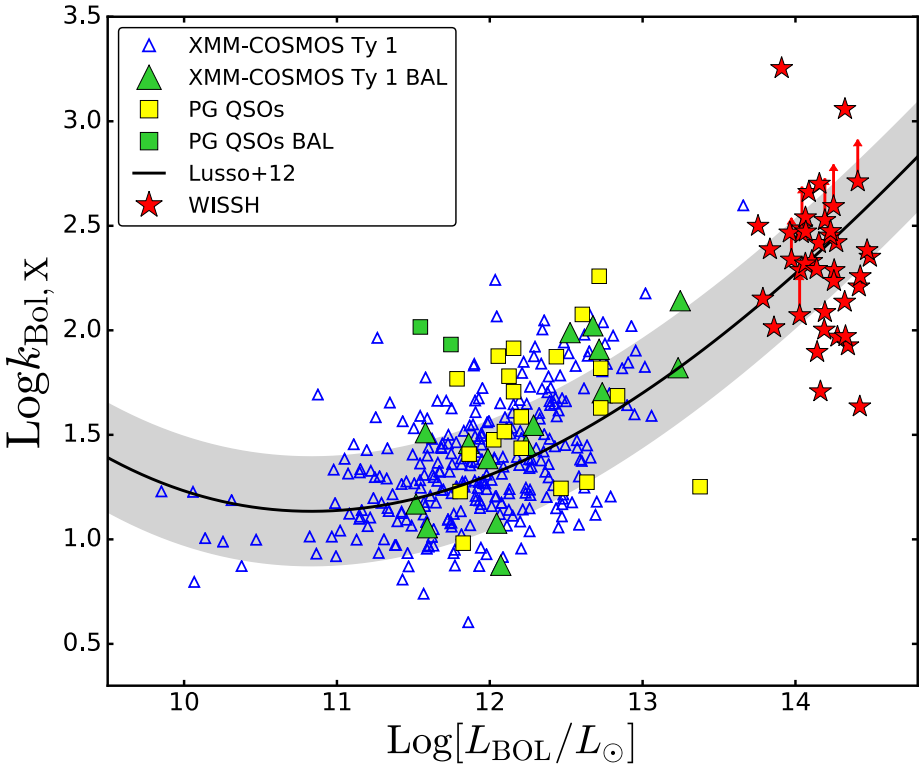
HIGH-LUM QUASARS HAVE WEAKER X-RAY EMISSION

At odds with the scenario of a torus with a lum-dependent covering factor

LARGE X-RAY BOLOMETRIC CORRECTION

WISSH QSOs with Lbol>> 1e47 erg/s allows to sample a poorly explored region of the $K_{X,\,Bol}$ – Lbol plane

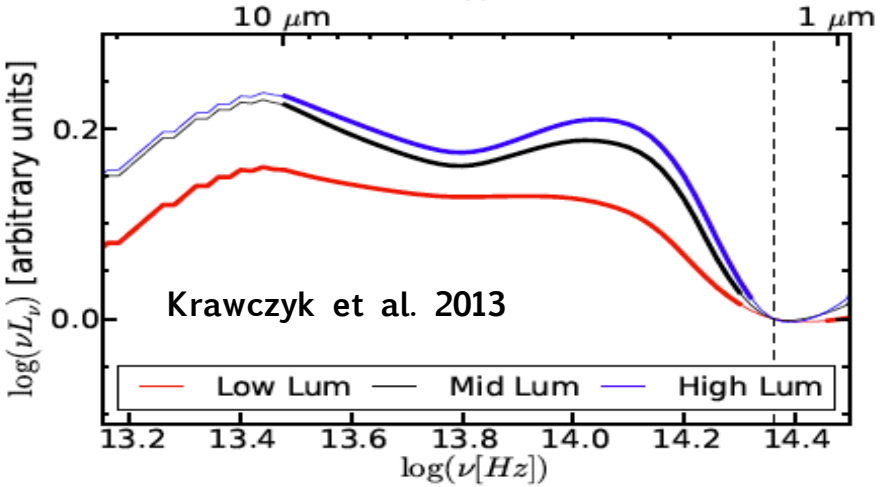
Large Lbol → Large $K_{X,\,Bol}$



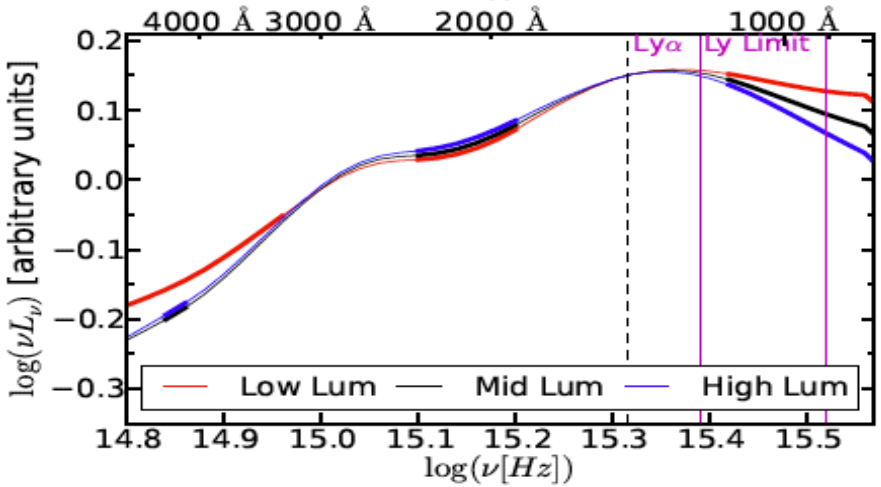
- Extrapolated Lusso+12 relation well fits also Hyper-Lum quasars
- X-ray corona in Hy-Lum QSOs provides a smaller contribution to Lbol than in "standard" AGN

Relative X-ray weakness of Hy-Lum quasars compared to less luminous AGN

- Lower X/O, steeper alphaOX, lower MIR/X, larger KX,Bol
- cannot be explained by obscuration (WISSH are unobscured sources)
- Mean SED of high-L AGN is characterized by a softer (= redder) far-UV spectral slope, a bluer optical continuum and a stronger hot dust emission



(a) Luminosity SEDs normalized at 1.3 μm



(b) Luminosity SEDs normalized at 1450 Å

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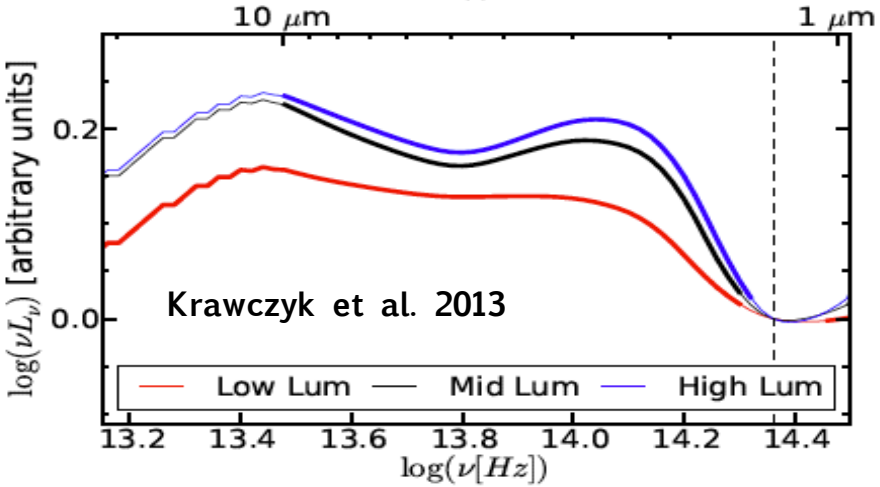

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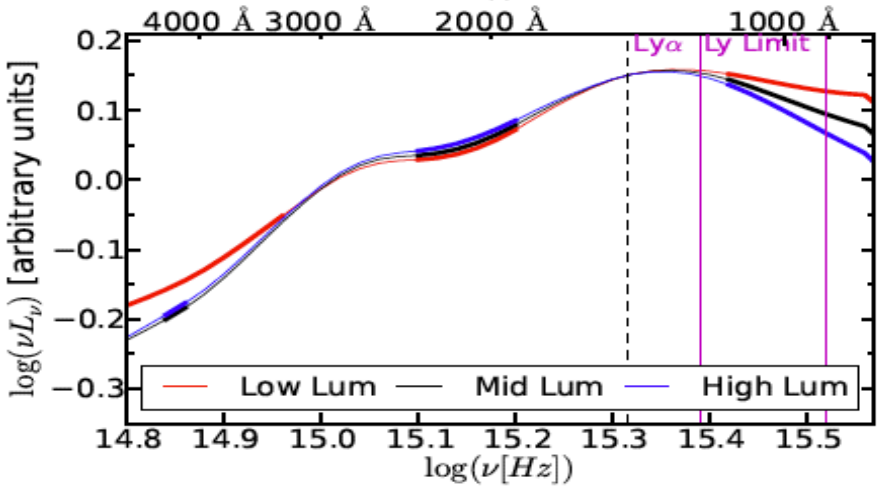
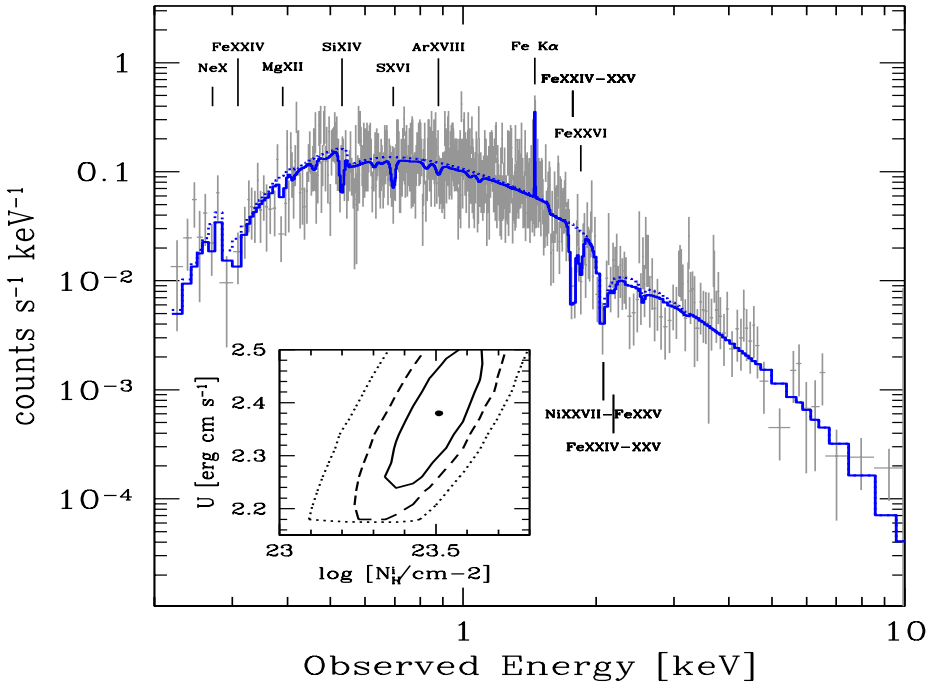


(b) Luminosity SEDs normalized at 1450 Å

X-ray weakness is a key feature to produce line-driven winds

Proga (2005) luminous AGN can launch UV radiation-driven accretion-disk winds being able to weakening/destroying the X-ray corona

PERSPECTIVE WITH ATHENA & CONCLUSIONS



15 ks X-IFU simulated spectrum for a WISSH-like quasar at z=3.4 with a PDS456-like UFO

[v= 0.15c, Nh =23.4 cm-2, log *U* = 2.3 and v= 5000 km/s]

Cheap ATHENA Program: Sizable fraction of WISSH (~25%) can be targeted with a total exp. of 300 ks

PERSPECTIVE WITH ATHENA & CONCLUSIONS

- The WISE/SDSS selected Hyper-Luminous (WISSH) Quasars Project aims to offer a panchromatic view of nuclear, outflows and host galaxy properties (Bischetti et al. 2017; Duras et al. 2017)
- X-WISSH: X-ray properties for 35 hyper-luminous, broad-line quasars (Martocchia et al. 2017, sub.)
- Opportunity to significantly extend & validate relations involving X-ray Lum.
- Γ-M(BH): Flatter dependence than previously found over $5 < \log M/M_{\odot} < 11$
- X-ray emission of hyper-luminous quasars is relatively weaker compared to lower-luminosity AGN (low X/O, X/MIR and largest X.ray Bol corrections)
- Hy-Lum QSOs to complete the view of the accretion disk-corona system (i.e. X-ray vs. broad-band SED properties)
- X-ray weakness as a key ingredient for nuclear winds acceleration

Additional SLIDES

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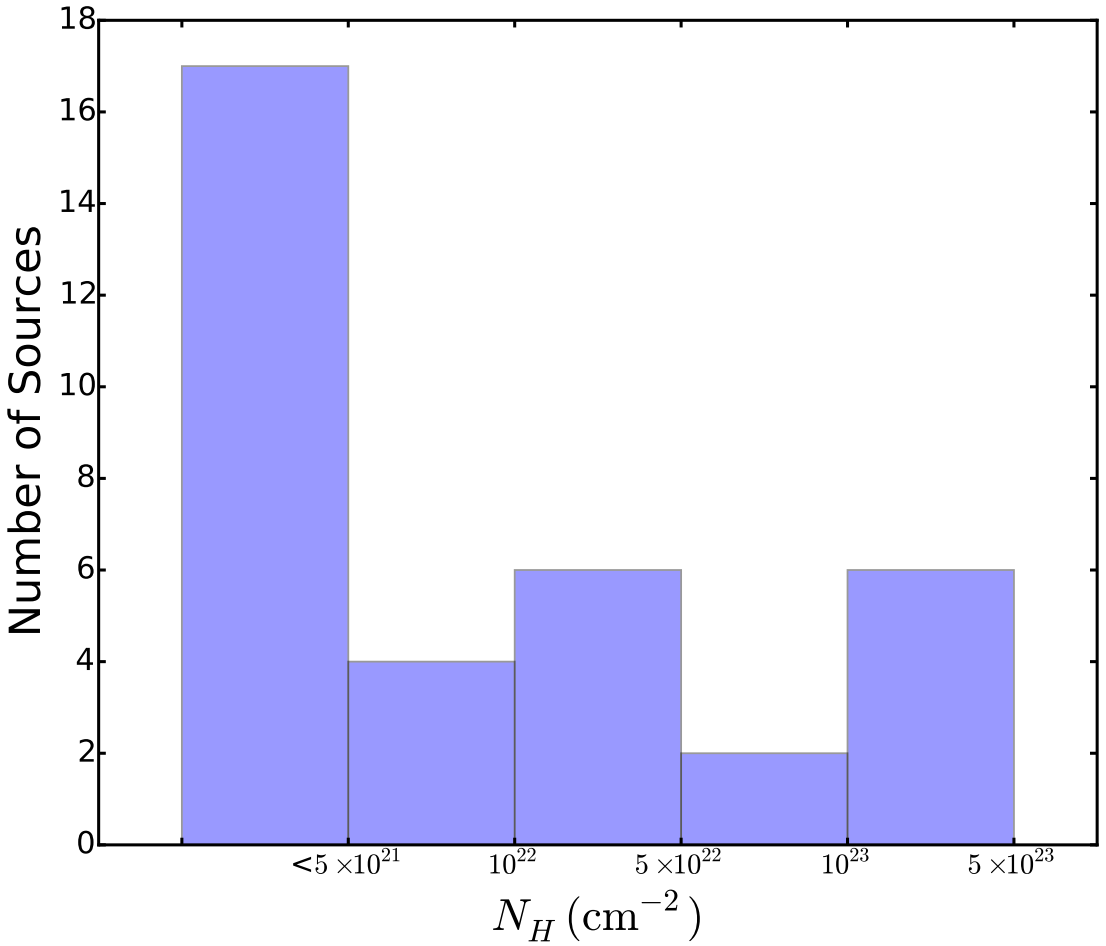

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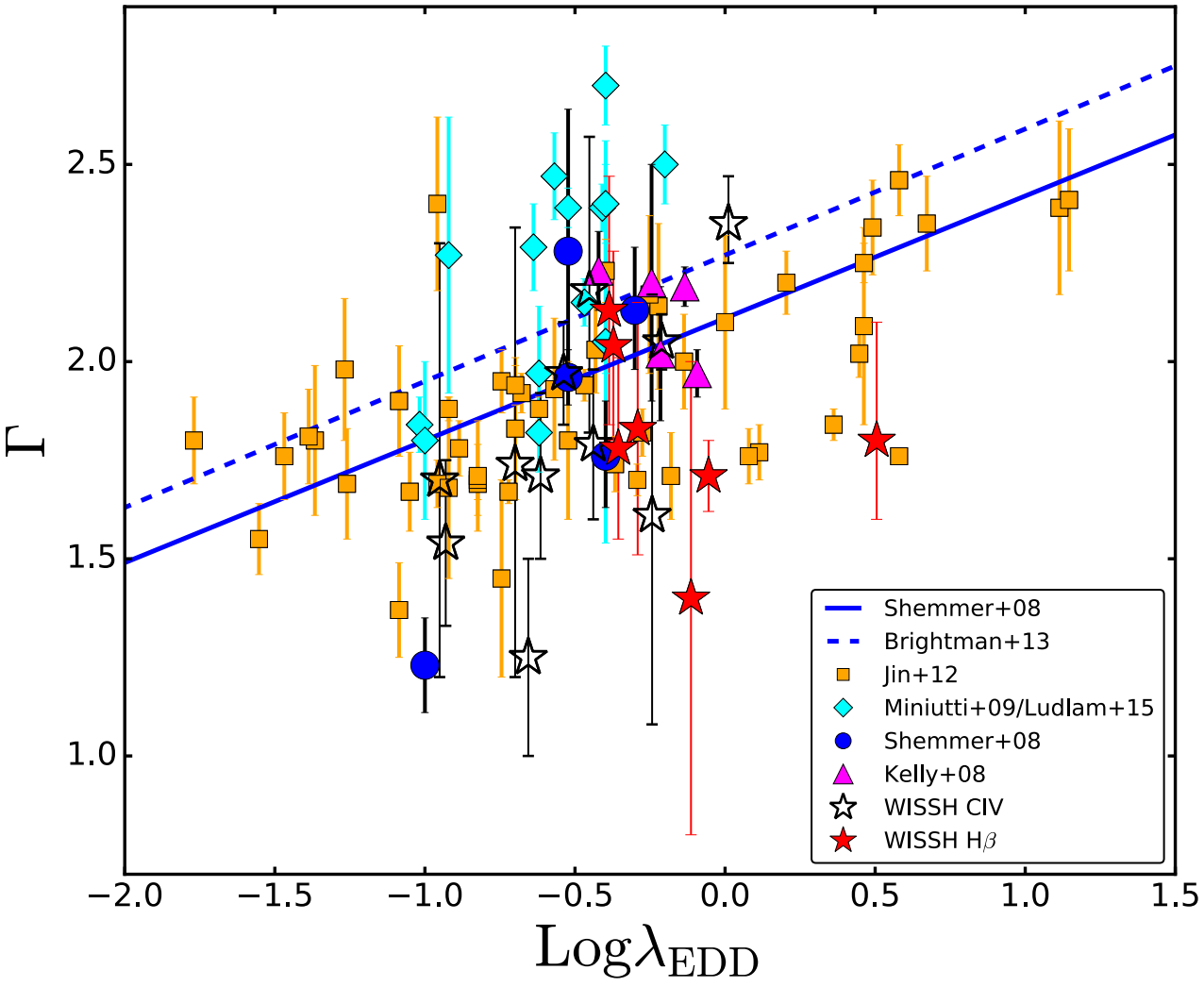

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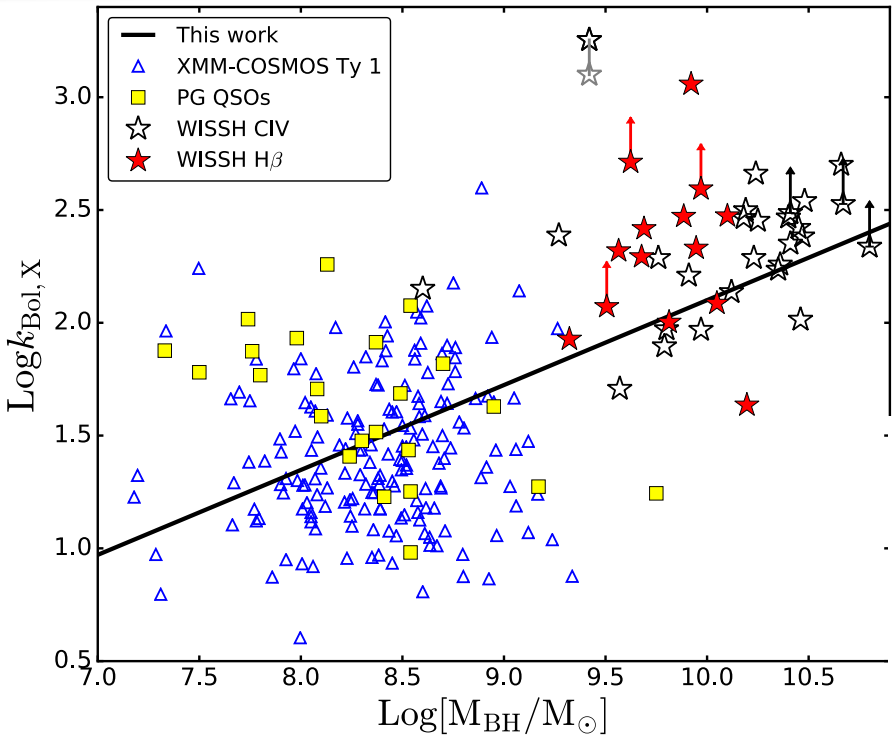

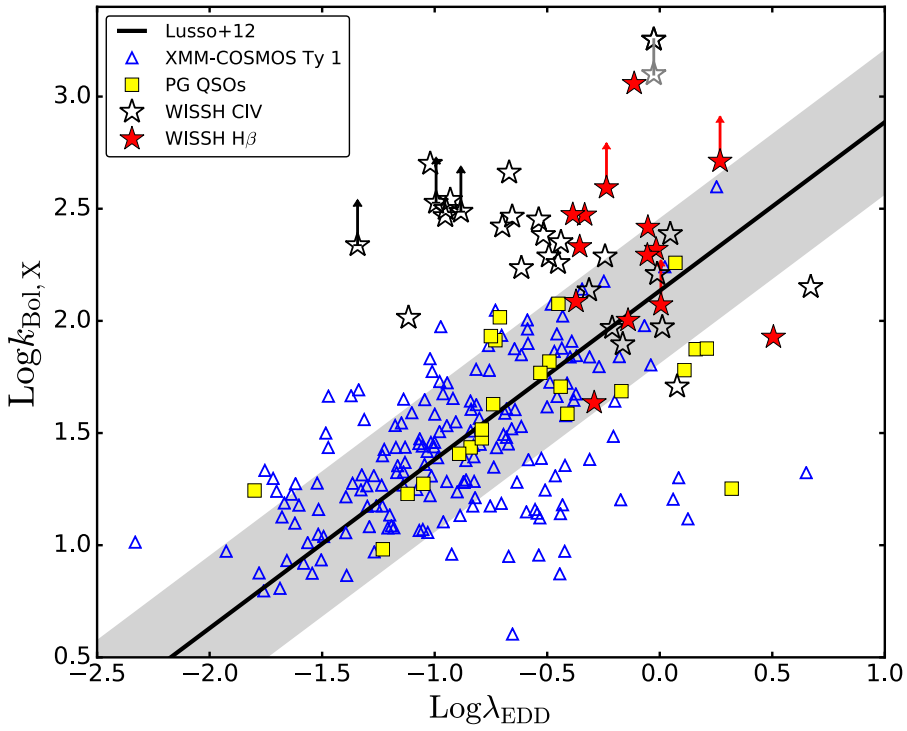

X-RAYING LUMINOUS QUASARS

Hyper-Luminous QSOs → Bolometric luminosity >> 10^{47} erg/s
→ X-ray luminosity > 10^{45} erg/s
VERY RARE → Sampling of large sky area required
VERY FAINT→ Cosmic downsizing, peak of density at high z

★ Systematic study of the X-ray spectral properties of quasars available only for z < 0.1 QSOs (i.e. PG QSOs; Piconcelli+05)

★Chandra snapshots eg V ignali+03 Just+07 Shemmer+08
★Few targeted obs. of *(mostly lensed)* luminous QSOs Chartas+02,07 Lanzuisi+12,16 Banerji+14

★ Deep fields only cover sky fields of ≤ few deg^2

X-raying the unexplored brightest end of the LF
- ✓ Spectral features
- ✓ X-ray bolometric correction
- ✓ Extending correlations involving LX