The realm of hyperluminous quasars

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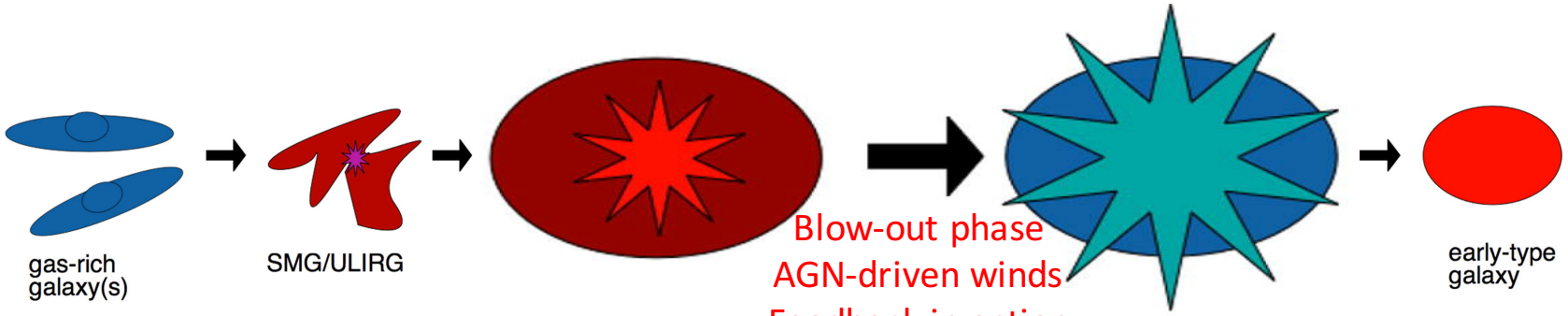
Hunting for the most luminous *quasars*



Adapted from Alexander & Hickox 2012

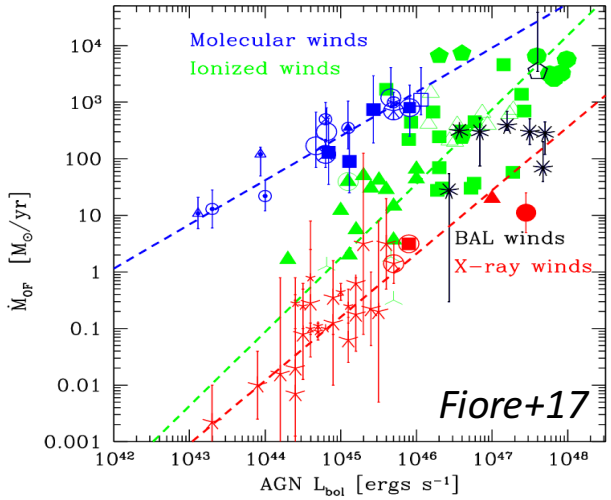
Obscured quasar
- Dust-enshrouded
- High obscuration
- High SFR

Unobscured QSO
- Blue
- Optically bright
- X-ray unobscured

Aim: probe and study the AGN-driven feedback phase

the strength of outflows is proportional to $L_{bol}^{0.5-1.3}$
(Menci+2008, Faucher-Giguère & Quataert 2012, Fiore+2017)

The most luminous QSOs at the epoch in which their activity peaks (2<z<4)



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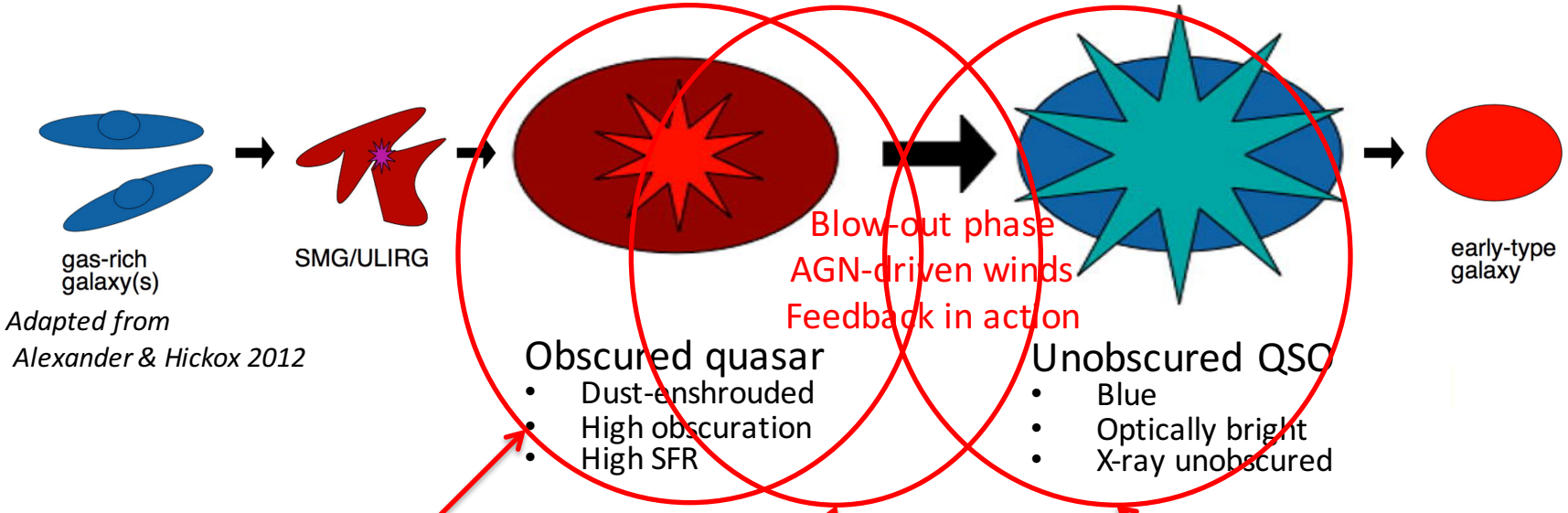


Efficient large-area IR selection: search for hyperluminous (L_{bol}=10^{47-48} erg s^{-1}) dust-reddened/IR bright 2<z<4 QSOs

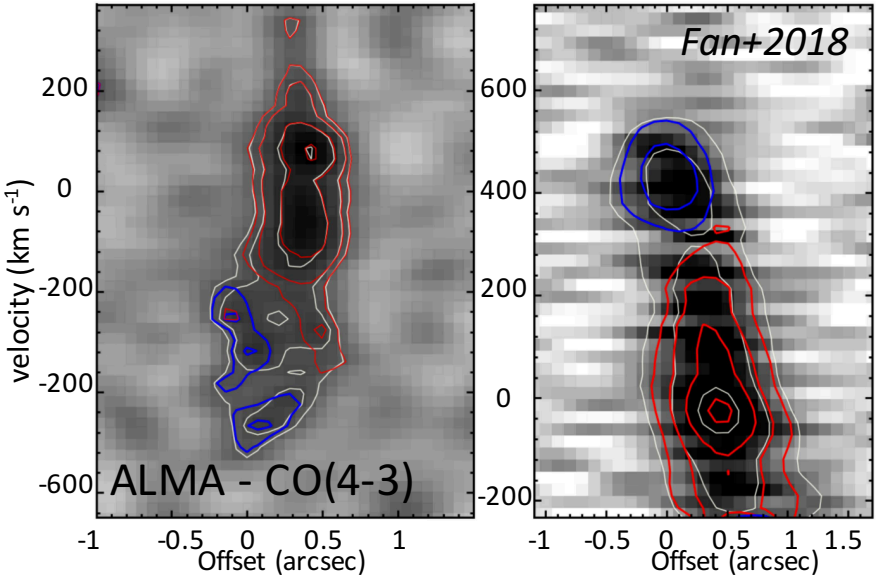
Hot DOGs: W1W2-dropout →heavy obscuration *(Eisenhardt+2012, Wu+2012)*

Red QSO: NIR color (J-K>2) → dust-reddened sources *(Glikman+2004, Banerji+2012, Ross+2015)*

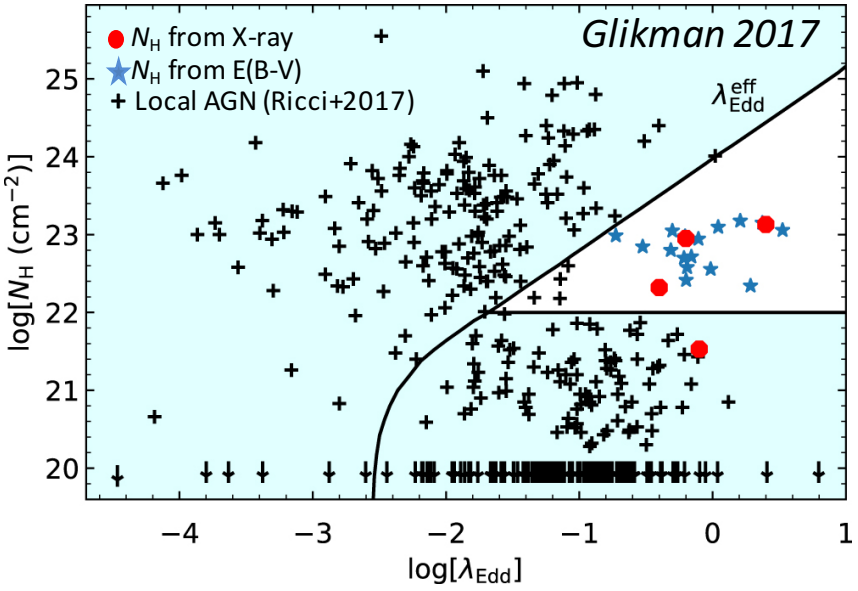
WISSH QSOs: WISE/SDSS →~90 MIR-bright Type 1 AGN *(Bischetti+2017, Vietri+2018, Duras+2017)*

Signature of outflows in dust-reddened/obscured sources

Hot DOGs: Indication of molecular outflow

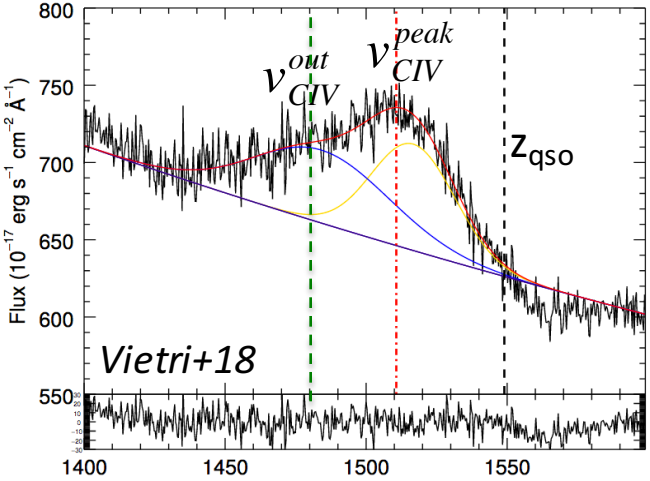


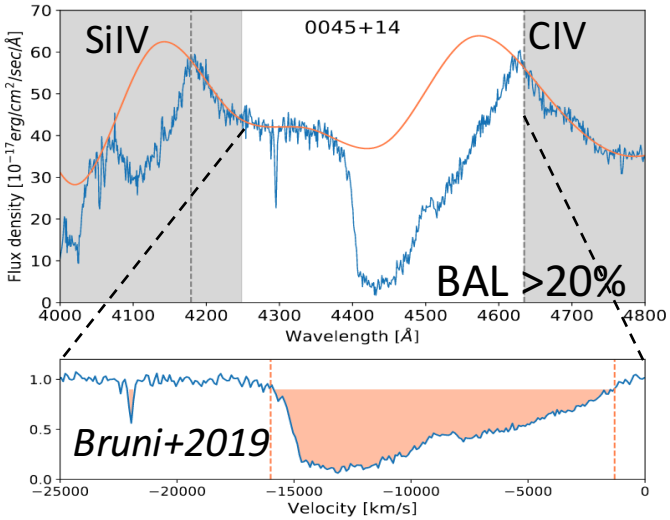
Red QSOs in blow-out phase



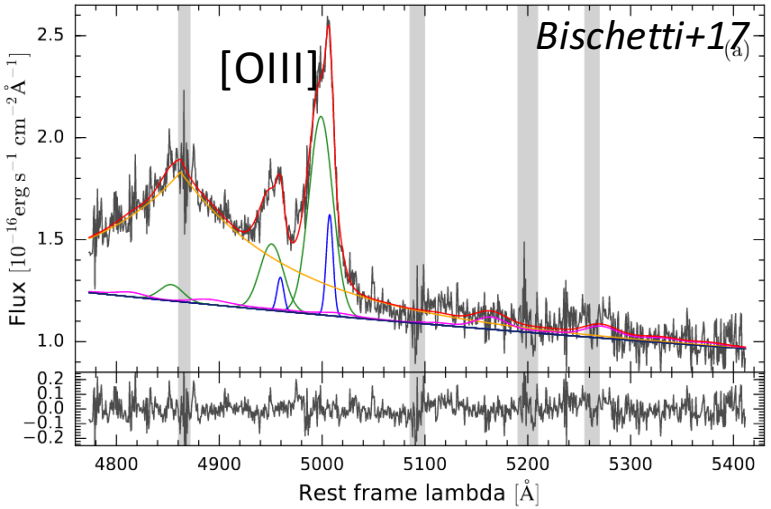
Pervasive outflows at all scales in *the Type 1 WISSH QSOs*

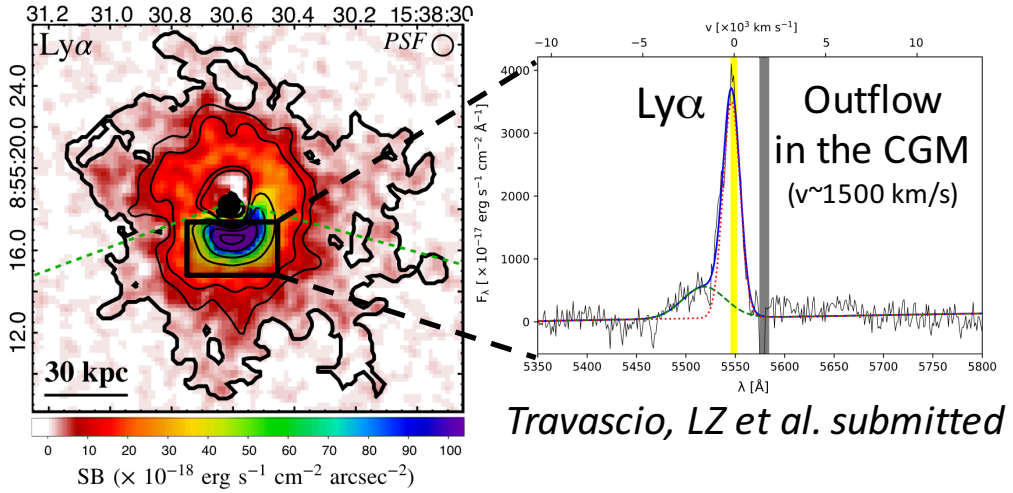
Remarkable nuclear winds (~70%):
strong CIV blueshifts (up to 7000 km/s)





Powerful [OIII] kpc scales outflows (~30%)
(v~1000-2000 km/s, $\dot{E}_{kin} \approx 0.01 \times L_{bol}$)

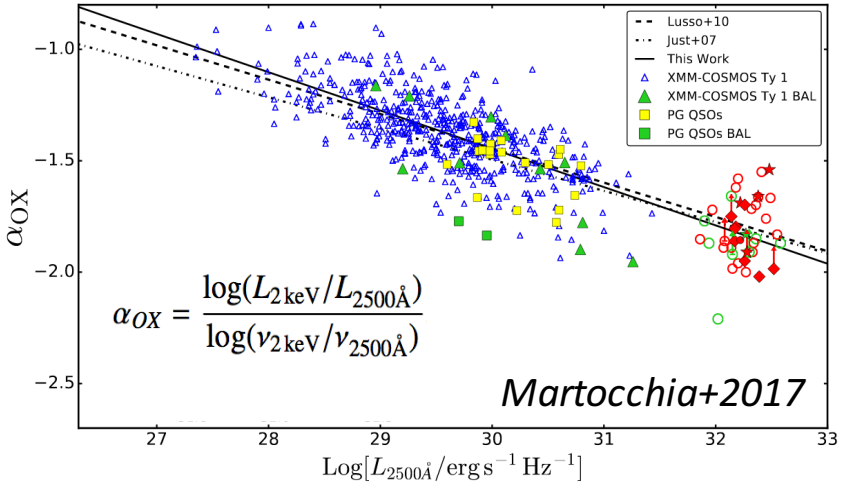


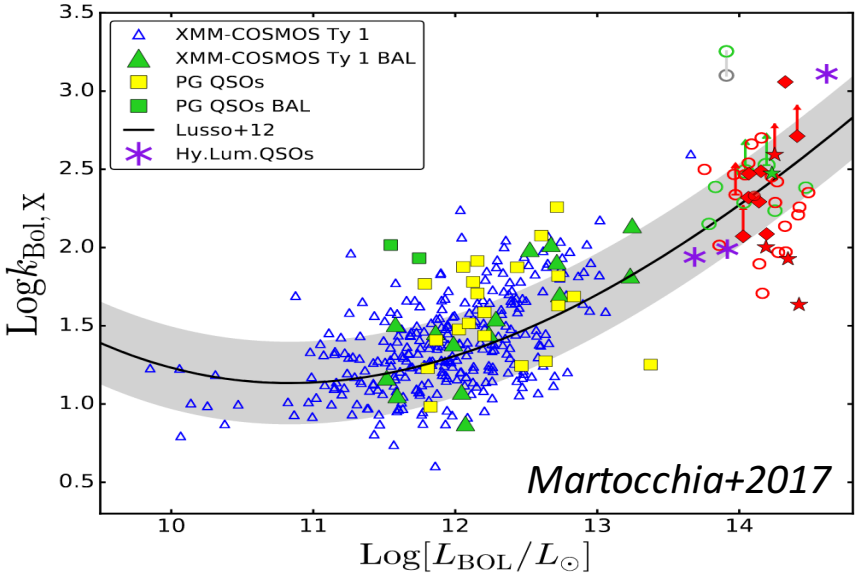


Travascio, LZ et al. submitted

X-ray view of hyperluminous quasars

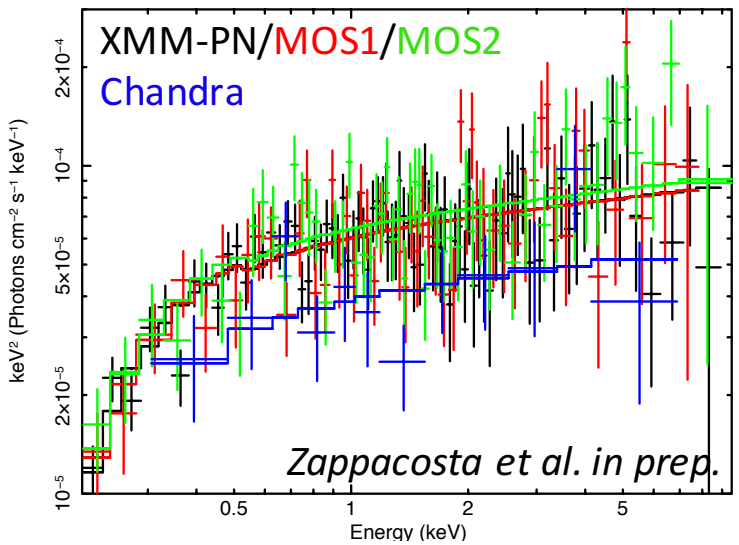
- X-ray nuclear properties for ~50% of WISSH quasars
- N_H up to ~5×10^{23} cm^{-2}
- disk emission largerly dominates over coronal
- little X-ray contribution wrt the bolometric output $k_{bol,X}$~300 (~1 dex scatter)



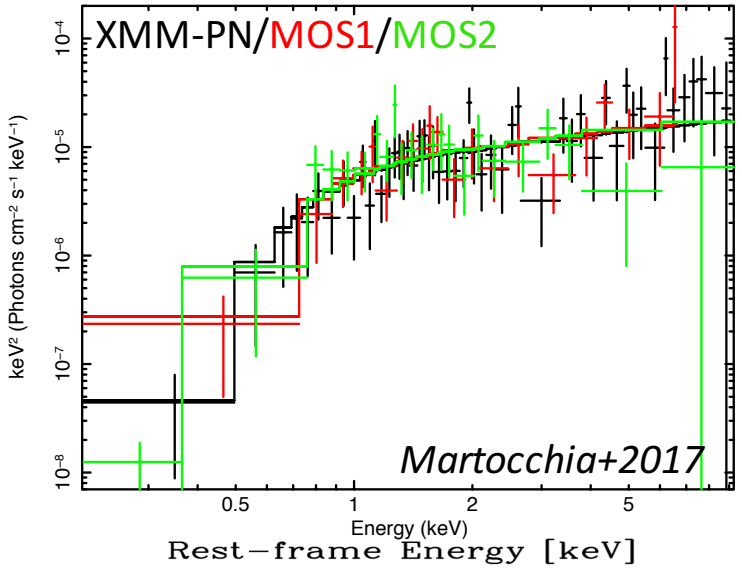


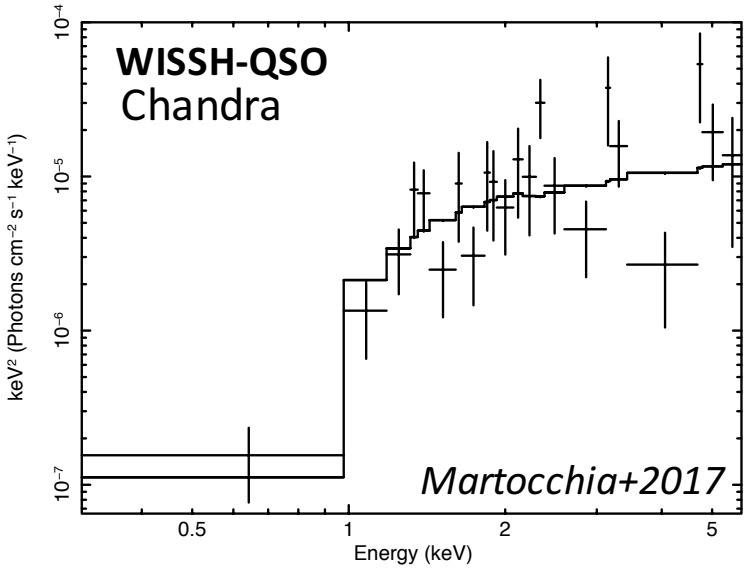
Few examples of X-ray spectra

WISSH-QSO

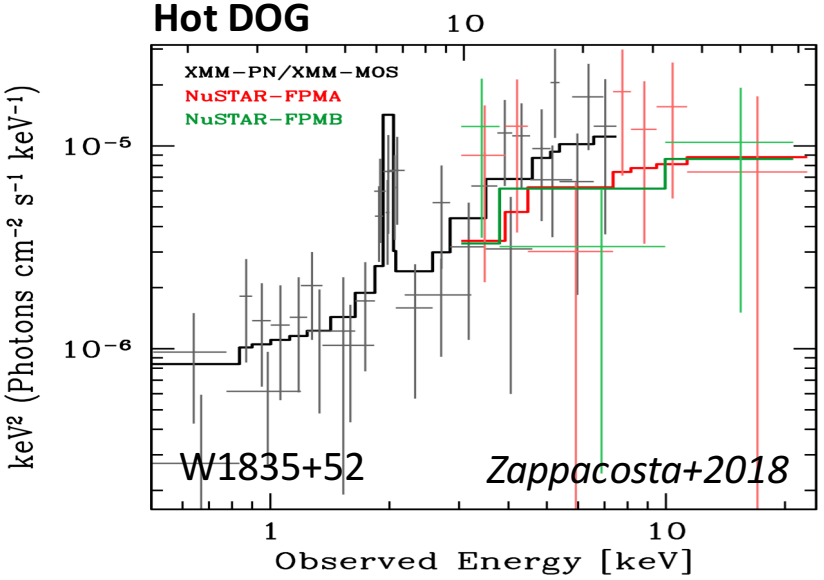


Red-QSO



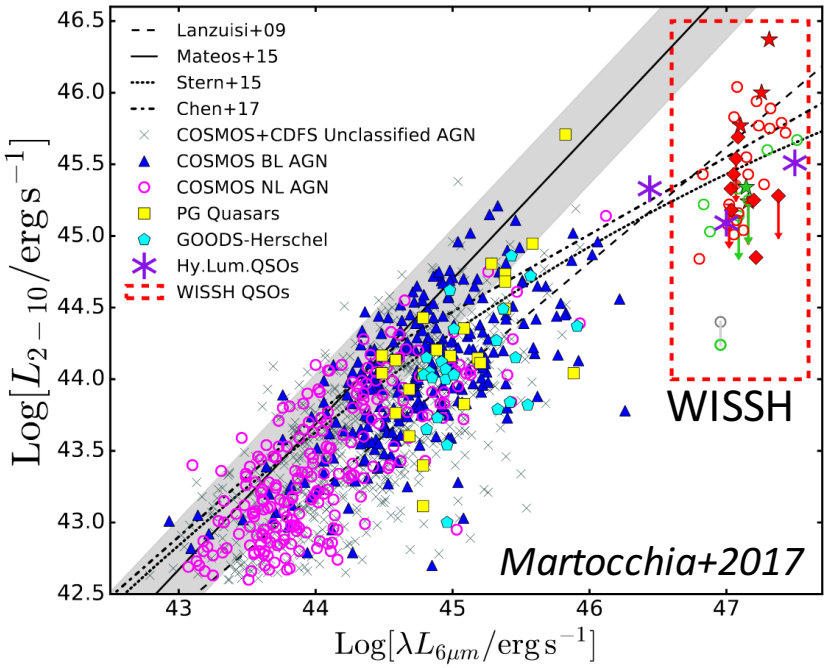


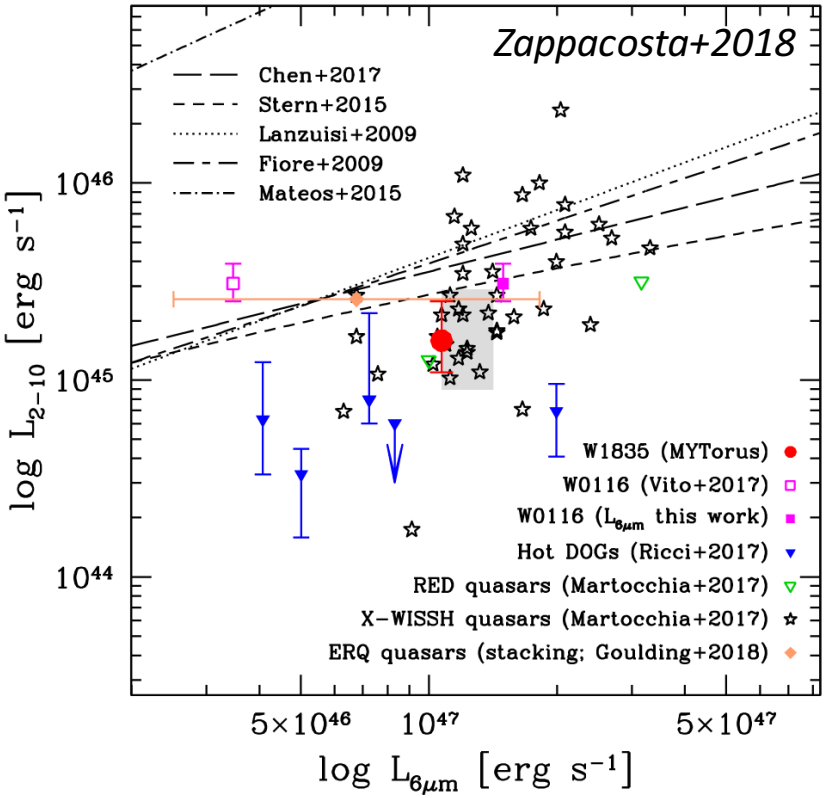
Hot DOG



X-ray vs Mid IR

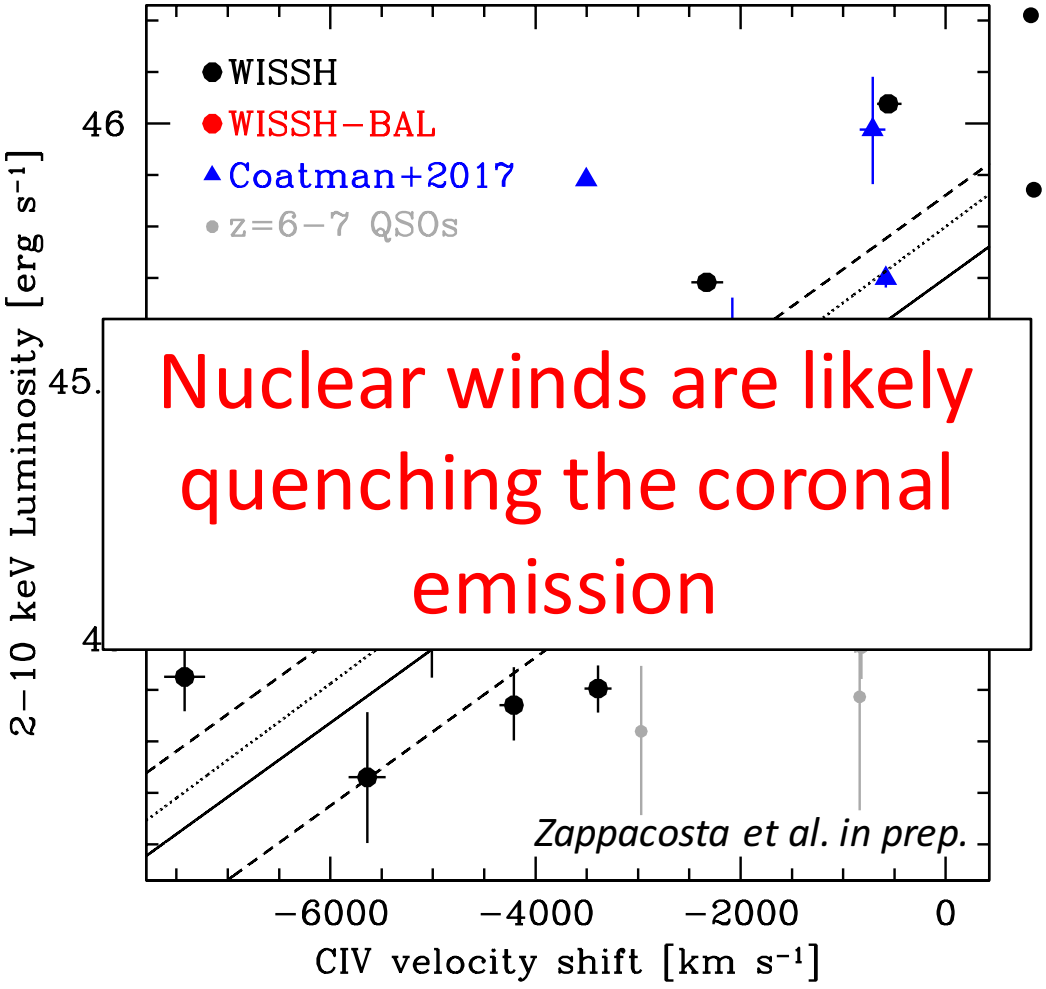
X-ray nuclear radiative output compared
to larger-scale Mid-IR emission



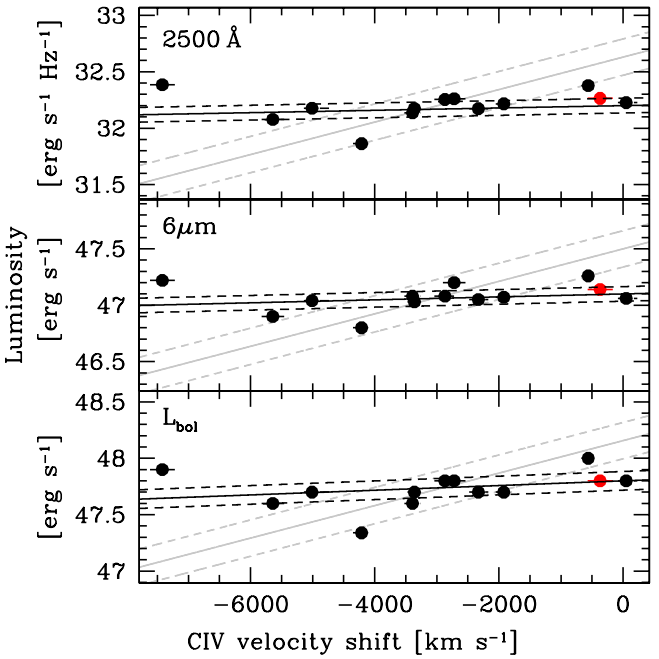


Strong UV output → line driven winds → quenching of the X-ray coronal emission
(Proga 2003, 2005, 2007)

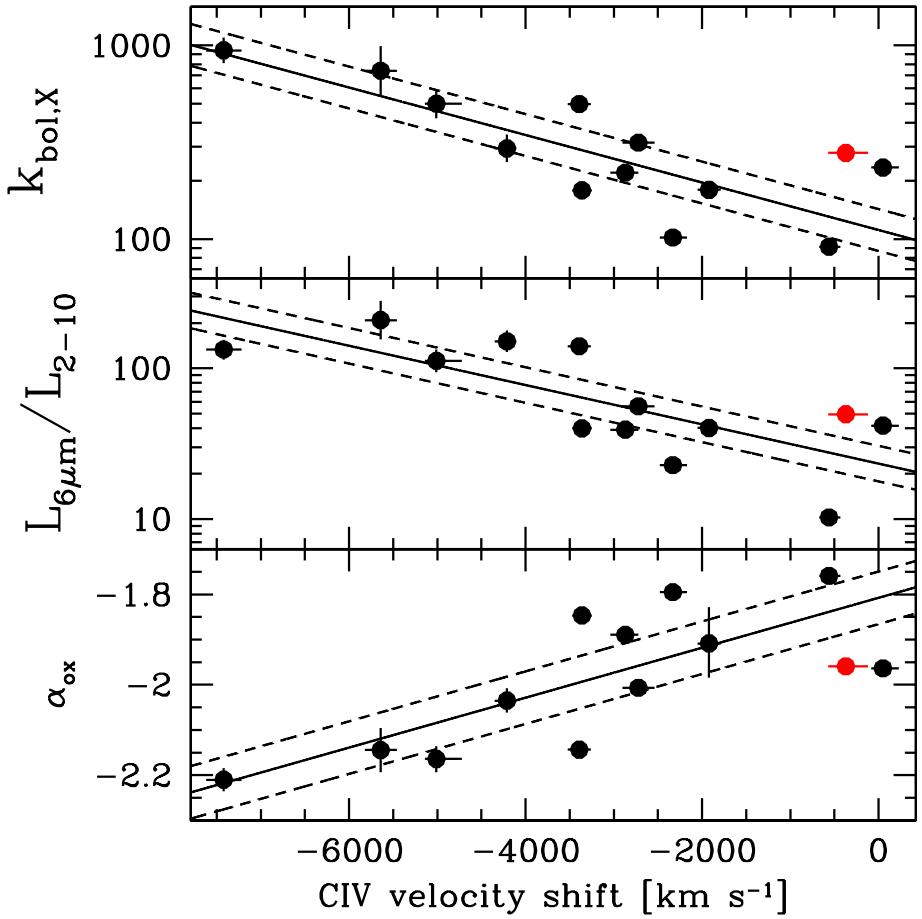
Wind regulated X-ray emission



- Relation between X-ray luminosity and CIV blueshifts
- No significant dependence at other wavelengths

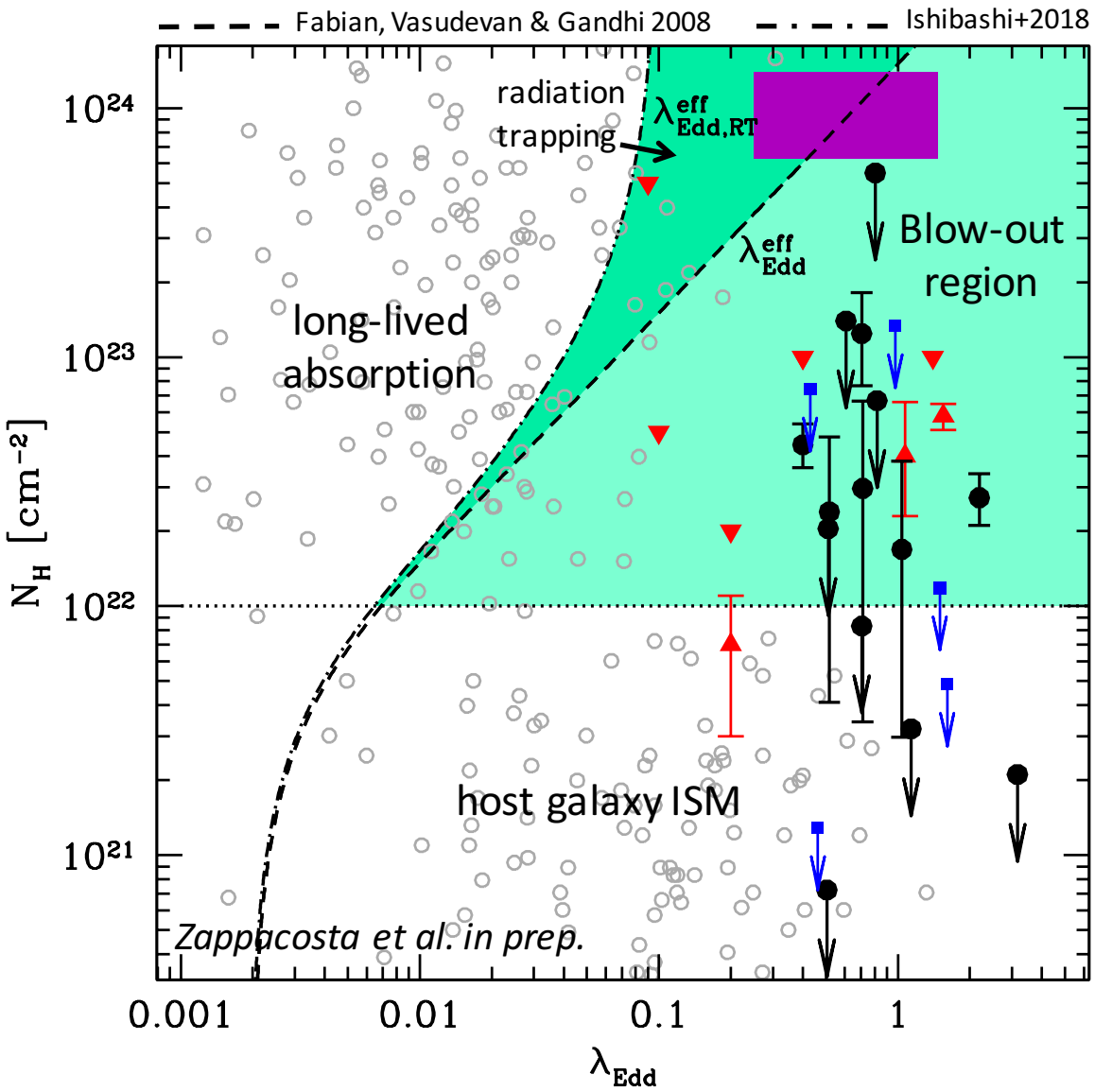


Comparing X-ray emission to other wavelengths



- 1 dex dependence
- shrink scatter in this regime
- refinement of relations at the highest luminosities

The dust-driven blow-out phase



- WISSH
- Bright QSOs (Coatman+17)
- Red QSOs (Martocchia+2017, Goulding+18 Banerji+15, Feruglio+14)
- Red QSOs (N_H from HR) (Piconcelli et al. in prep.; Banerji+15)
- Hot DOGs (Ricci+2017; Vito+2018; Zappacosta+2018; Wu+2017)
- Local AGN (BASS sample) (Ricci+2017)

WISSH quasars and other hyperluminous quasars are mostly blowing out their obscuring medium

Conclusions

- Hyperluminous QSOs exhibit pervasive signs of outflows
- The X-ray emission correlates over more than 1 dex with the velocity of the broad-line region winds
  - nuclear winds are likely quenching the corona
  - needs to refine $k_{bol,X}$, $L_{6\mu m}/L_X$, α_{ox} at the highest luminosities
- A large fraction of hyperluminous QSOs is blowing-out their surrounding obscuring medium
- Future perspective:
  - study the X-ray weakness - CIV velocity shift at lower L_{bol}
  - investigate mildly relativistic highly ionized SMBH winds with ATHENA

Nuclear winds in hyperluminous QSOs: the Athena perspective

X-IFU simulation

- WISSH quasar at z=3.4
- Wind parameters:
  - v_{wind}=0.15c;
  - $\log(N_H/cm^{-2})$=23.4
  - $\log(U/erg\ cm\ s^{-1})$=2.3,
  - v_{turb}=5000 km/s
- 20 ks → 2500 counts
  - accuracy on 1%, 2% and 5% on $\log N_H$, v_{wind} and logU
- Variability studies on few hours time-scales

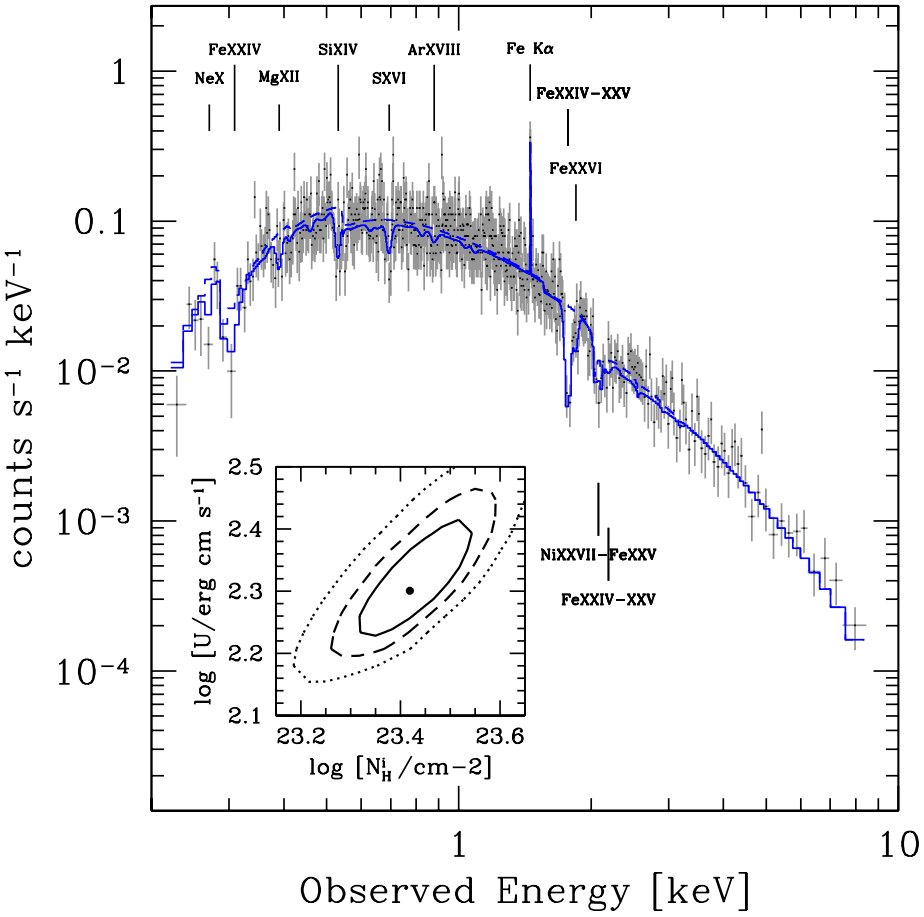


Figure: from Martocchia+2017, with updated X-IFU responses