# THE WISSH QUASARS PROJECT: BLR VS GALAXY SCALE WINDS


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## The WISSH quasars project


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**M. Brusa, C. Vignali UNIBO - INAF OABO**
**A. Marconi, G. Cresci INAF Arcetri**
**… and many others**



QUASARS AT ALL COSMIC EPOCHS Padova, 2-7 APRIL 2017

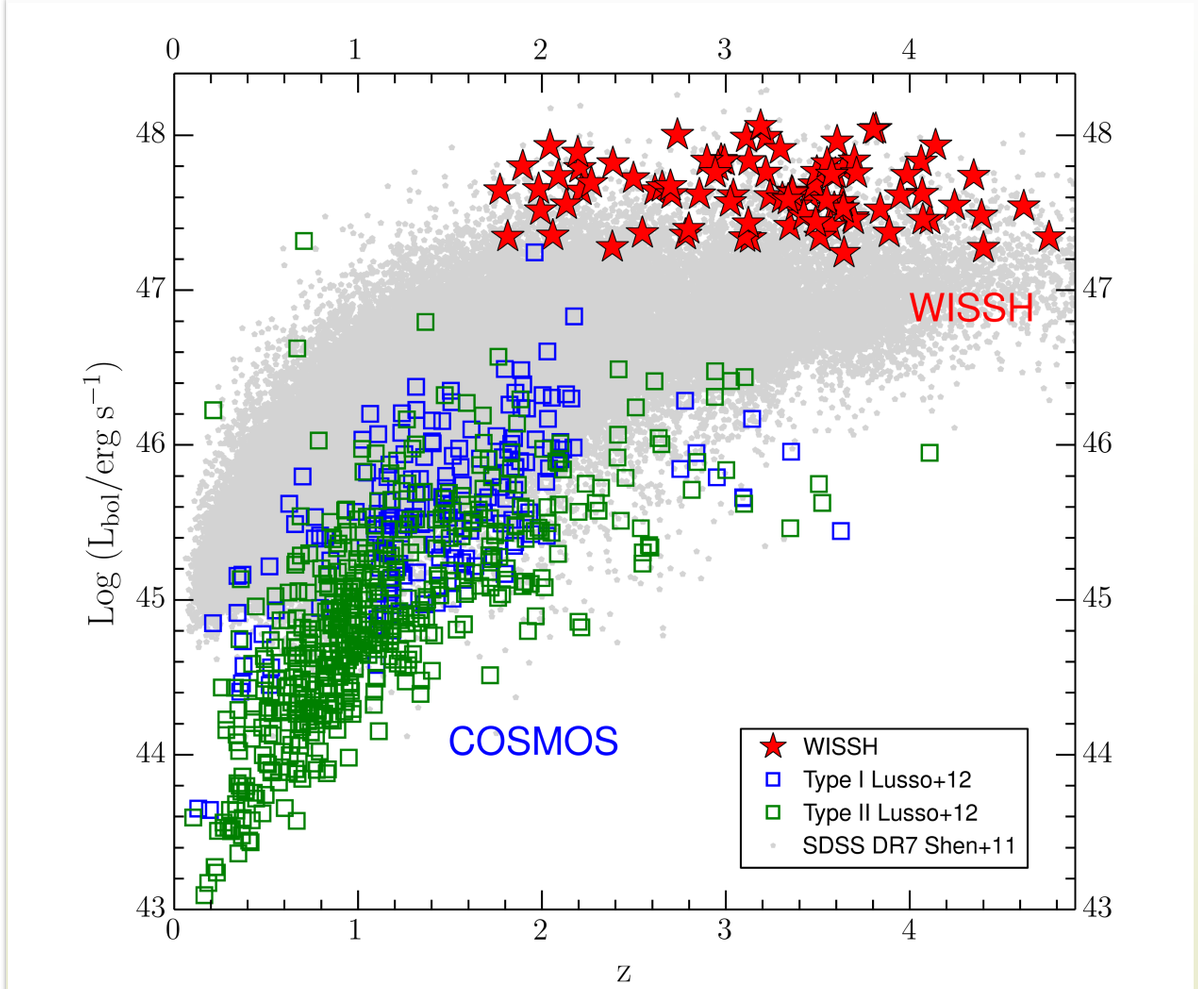
# THE WISSH QUASARS SURVEY

## Goal: Observing AGN feedback at its best

Theory & Observations → **The most luminous quasars are the best targets to hunt for powerful AGN-driven outflows**

## WISSH Quasars

86 WISE/SDSS Selected Hyper-luminous broad-line Quasars with $L_{Bol} > 2 \times 10^{47}$ erg $s^{-1}$




### Extensive multi-λ observing program

**Panchromatic view of Hyper-Lum QSOs**

**XMM & Chandra** X-rays

**X-shooter** Hβ + CIV + MgII

**SINFONI** IFU Spec Hβ + [OIII] + Hα

**LBT/LUCI – TNG** Hβ + [OIII]

**ALMA** CO + CII + FIR continuum

+ Herschel – WISE – 2MASS – SDSS public data

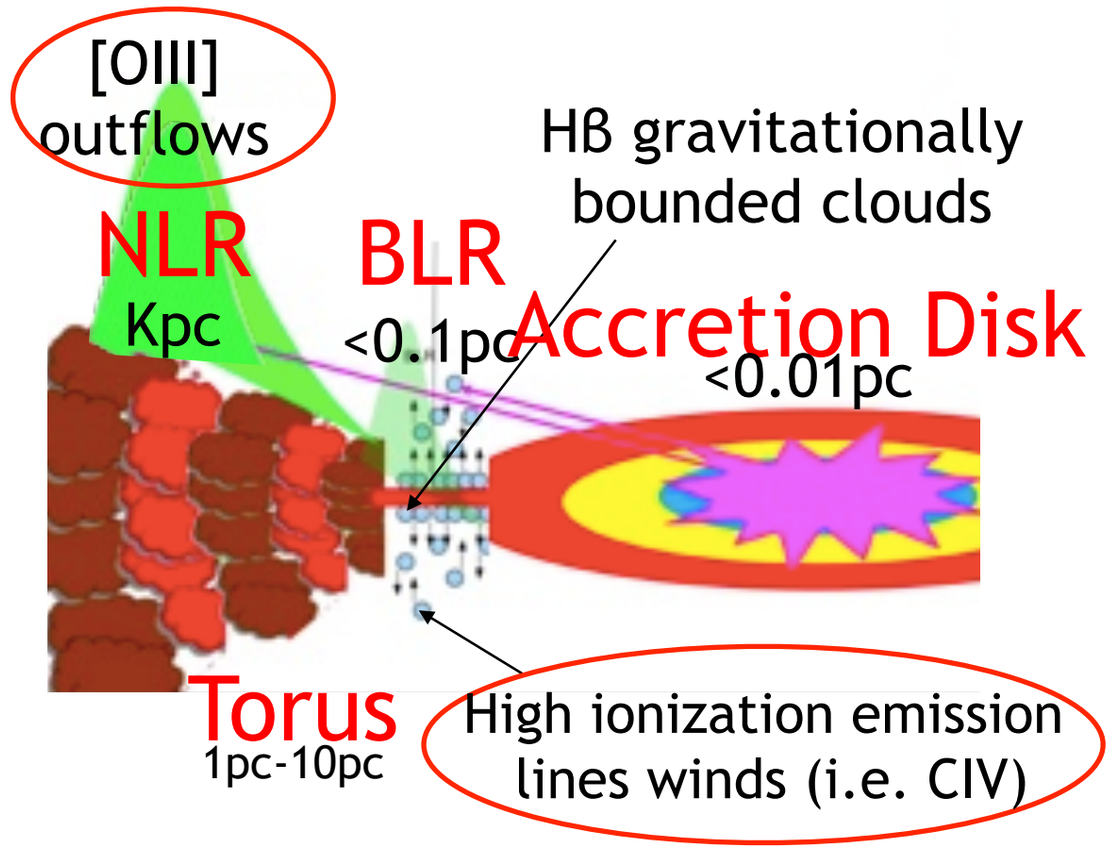
# TARGETING WISSH QUASARS

*This talk:*

Systematic study of
nuclear and galaxy scale winds
in luminous quasars

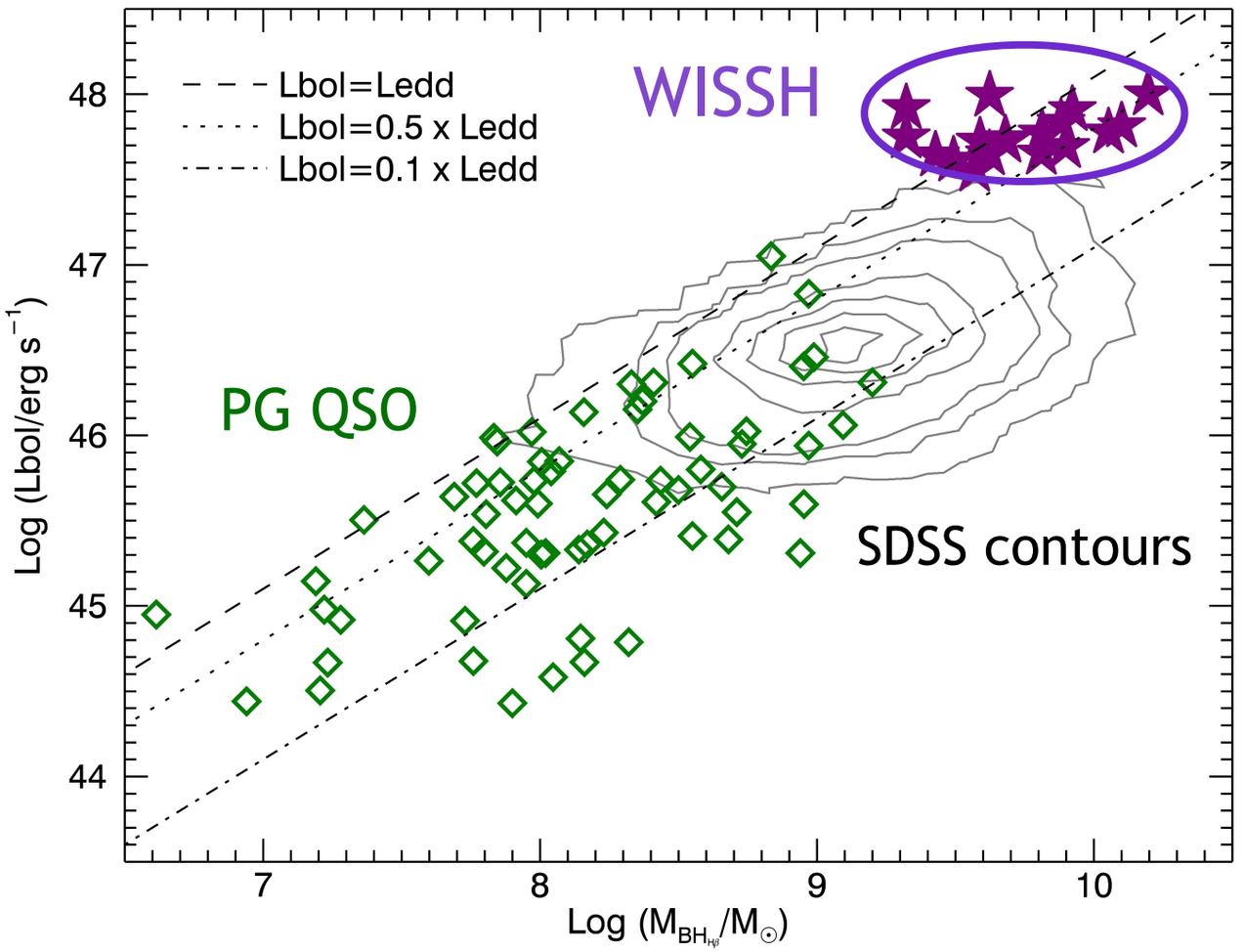
**NIR spectroscopy-Optical rest-frame**

(I) SMBH mass (Hbeta)
(II) NLR winds ([OIII])
(III) BLR winds (CIV)



# (I) SMBH MASS FROM Hβ EMISSION LINE

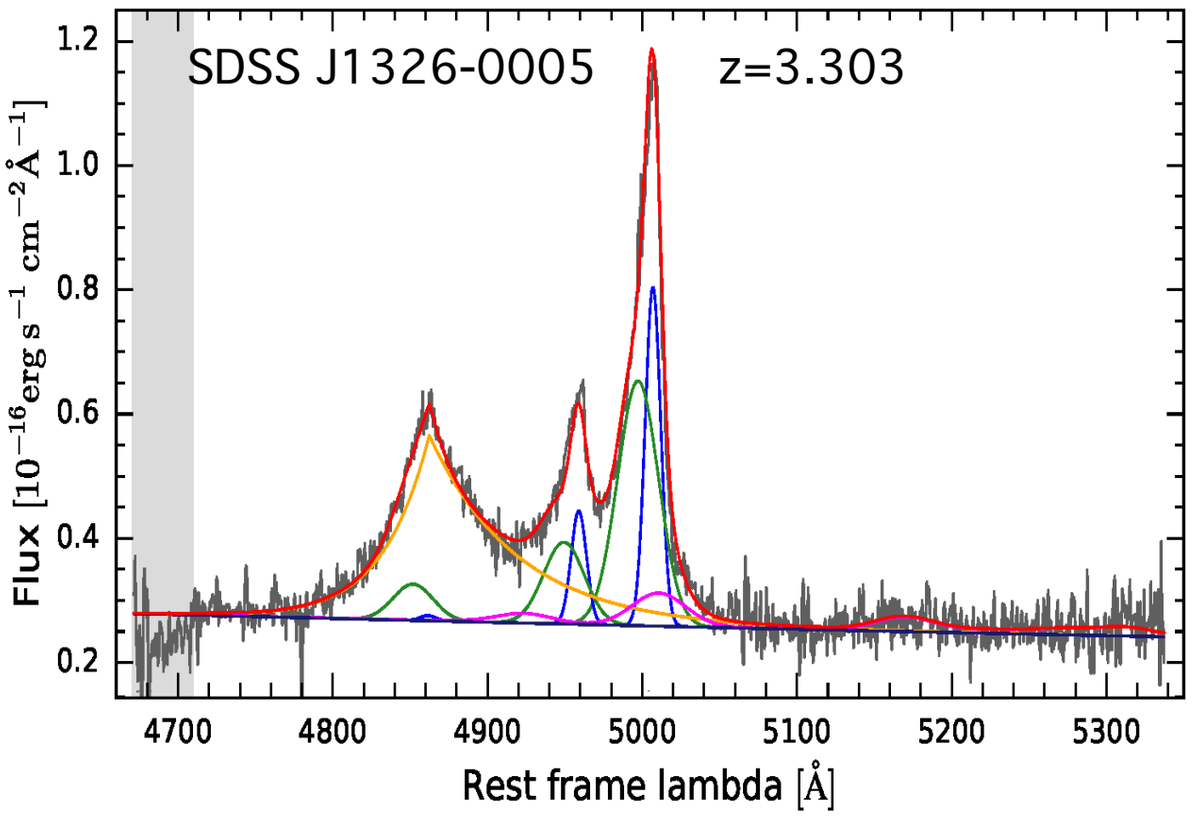
- LBol from multi-component broad-band (MID-IR to UV) SED fitting (Duras et al. in prep)
- FWHM(Hβ) 3,000-8,000 km/s
- Hβ-based SMBH masses
  from ~ $2 \times 10^9$ M⊙
  up to ~ $2 \times 10^{10}$ M⊙
- High accretion rates $0.4 < \lambda Edd < 3$



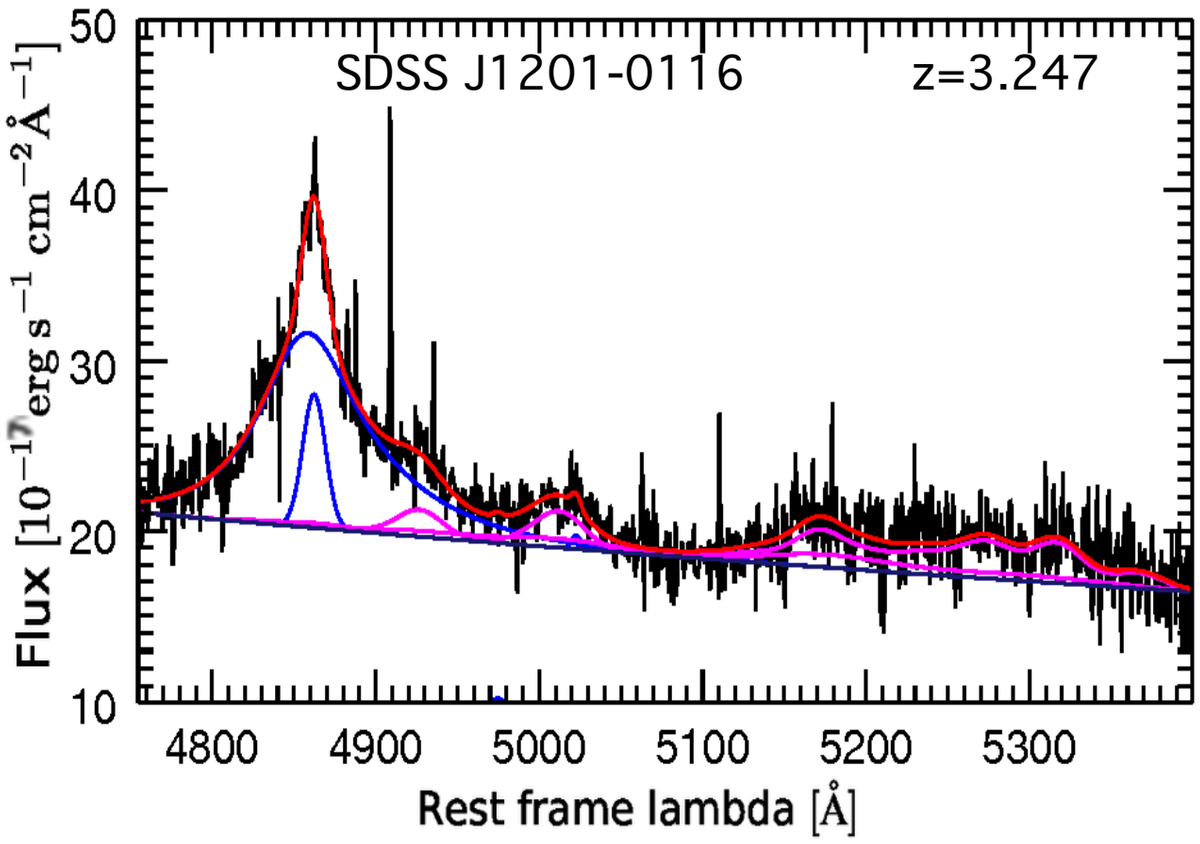

**Opportunity of collecting high-mass, highly accreting SMBHs at the peak of the quasar number density**

# NIR SPECTRA OF THE WISSH QUASARS

## 30% prominent broad [OIII] emission

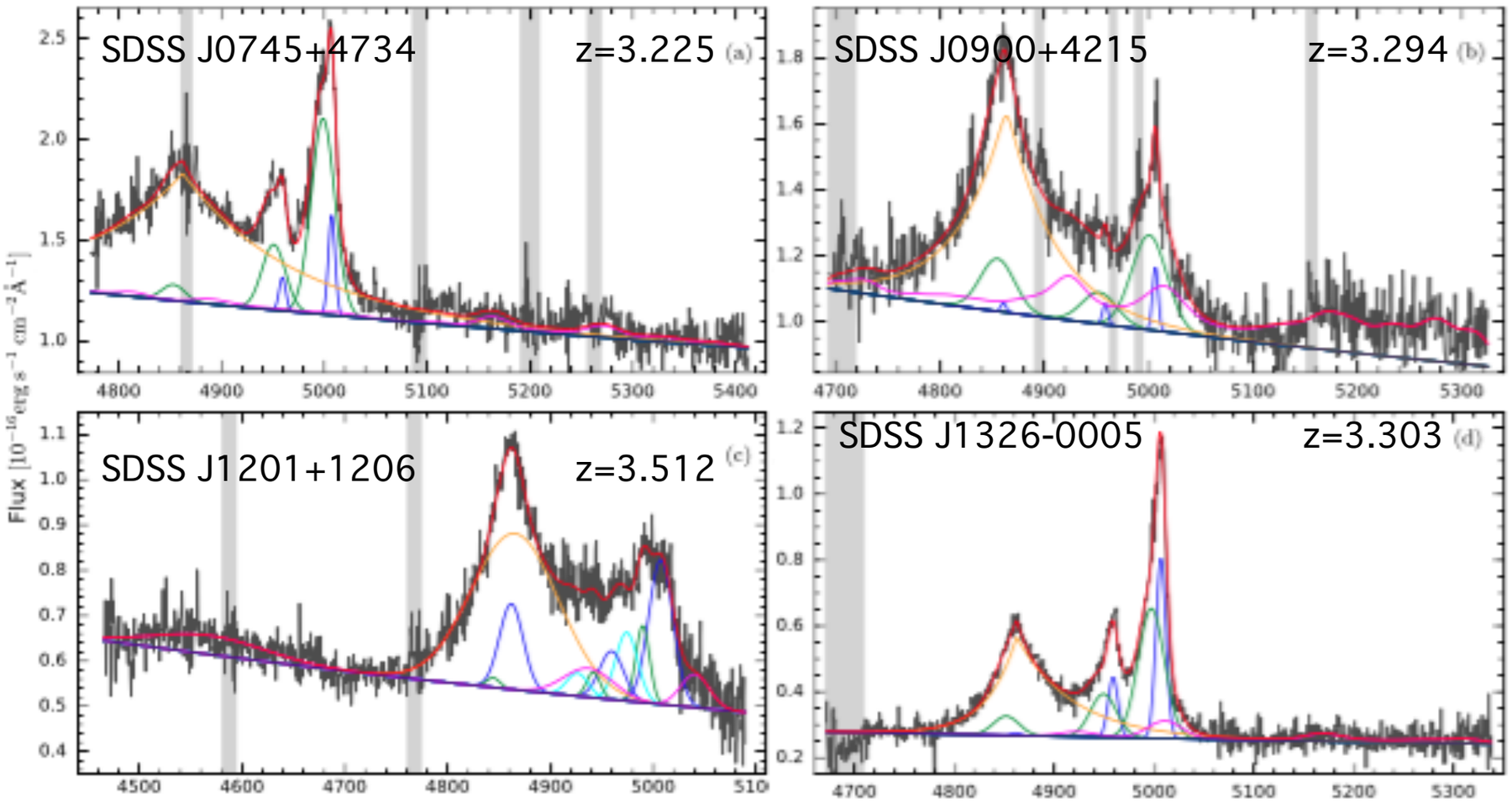


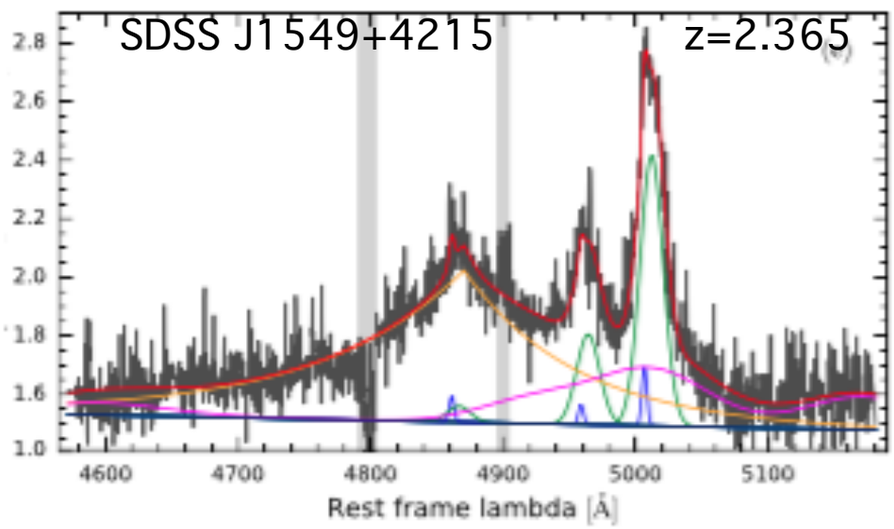

## 70% weak/lack [OIII] emission




- Very complex spectra
- Narrow [OIII] emission weak or absent in all of them
- If present, [OIII] shows broad blue-shifted profiles (in 6/18 quasars) indicative of outflows
- Strong, complex FeII emission

# (II) NLR WINDS VIA [OIII] EMISSION LINE




**30% broad prominent [OIII] emission**

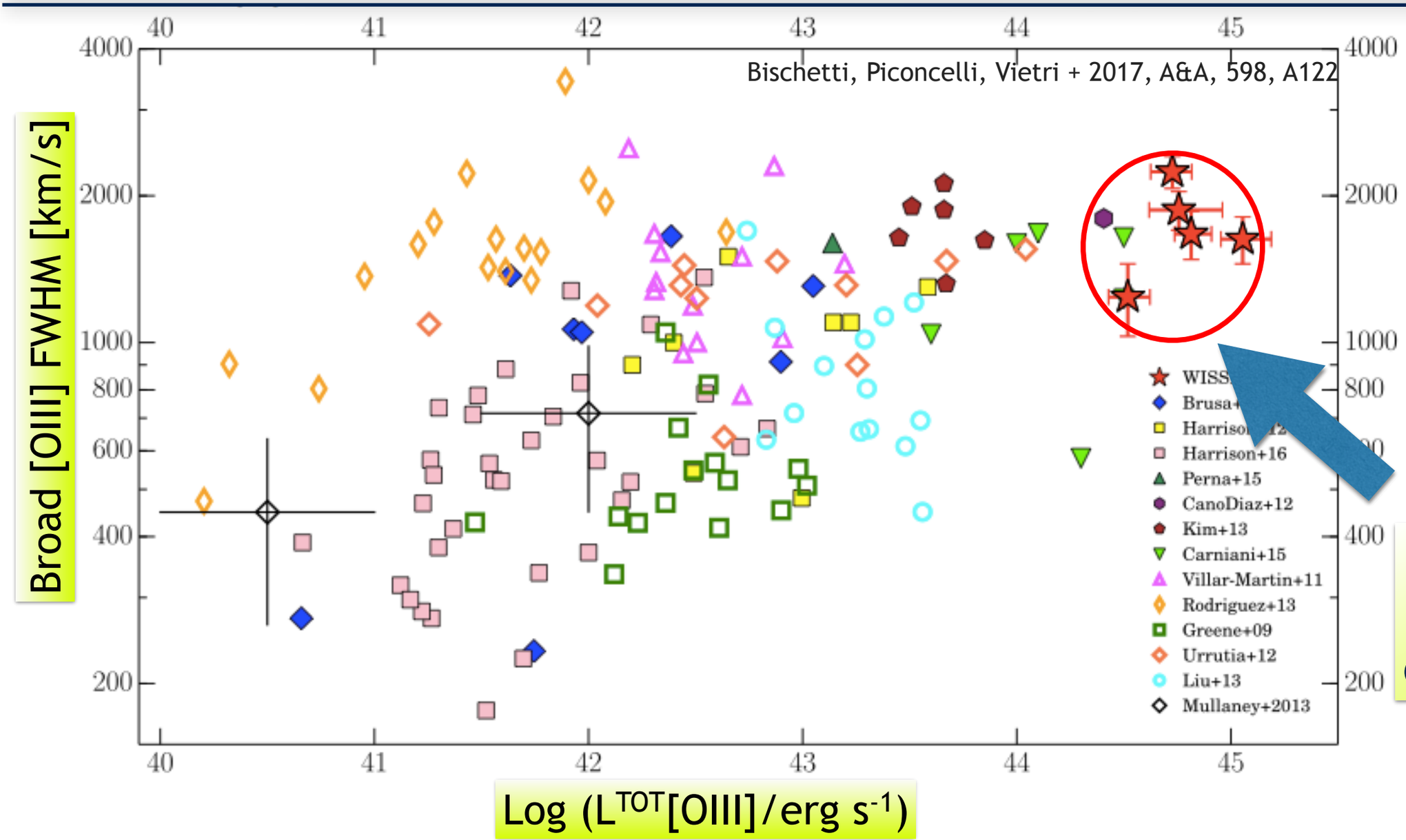
**Very broad blue-shifted [OIII] lines**

**$FWHM_{[OIII]}$ ~ 1200 -2200 km $s^{-1}$**

**v(max) ~ 1400 -3000 km $s^{-1}$**

Bischetti, Piconcelli, Vietri + 2017, A&A, 598, A122

# (II) NLR WINDS VIA [OIII] EMISSION LINE




$$L^{broad}_{[OIII]} \rightarrow M_{ion}$$

$$\dot{M} \sim \frac{3\, M_{ion}\, v_{max}}{R}$$

$$\dot{E}_{kin} = \frac{\dot{M} v_{max}^2}{2}$$

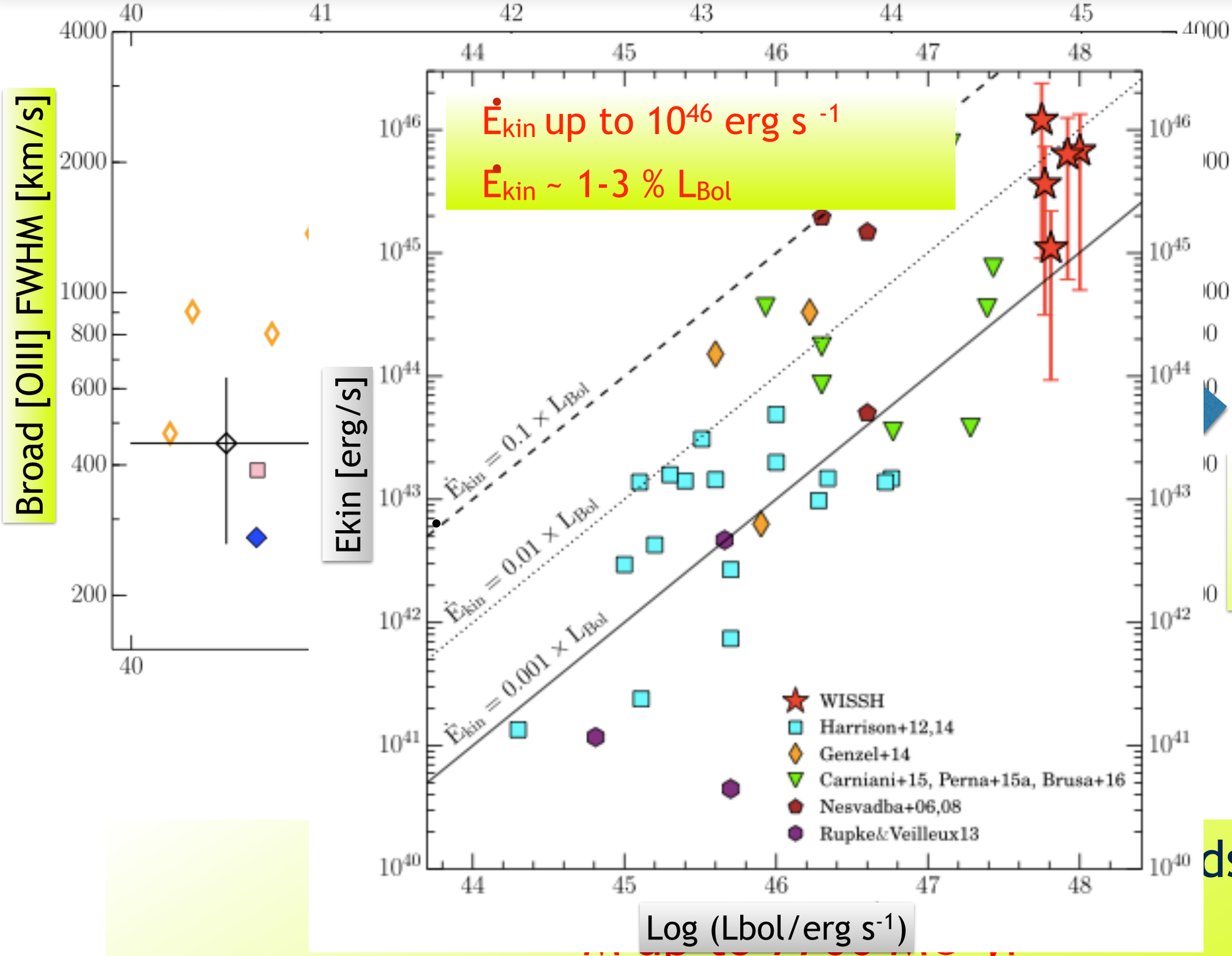
**Highest [OIII] luminosities observed so far**

Powerful kpc-scale ionized winds:

$\dot{M}$ up to 7700 $M_\odot$ yr $^{-1}$

$\dot{E}_{kin}$ up to $10^{46}$ erg s $^{-1}$

# (II) NLR WINDS VIA [OIII] EMISSION LINE




$\dot{E}_{kin}$ up to $10^{46}$ erg s $^{-1}$

$\dot{E}_{kin}$ ~ 1-3 % $L_{Bol}$

$$L^{broad}_{[OIII]} \longrightarrow M_{ion}$$

$$\dot{M} \sim \frac{3\, M_{ion}\, v_{max}}{R}$$

$$\dot{E}_{kin} = \frac{\dot{M} v_{max}^2}{2}$$

**Highest [OIII] luminosities observed so far**

ds:

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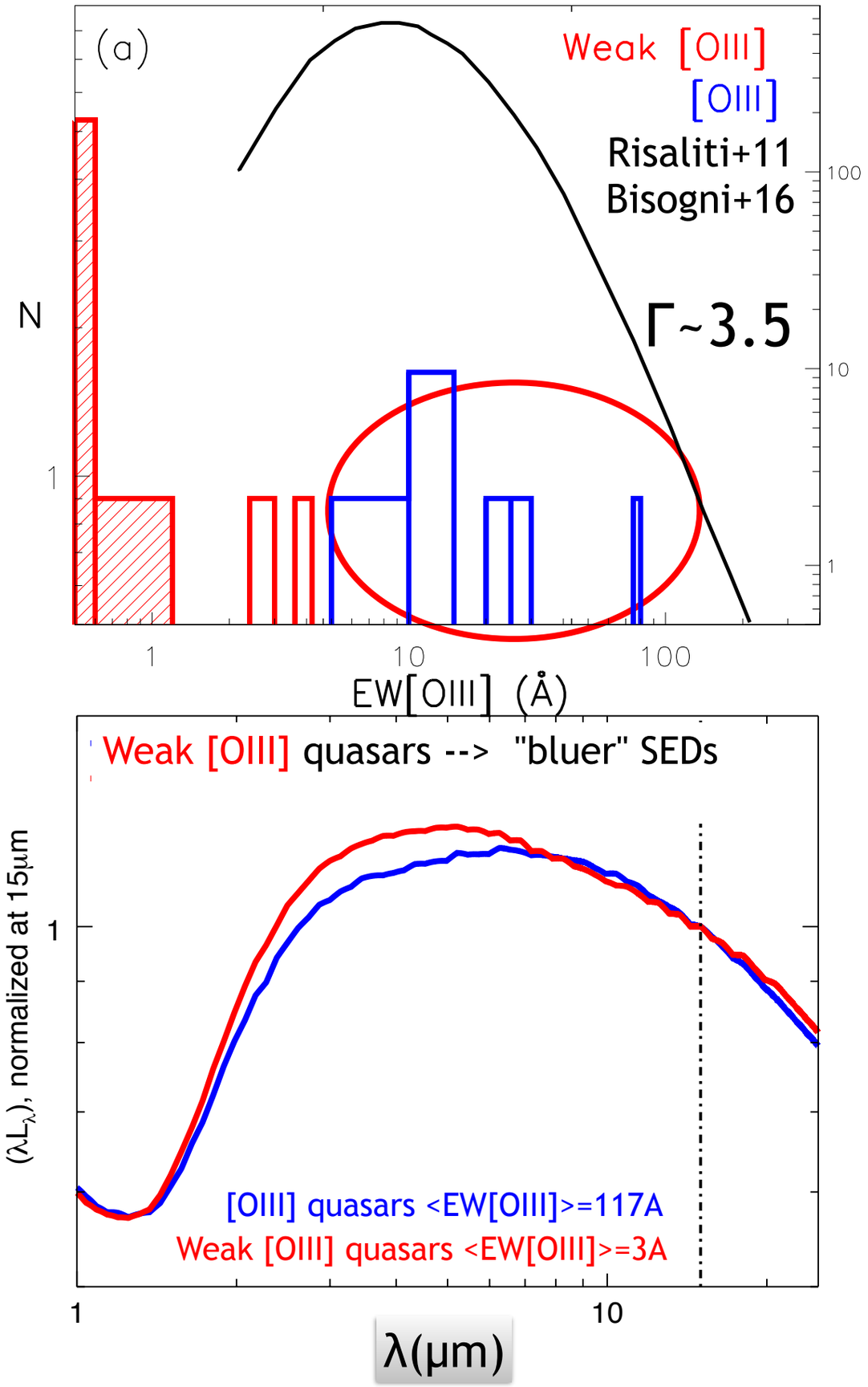
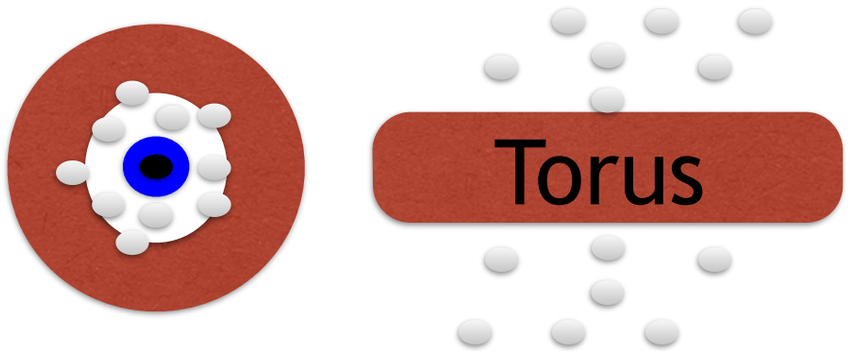



EW[OIII],obs = EW[OIII]/cosθ

WISSH: θ~30-70°




Weak [OIII] sample intrinsic distribution
[OIII] sample high inclination
(partial view of the inner, hotter dust?)

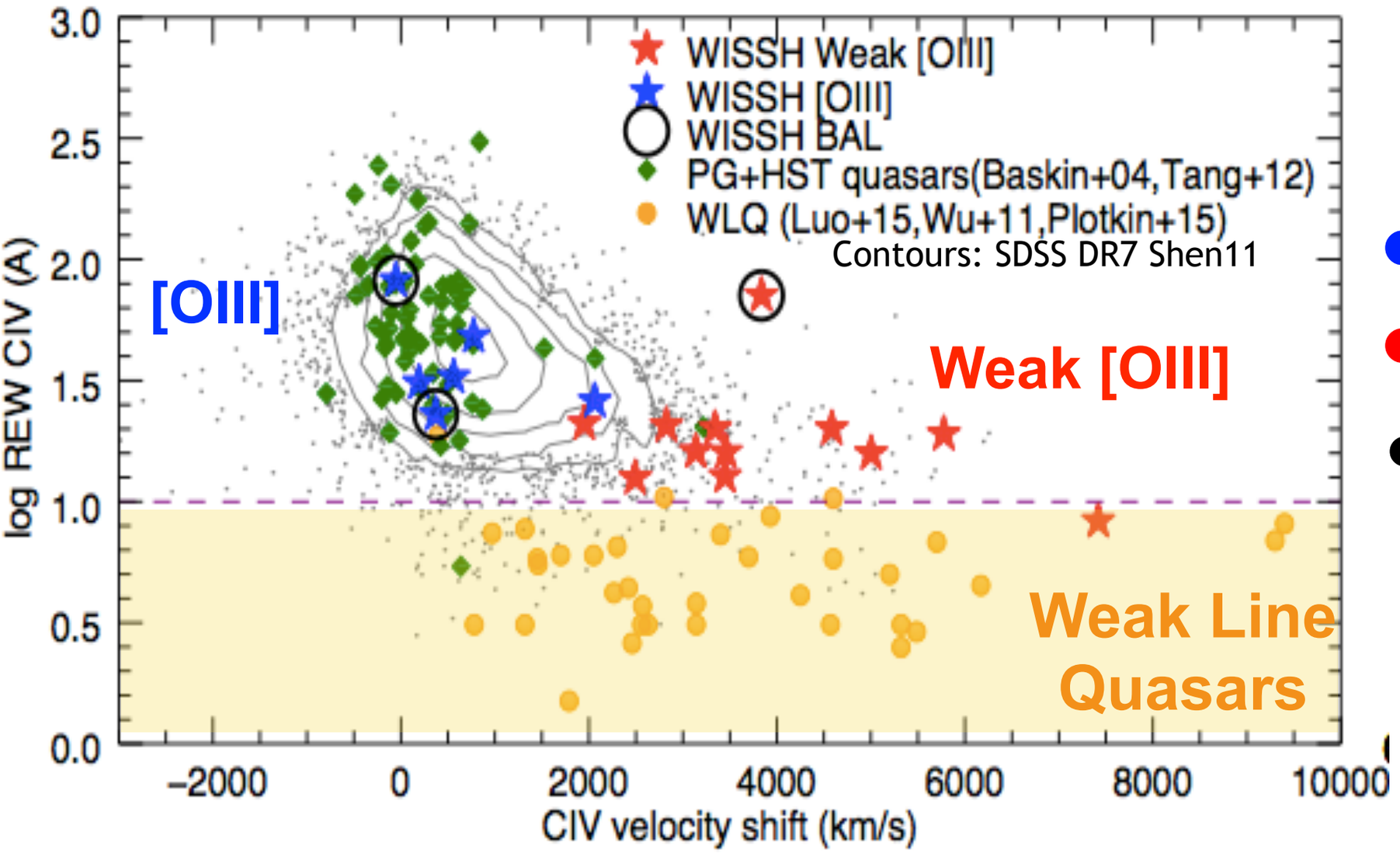
(Susanna Bisogni Poster)

# (III) BLR WINDS VIA CIV EMISSION LINE

## BLR winds traced by CIV(SDSS)-Hbeta(LBT) velocity shift

Corbin & Boroson 1996
Richards et al. 2002a

Gaskell 1982
Marziani+1996
Richards+2011



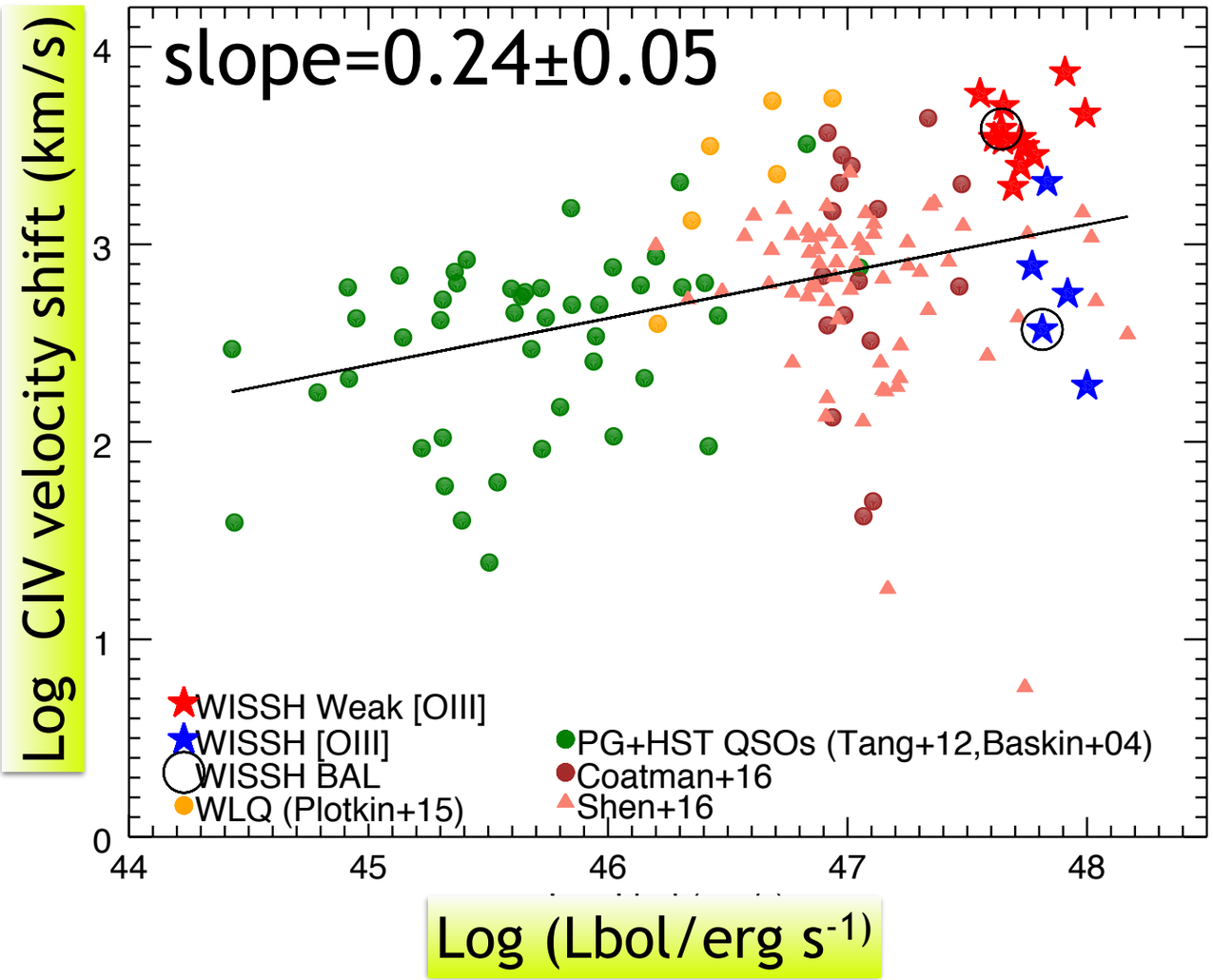

- Weak CIV shift
- Strong CIV shift
- Shifts comparable with Weak Line Quasars

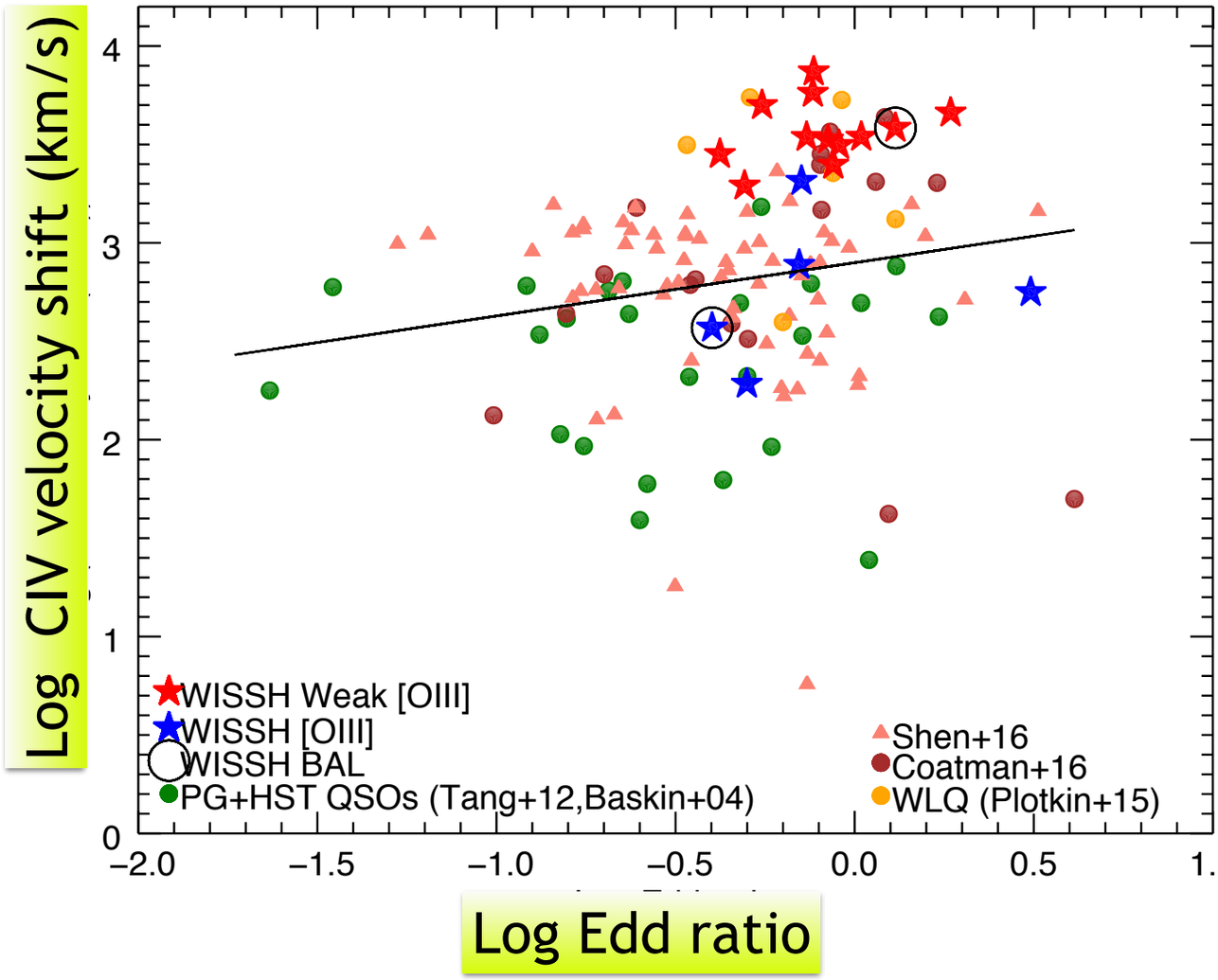
**WISSH QSOs also very effective in collecting the strongest CIV winds**

**(Vietri et al. in prep)**

# What is the Driver of BLR winds?

Sample of 183 QSOs with Hbeta SMBH mass




**As expected for radiatively driven winds**

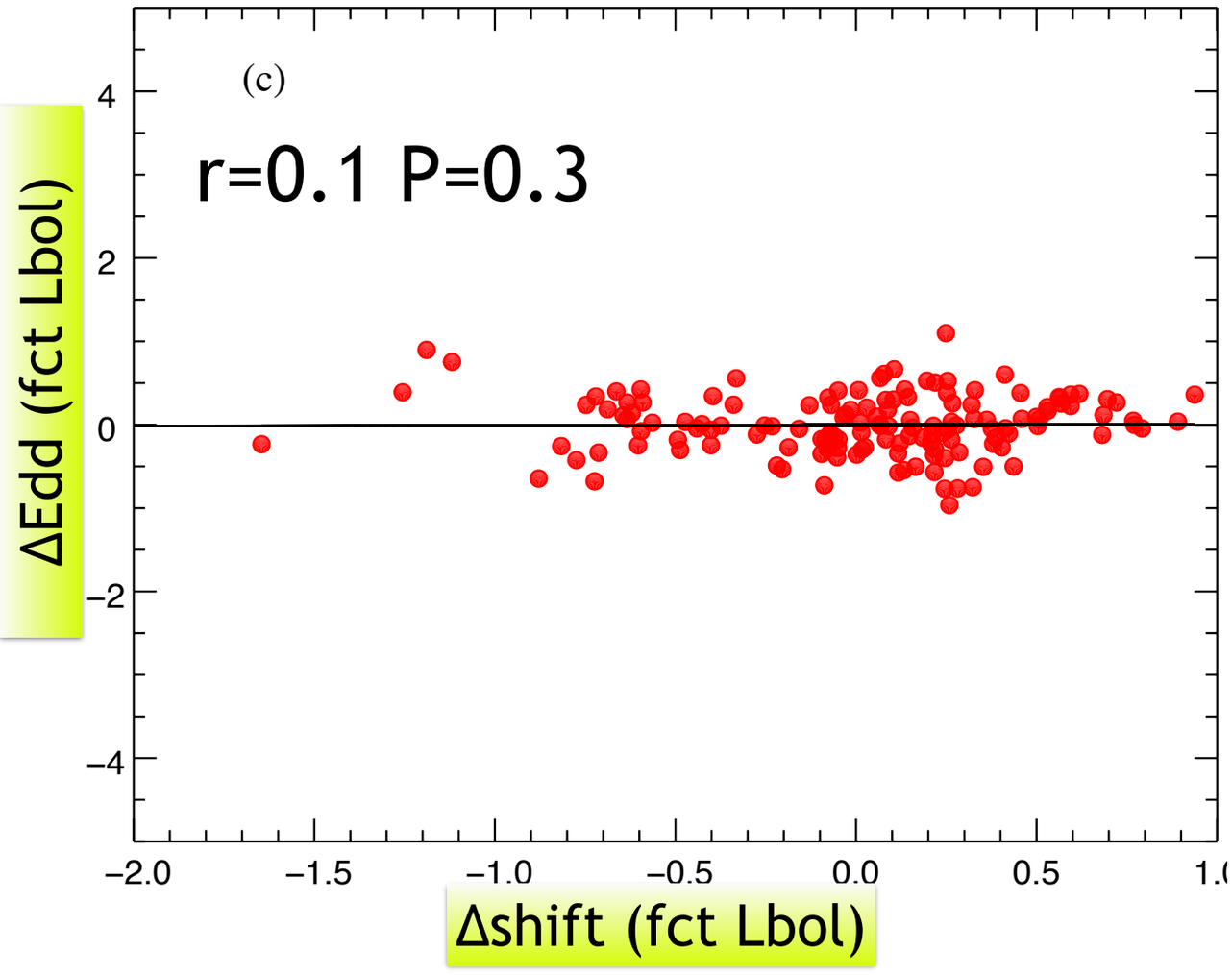
**Log Vout $\propto$ 0.25 Log $L_{Bol}$**

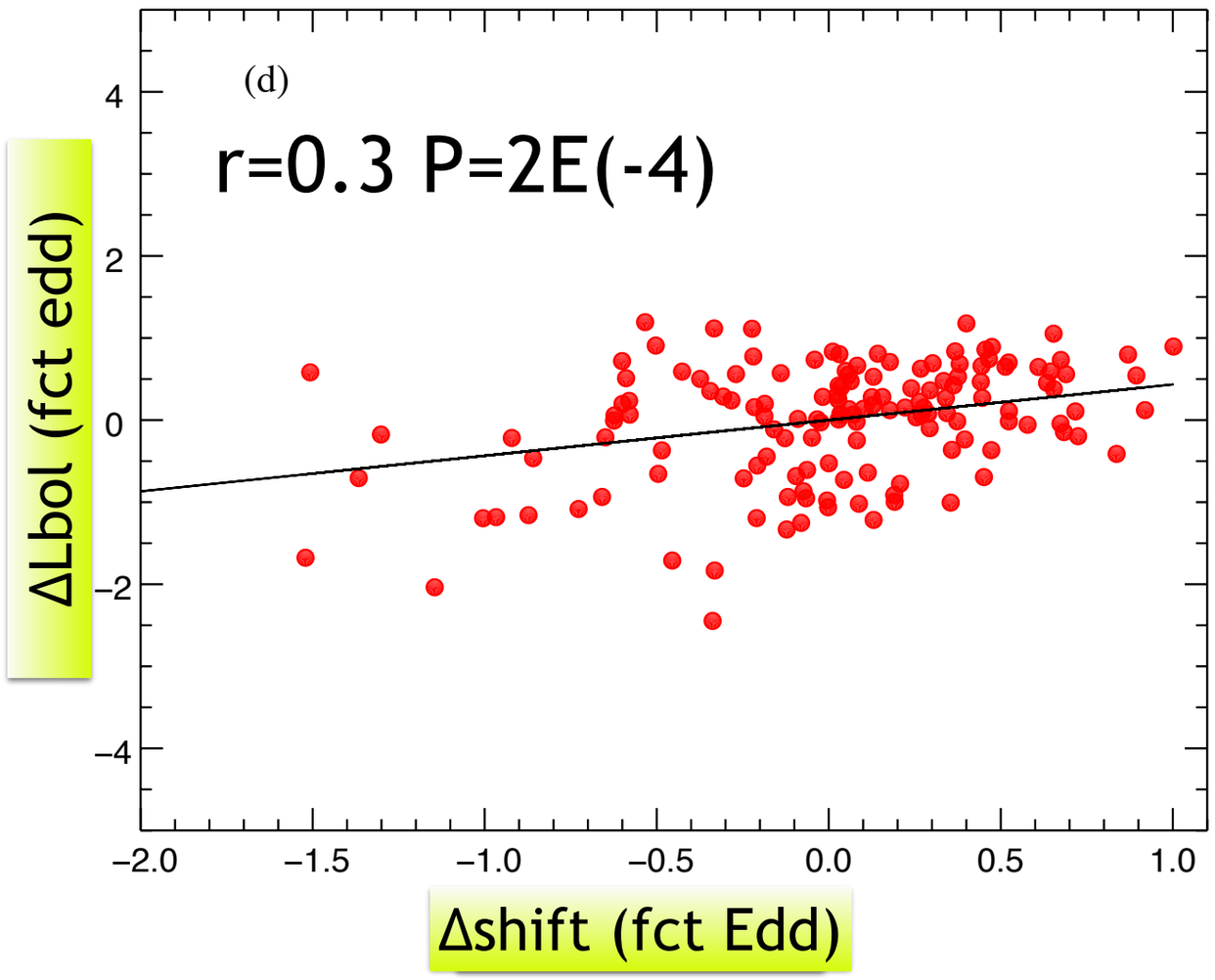
(Vietri et al. in prep)

# What is the Driver of BLR winds?

Correlations between residuals:

Hypothesis → Fundamental correlation with Lbol




**As expected for radiatively driven winds**

**Log Vout ∝0.25 Log $L_{BOL}$**

(Vietri et al. in prep)

# CONCLUSIONS

WISSH: Revealing widespread presence of outflows in the most luminous quasars

## (I) ULTRAMASSIVE (UP TO $2 \times 10^{10}$ M$\odot$) – HIGHLY ACCRETING SMBH AT Z~3

## (II) POWERFUL MASSIVE KPC SCALE IONIZED WINDS

- SINFONI IFU spectrocopy follow-up is on-going

## (III) HIGH-VELOCITY (3000-8000 KM/S) BLR WINDS

- Lbol as primary driven of BLR winds

.....MANY WISSH PAPERS ARE FORTHCOMING

**STAY TUNED!!!!!**