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Authors	VIETRI, GIUSTINA, FIORE, Fabrizio, PICONCELLI, Enrico, BONGIORNO, ANGELA, Bischetti, M., Duras, F., Martocchia, S., Travascio, A., ZAPPACOSTA, Luca, Brusa, M., Vignali, C., Marconi, Alessandro, CRESCI, GIOVANNI
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SAPIENZA
UNIVERSITÀ DI ROMA

THE WISSH QUASARS PROJECT: BLR VS GALAXY SCALE WINDS

GIUSTINA VIETRI
INAF-OAR University of Rome “La Sapienza”

The WISSH quasars project

F.Fiore, E.Piconcelli, A. Bongiorno, M. Bischetti, F. Duras, S. Martocchia, A. Travascio, L. Zappacosta INAF OAR
M. Brusa, C. Vignali UNIBO - INAF OABO
A. Marconi, G. Cresci INAF Arcetri
... and many others

THE WISSH QUASARS SURVEY

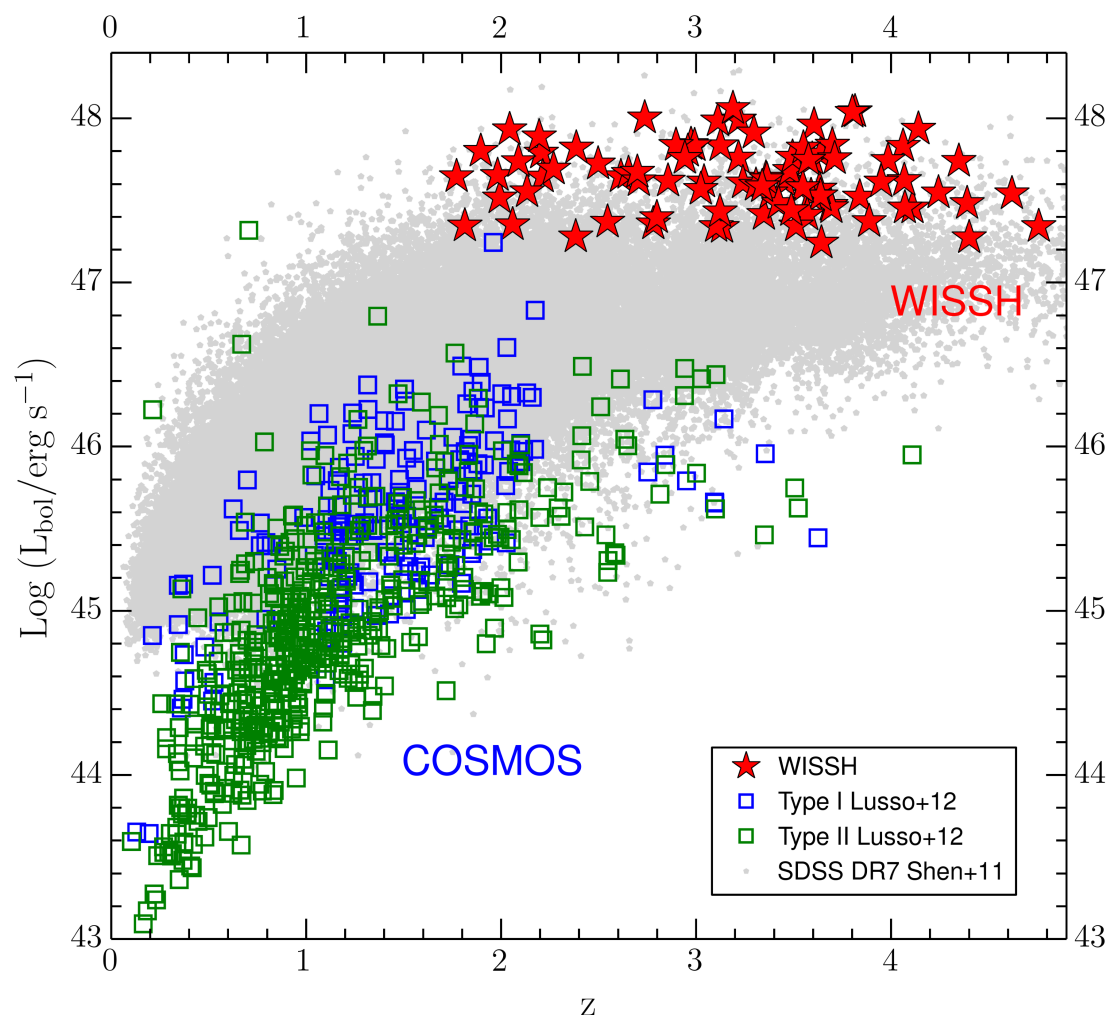
Goal: Observing AGN feedback at its best

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 $L_{\text{Bol}} > 2 \times 10^{47} \text{ erg s}^{-1}$



Extensive multi- λ observing program

Panchromatic view of
Hyper-Lum QSOs

XMM & Chandra X-rays

X-shooter $H\beta$ + CIV + MgII

SINFONI IFU Spec $H\beta$ + [OIII] + $H\alpha$

LBT/LUCI – TNG $H\beta$ + [OIII]

ALMA CO + CII + FIR continuum

+ Herschel – WISE – 2MASS – SDSS public data

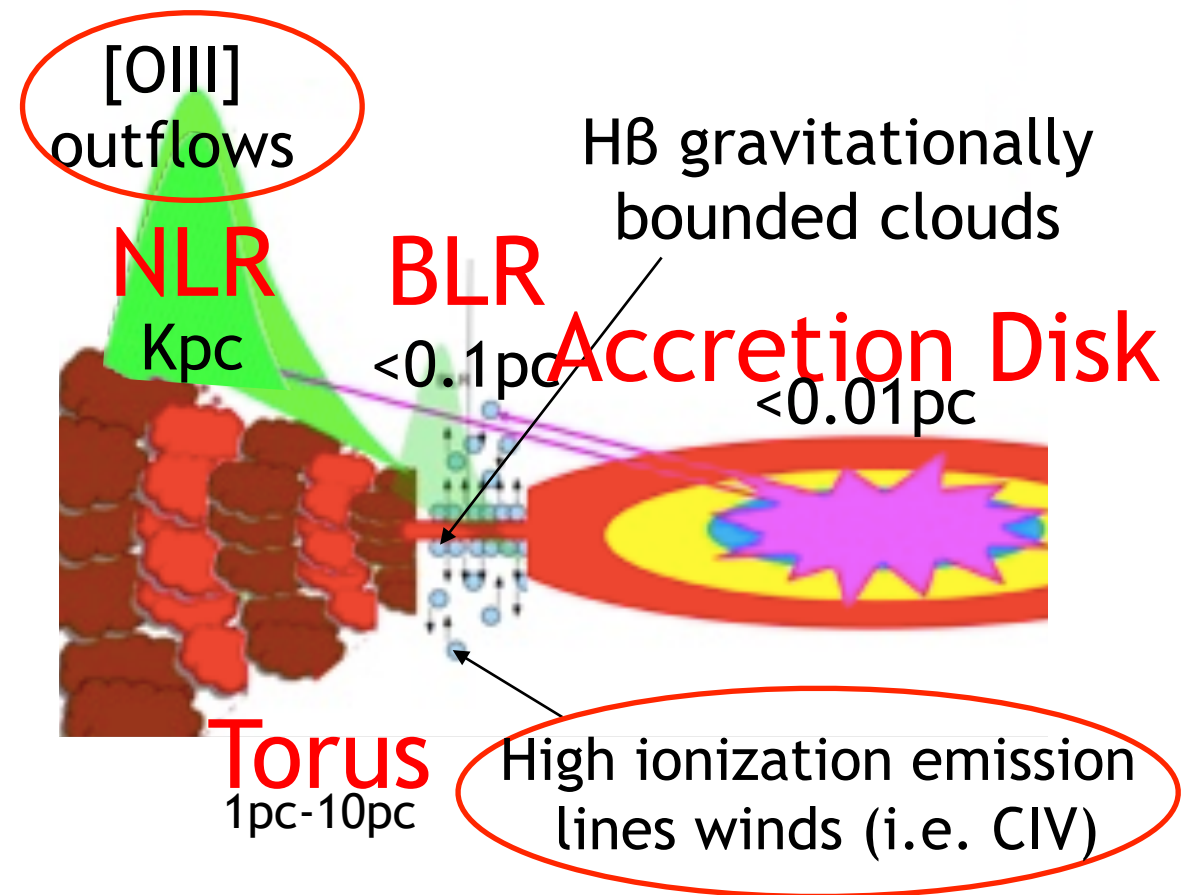
TARGETING WISSH QUASARS

This talk:

Systematic study of
nuclear and galaxy scale winds
in luminous quasars

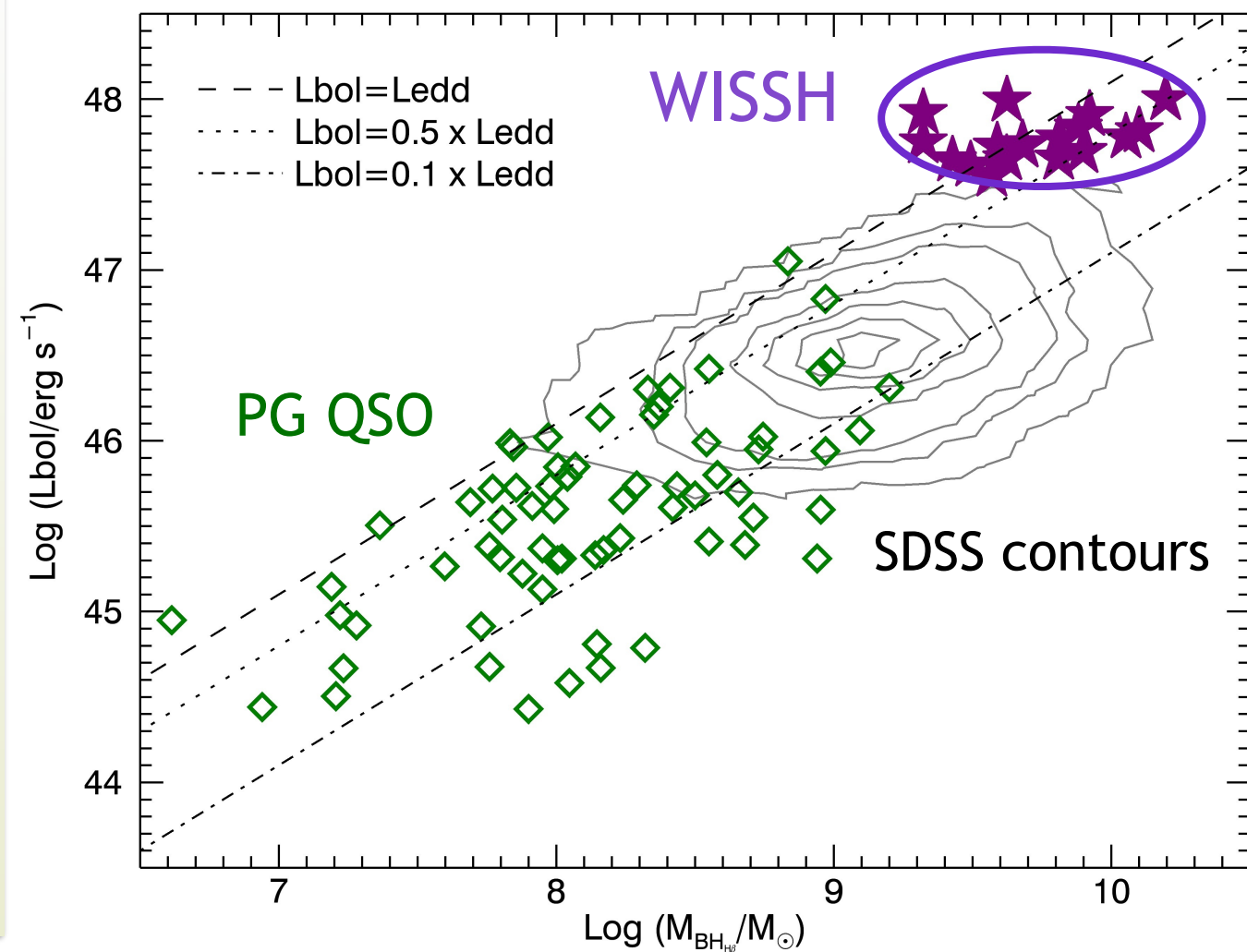
NIR spectroscopy-Optical rest-frame

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



(I) SMBH MASS FROM $H\beta$ EMISSION LINE

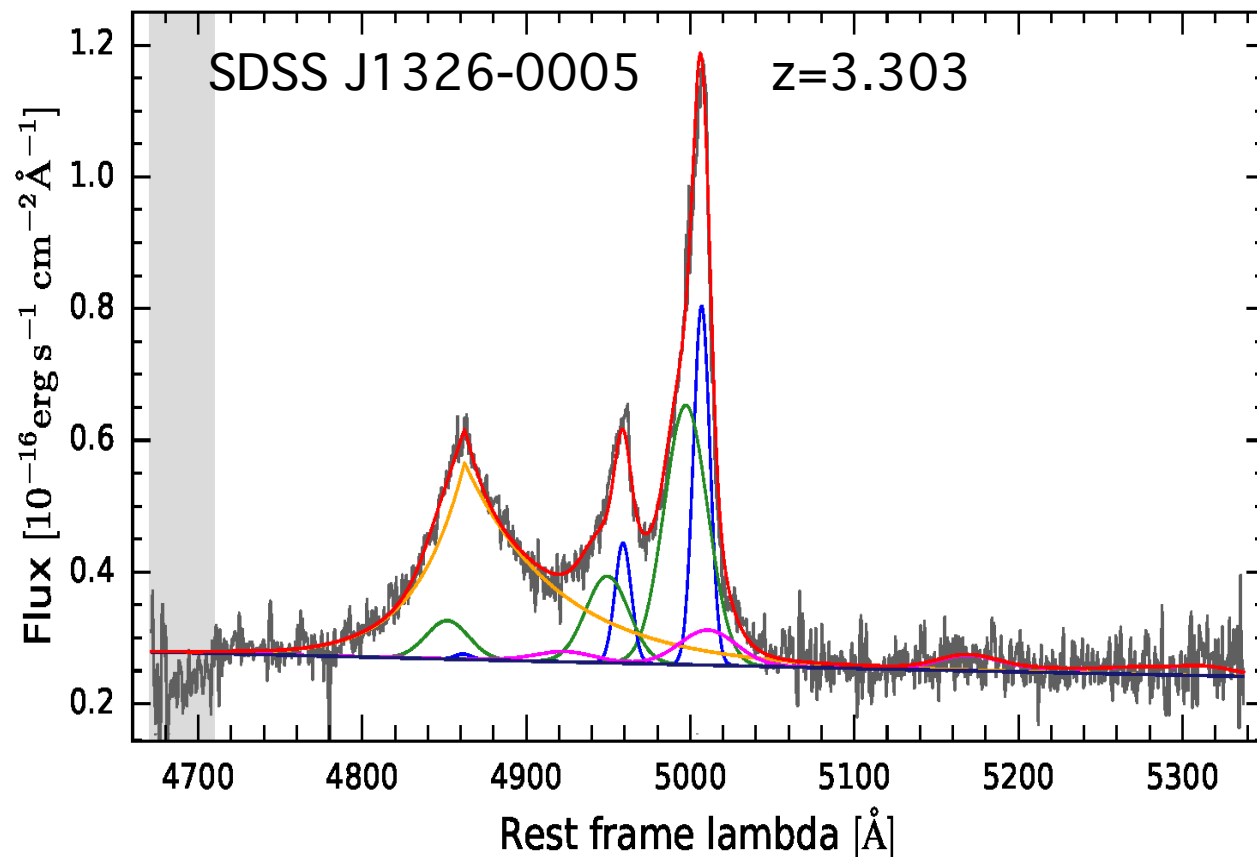
- LBol from multi-component broad-band (MID-IR to UV) SED fitting (Duras et al. in prep)
- FWHM($H\beta$) 3,000-8,000 km/s
- $H\beta$ -based SMBH masses
from $\sim 2 \times 10^9 M_\odot$
up to $\sim 2 \times 10^{10} M_\odot$
- High accretion rates $0.4 < \lambda Edd < 3$



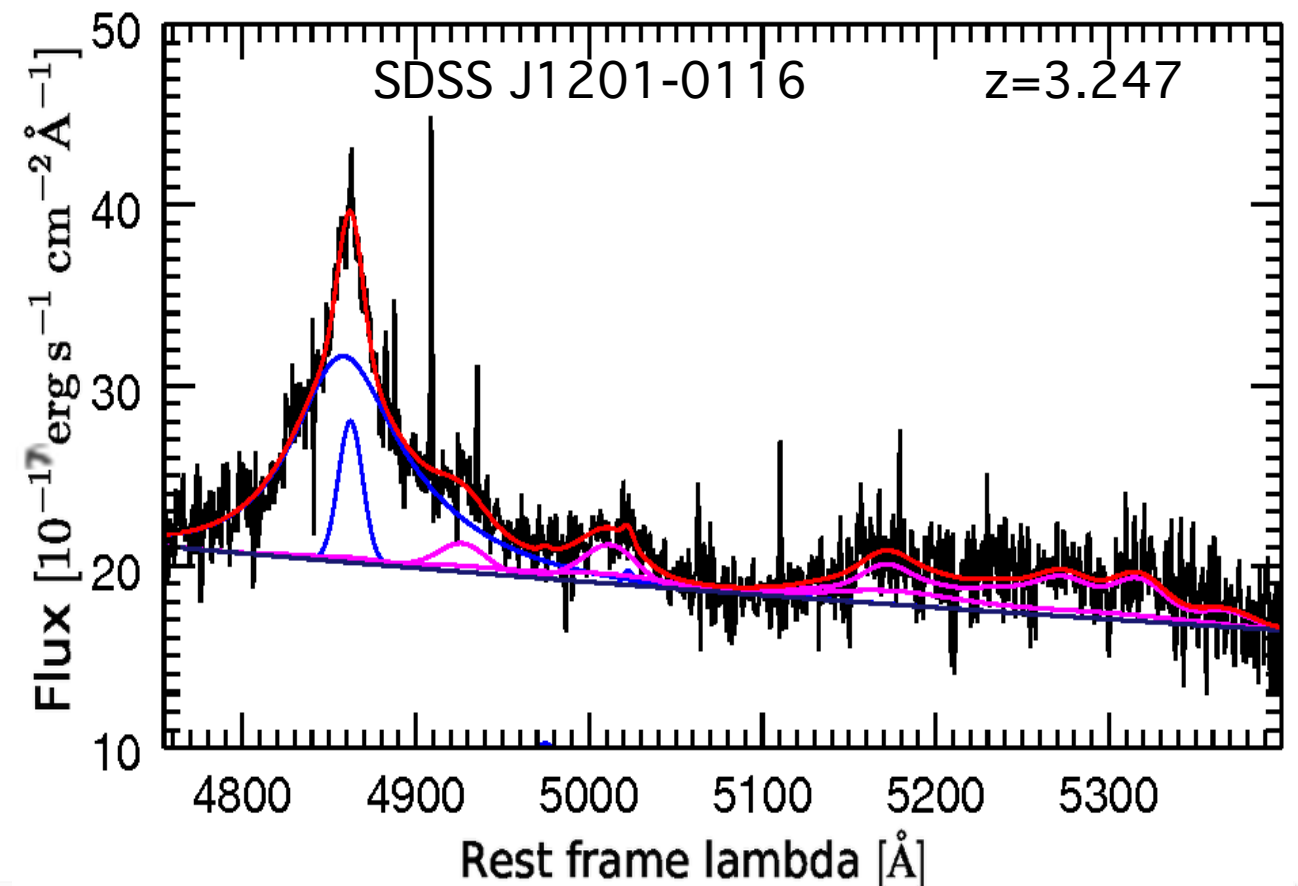
Opportunity of **collecting high-mass, highly accreting SMBHs** at the peak of the quasar number density

NIR SPECTRA OF THE WISSH QUASARS

30% prominent broad [OIII] emission

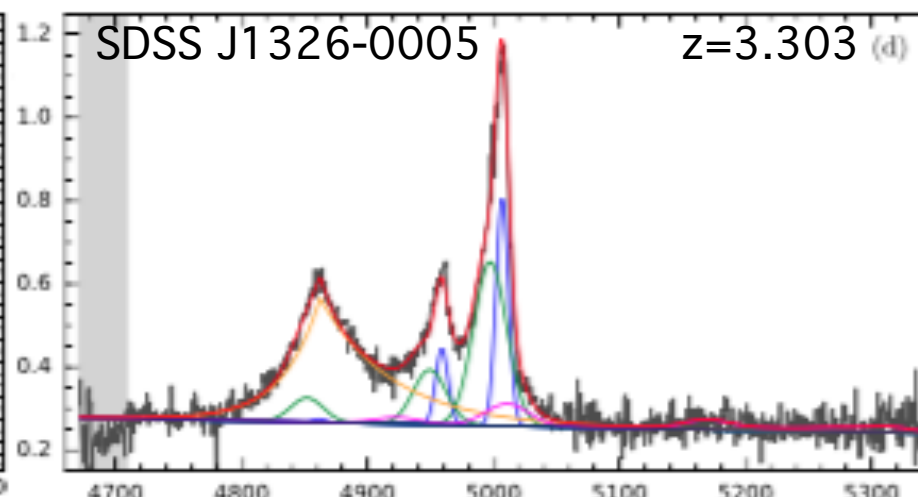
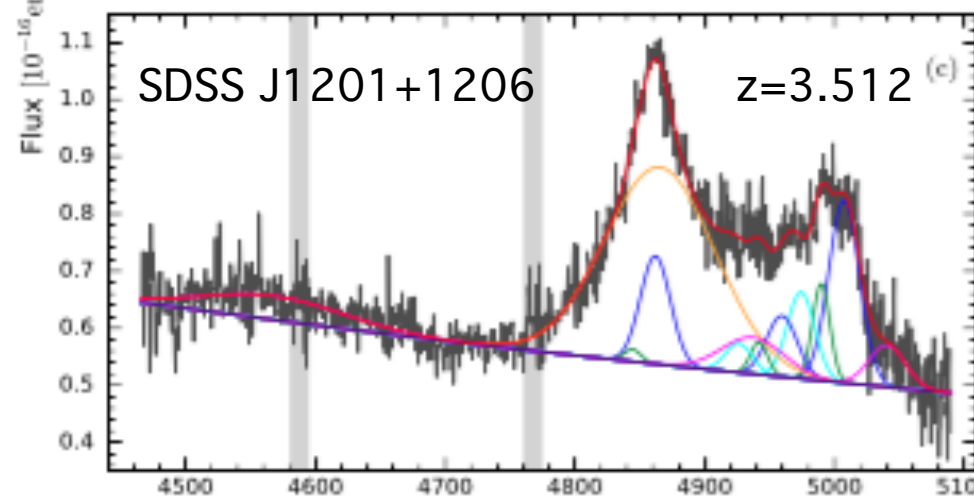
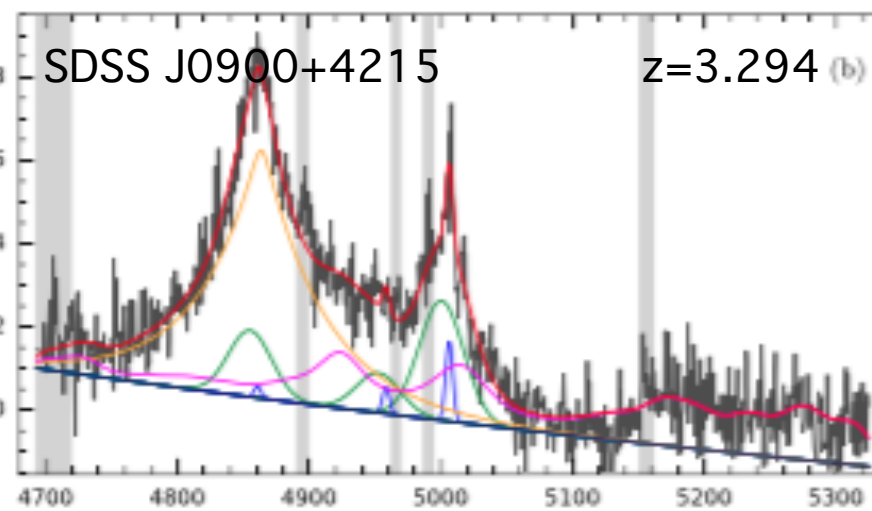
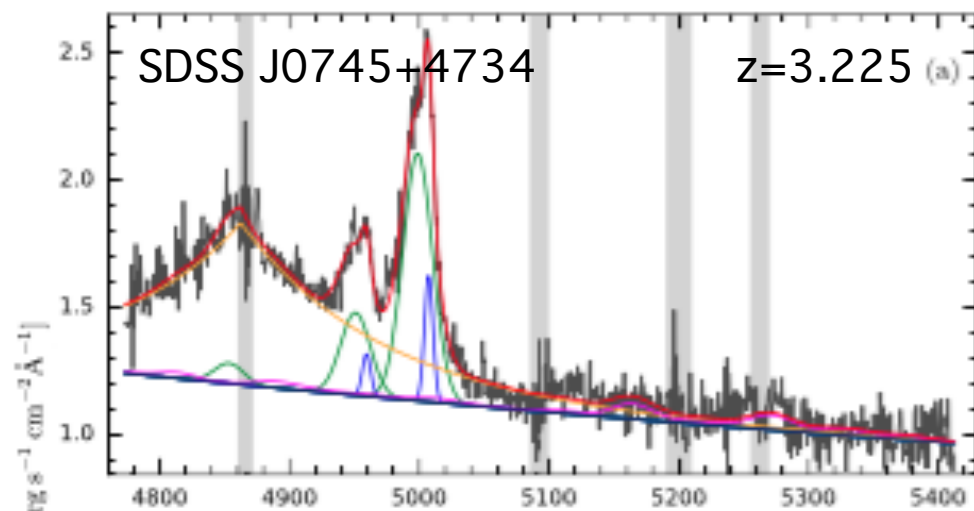


70% weak/lack [OIII] emission

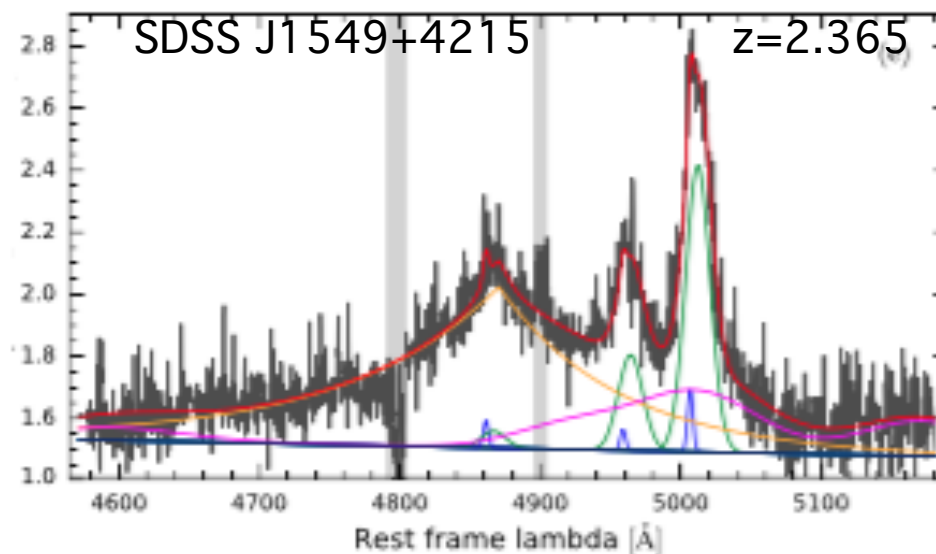


- Very complex spectra
- Narrow [OIII] emission weak or absent in all of them
- If present, [OIII] shows broad blue-shifted profiles (in 6/18 quasars) indicative of outflows
- Strong, complex FeII emission

(II) NLR WINDS VIA [OIII] EMISSION LINE



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



Very broad blue-shifted [OIII] lines

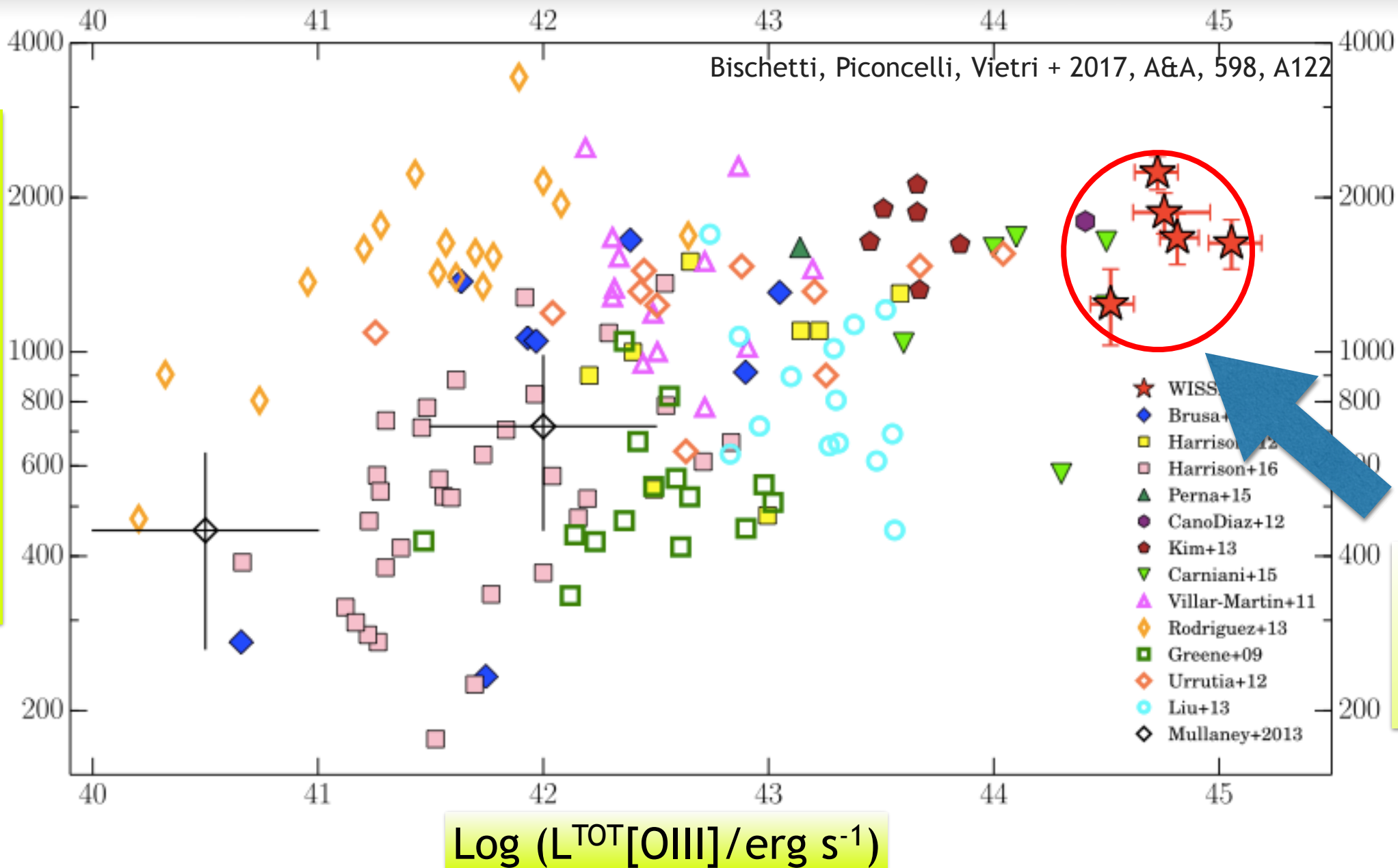
$FWHM_{[OIII]} \sim 1200 - 2200 \text{ km s}^{-1}$

$v(\text{max}) \sim 1400 - 3000 \text{ km s}^{-1}$

(II) NLR WINDS VIA [OIII] EMISSION LINE

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

Broad [OIII] FWHM [km/s]



$$L_{[\text{OIII}]}^{\text{broad}} \rightarrow \dot{M}_{\text{ion}}$$

$$\dot{M} \sim \frac{3 \dot{M}_{\text{ion}} v_{\text{max}}}{R}$$

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

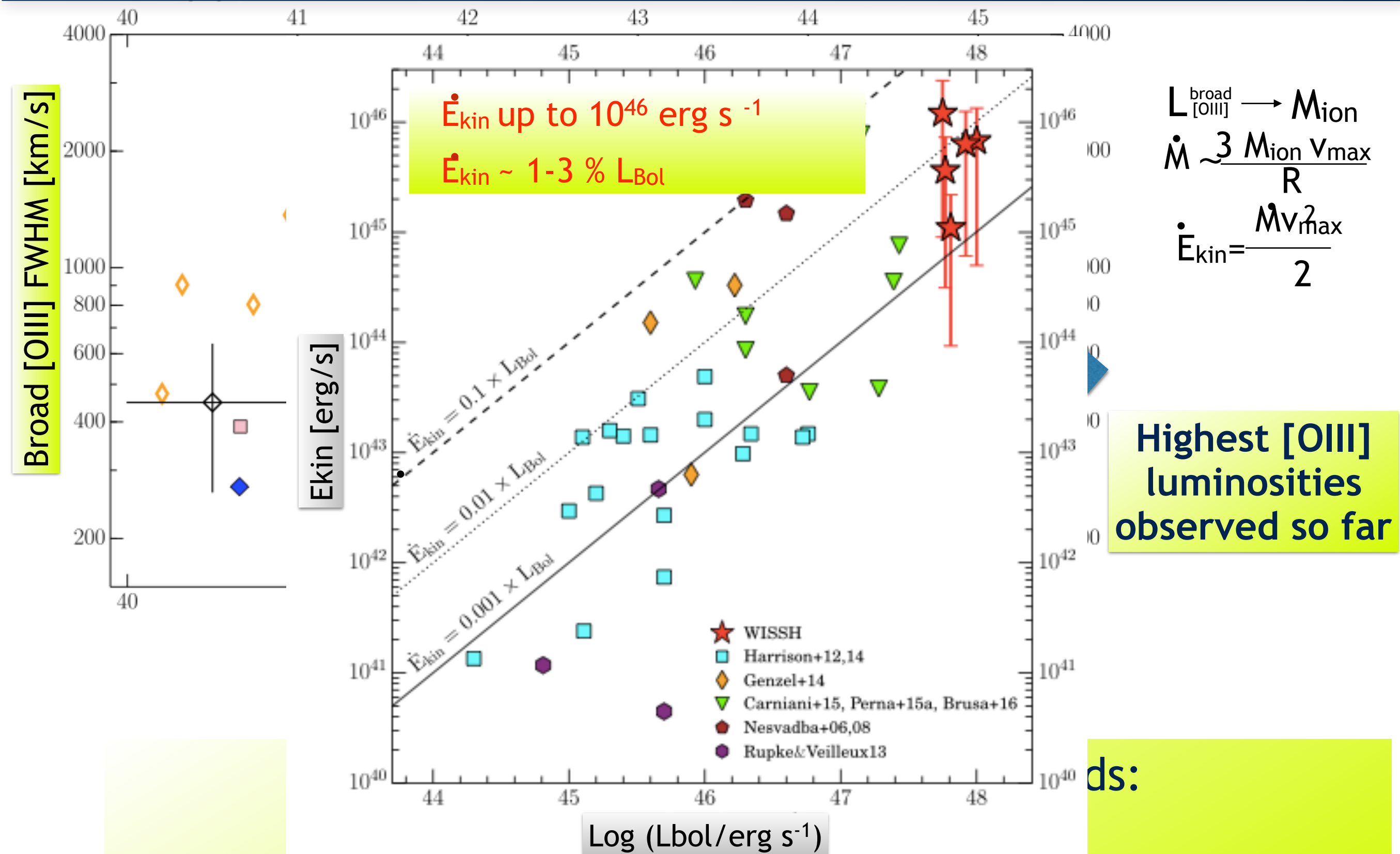
Highest [OIII]
luminosities
observed so far

Powerful kpc-scale ionized winds:

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

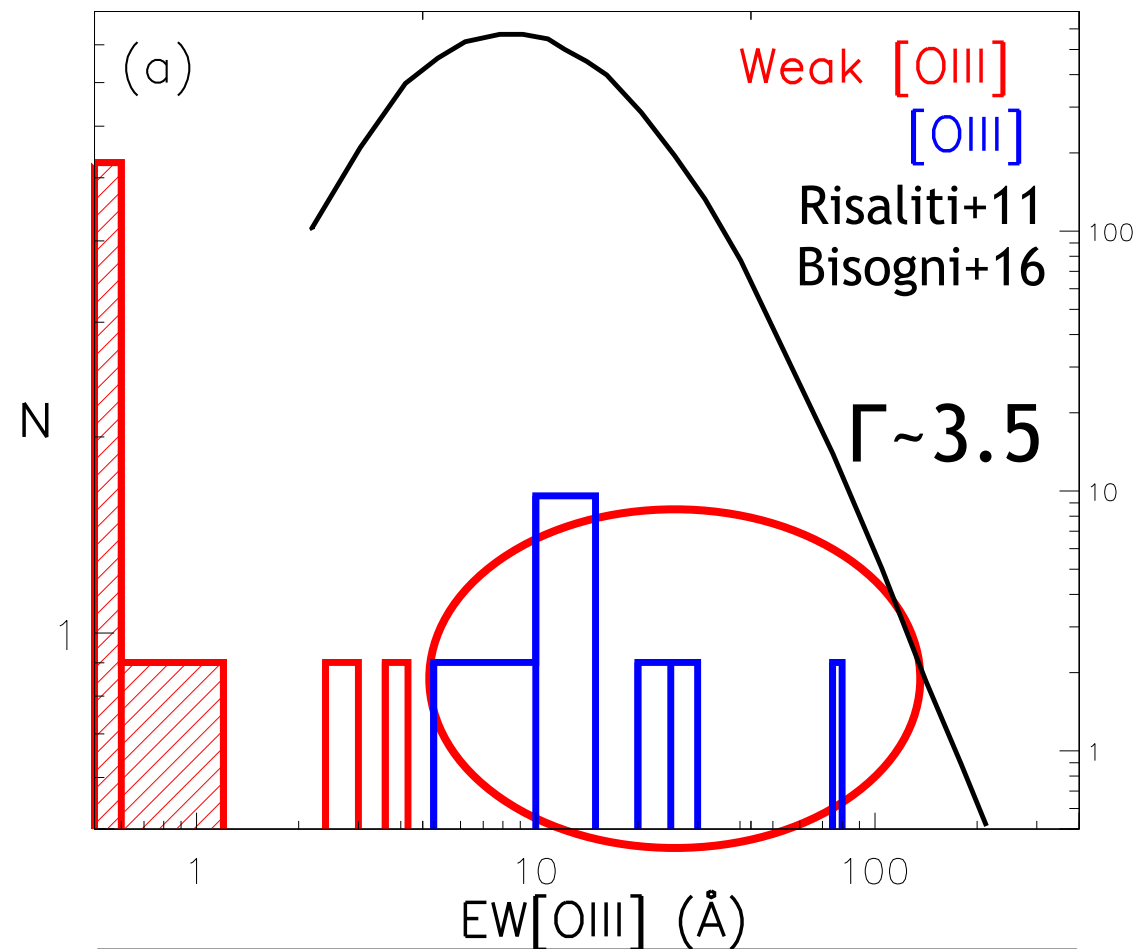
$\dot{E}_{\text{kin}}$ up to $10^{46} \text{ erg s}^{-1}$

(II) NLR WINDS VIA [OIII] EMISSION LINE



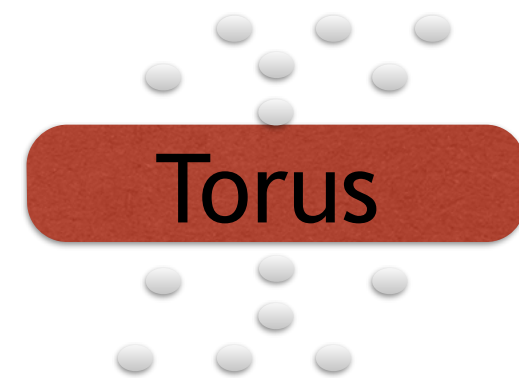
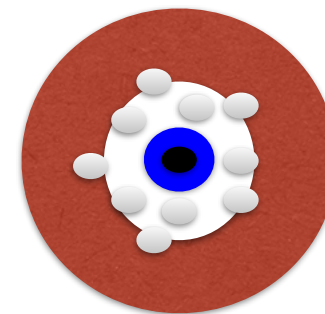
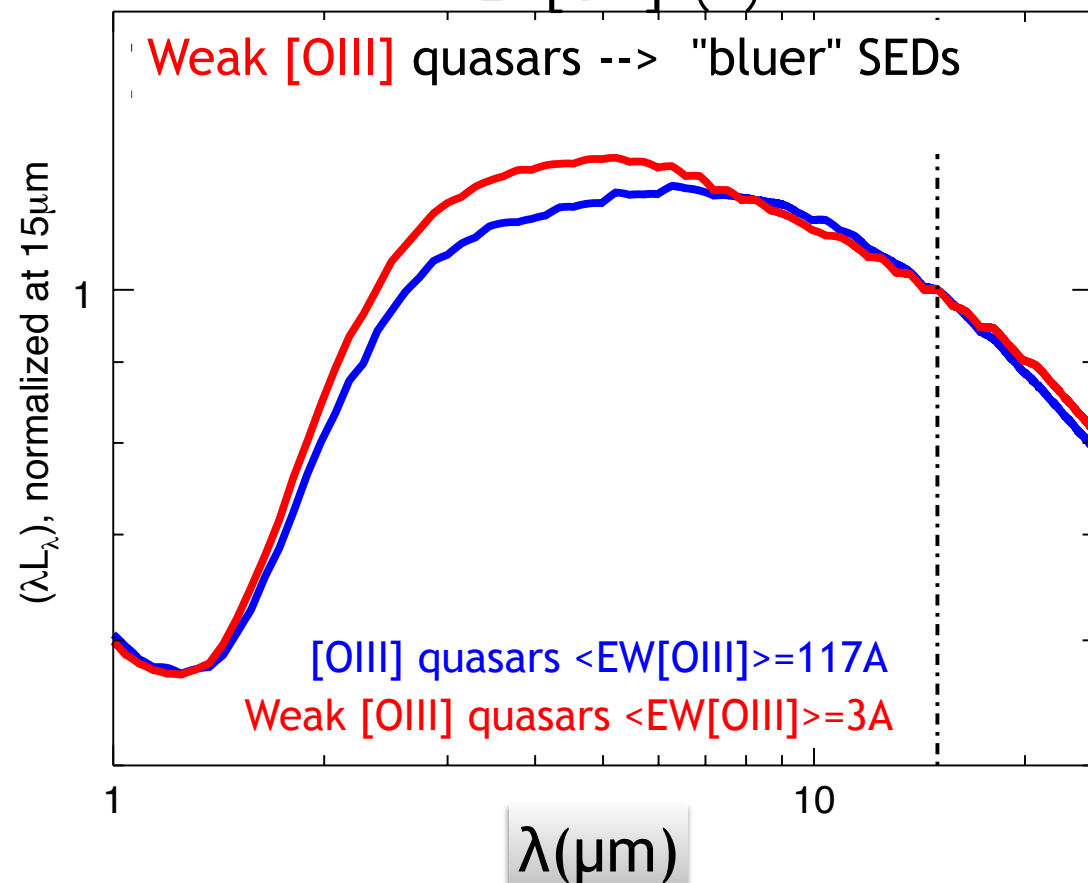
E_{kin} up to 10⁴⁶ erg s⁻¹

(II) NLR WINDS VIA [OIII] EMISSION LINE



$$EW[OIII]_{\text{obs}} = EW[OIII] / \cos\theta$$

WISSH: $\theta \sim 30-70^\circ$



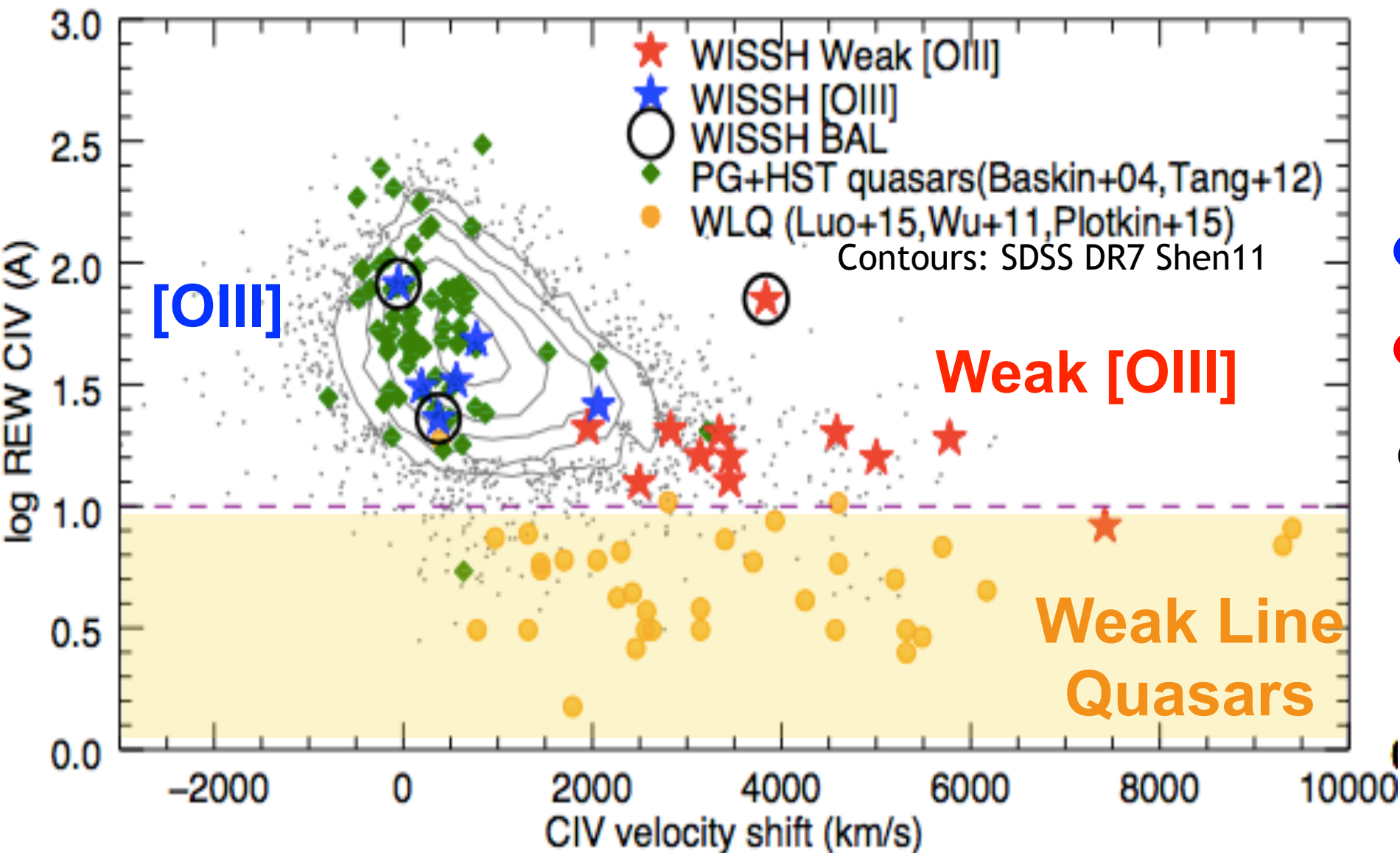
Weak [OIII] sample intrinsic distribution
[OIII] sample high inclination
(partial view of the inner, hotter dust?)

(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



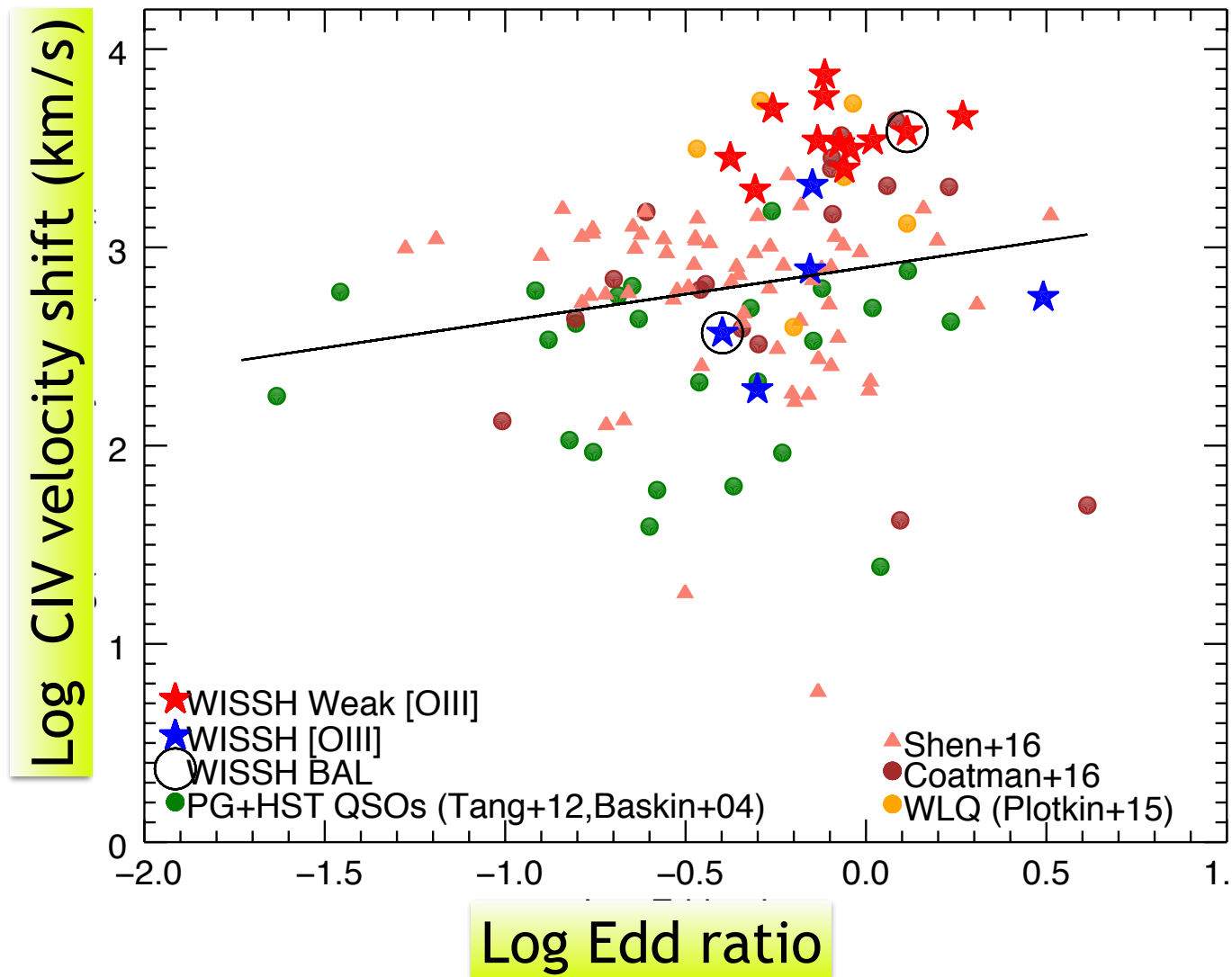
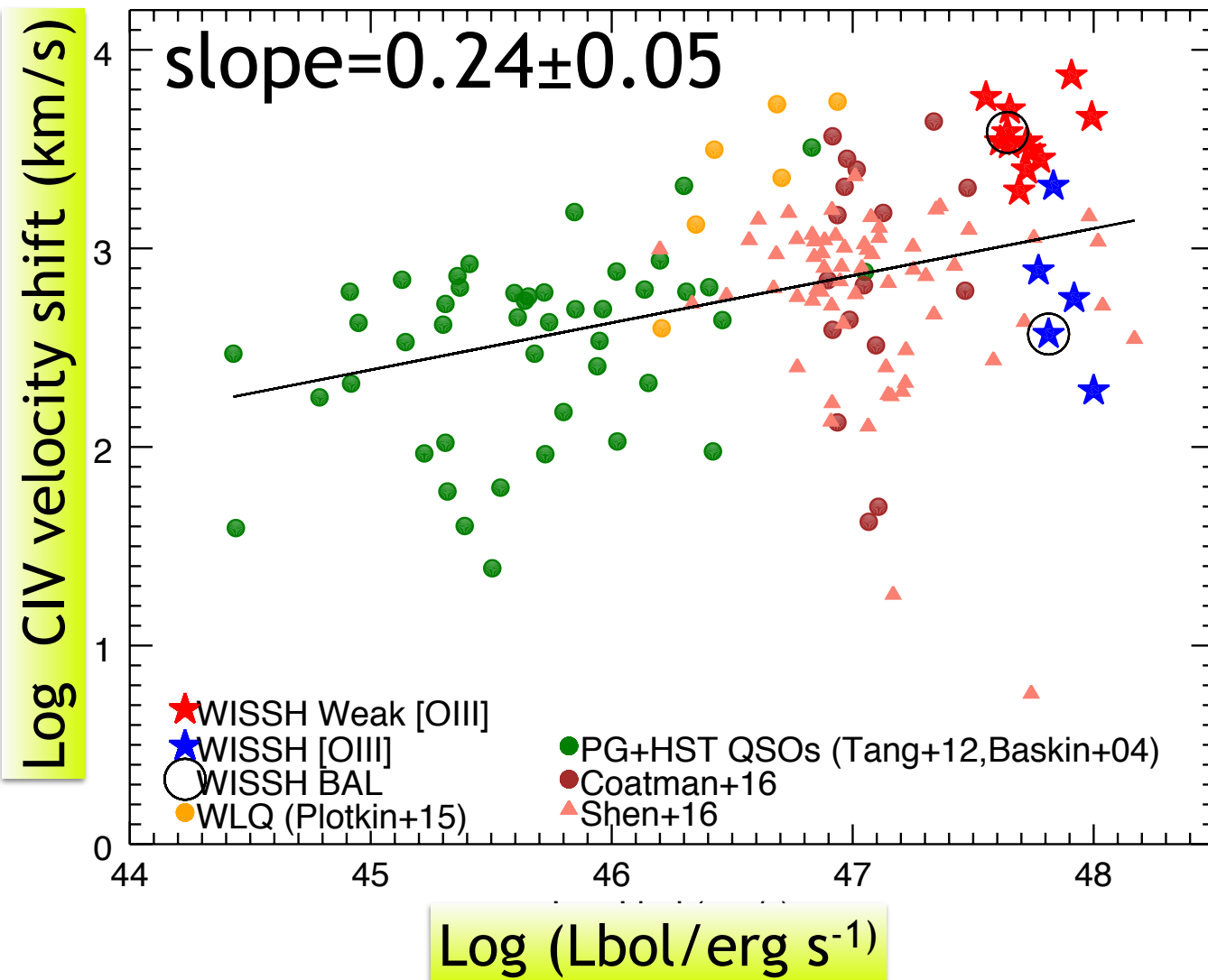
- Weak CIV shift
- Strong CIV shift
- Shifts comparable with Weak Line Quasars

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

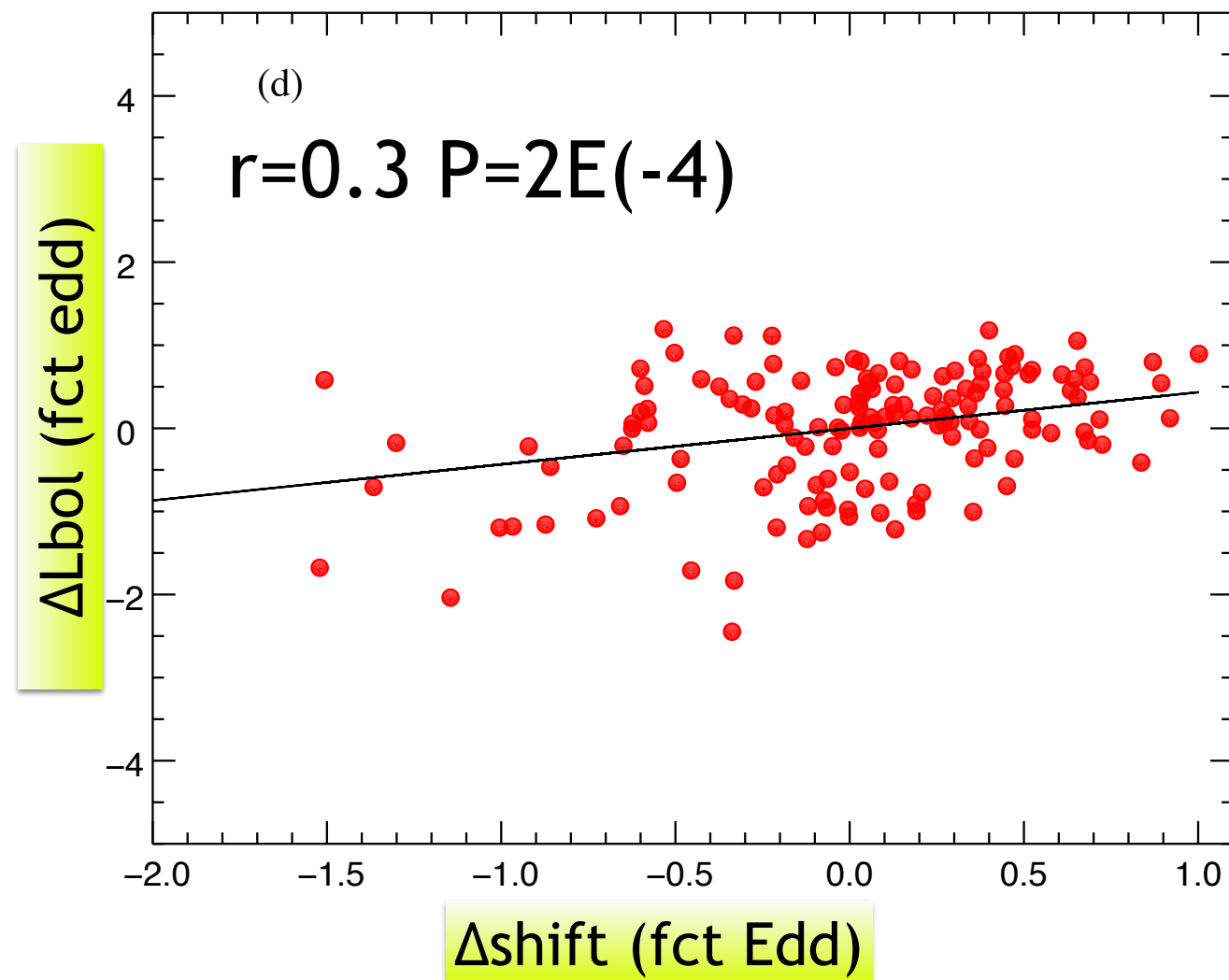
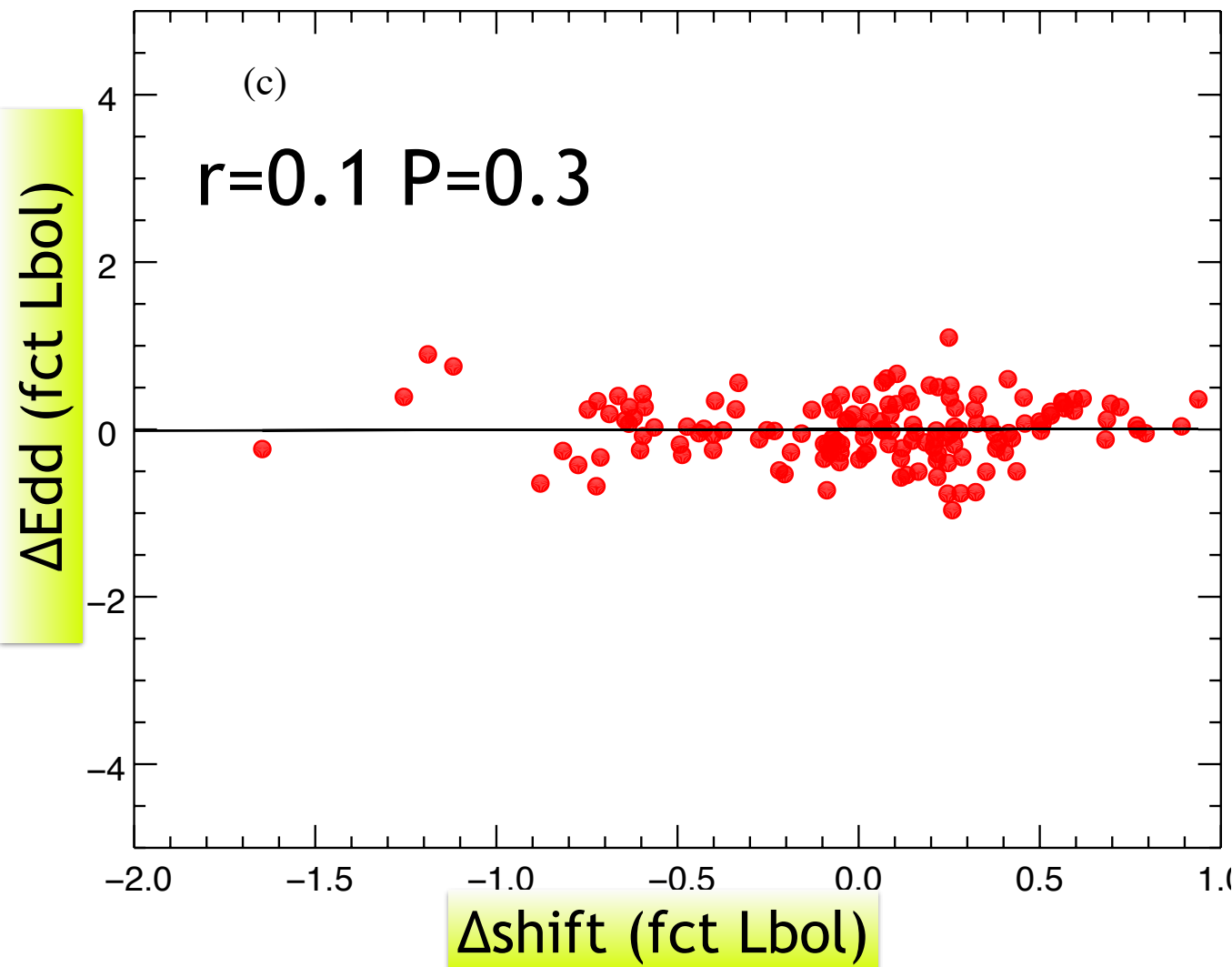
$$\text{Log } V_{\text{out}} \propto 0.25 \text{ Log } L_{\text{Bol}}$$

(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

$$\text{Log } V_{\text{out}} \propto 0.25 \text{ Log } L_{\text{Bol}}$$

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 $z \sim 3$

(II) POWERFUL MASSIVE KPC SCALE IONIZED WINDS

- **SINFONI** IFU spectroscopy follow-up is on-going

(III) HIGH-VELOCITY (3000–8000 km/s) BLR WINDS

- **L_{bol}** as primary driver of BLR winds

.....MANY WISSH PAPERS ARE FORTHCOMING
STAY TUNED!!!!