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| Publication Year | 2016 |
| Acceptance in OA @INAF | 2020-10-19T10:09:59Z |
| Title | The WISSH Quasars Project: Probing the AGN-Galaxy Coevolution In the Most Luminous Quasars |
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| DOI | 10.5281/zenodo.163588 |
| Handle | http://hdl.handle.net/20.500.12386/27885 |

The WISSH Quasars project: probing the AGN-galaxy coevolution in the most luminous quasars

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The *WISSH* quasars project

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... and many others

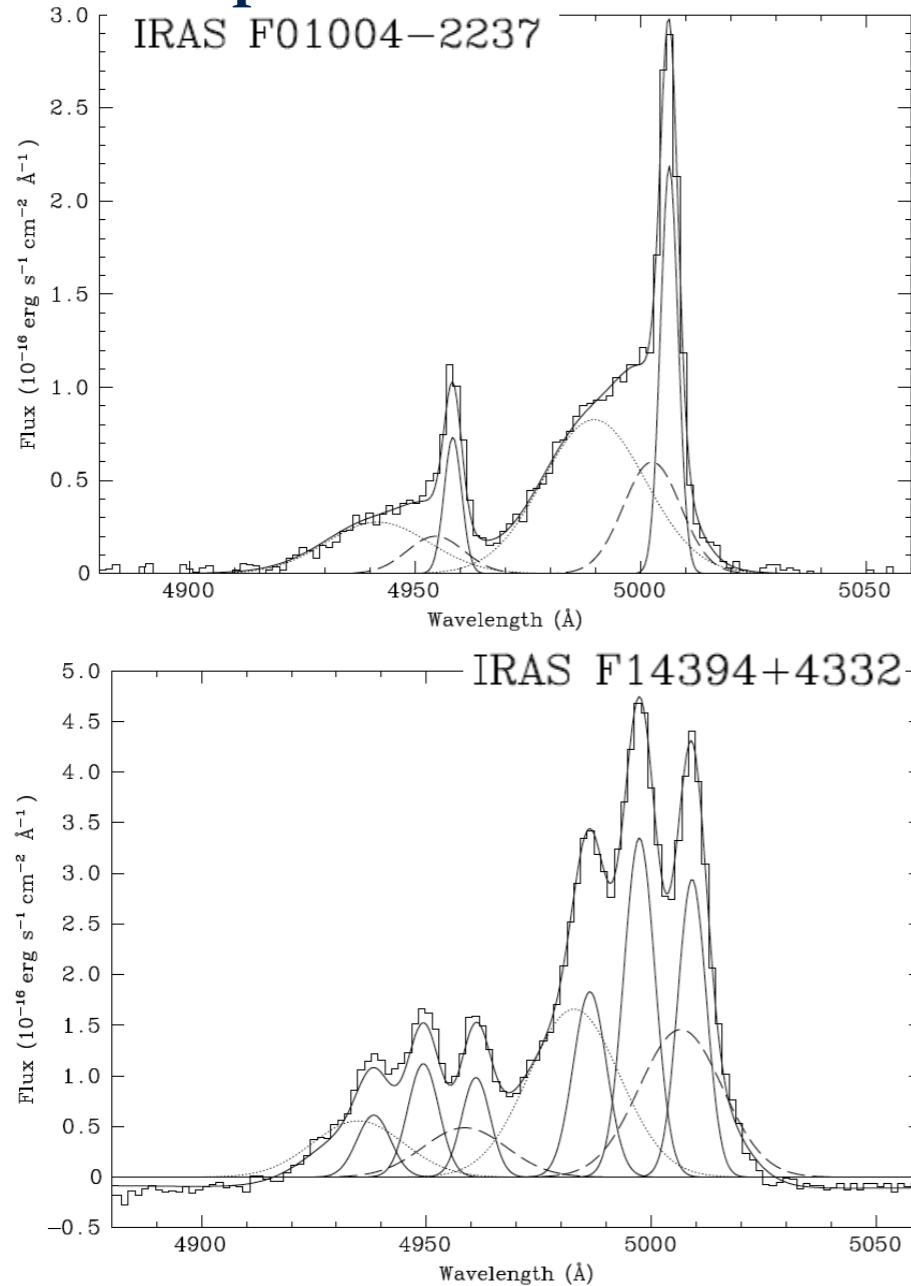


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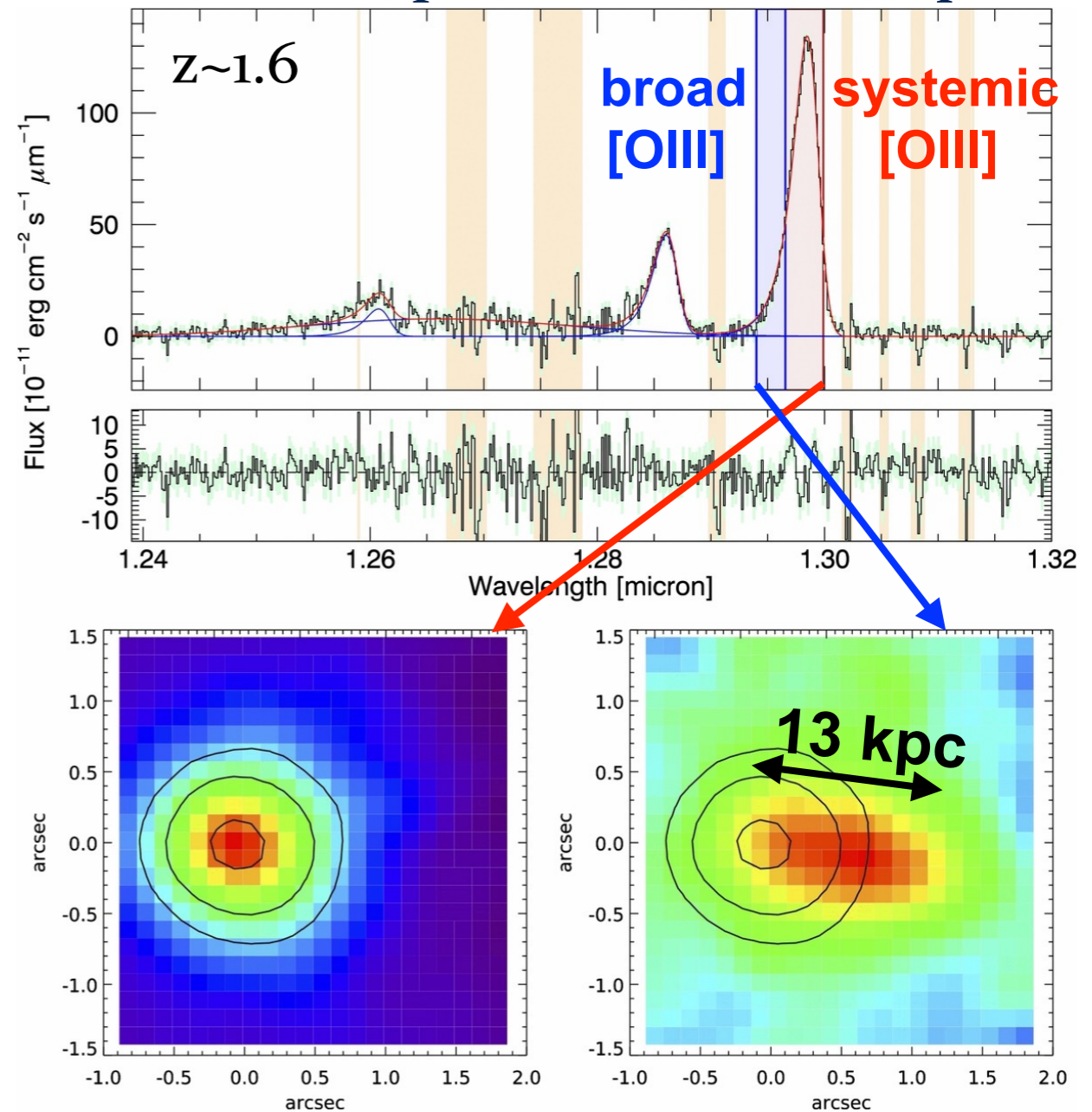
Collecting AGN-driven outflows: atomic ionised gas

Outflows historically revealed in the atomic ionised phase, from both absorption and emission (typically [OIII] with $v_{\text{out}} \sim 1000 - 2000 \text{ km/s}$) line features

WHT spectra of local ULIRGs



SINFONI IFU spectrum of XID2028 quasar



(Rodriguez-Zaurin+2013)

(Cresci+2015)

AGN-feedback models consider such galaxy wide outflows as responsible for the AGN-galaxy coevolution (e.g. King 2003, 05, 10)

At the brightest end of the AGN luminosity function

“Looking for AGN feedback in action: where to observe?”

Theory

e.g. Menci+08, Faucher-Giguère&Quataert 2012
Zubovas&King 2012

Observations

e.g. Ciccone+14, Feruglio+15



The more luminous
is the AGN, the higher is
the outflow
momentum rate
 $\dot{M}v \sim 20-50 L_{\text{Edd}}/c$

**The most luminous quasars are potentially the best targets
to hunt for powerful AGN-driven outflows**



WISSH Quasars sample
Primary targets to search for
AGN feedback at $z \sim 2 - 4$

LBT targeting of WISSH Quasars

This talk:

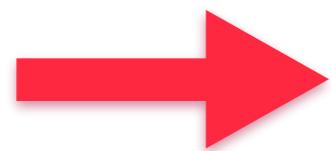
LBT/LUCI Spectroscopy

**to investigate [OIII] - H β spectral region
on 18 targets (21 more expected within 2017)**

Goal(s)

- **revealing ionised outflows
in hyperluminous quasars**
- **measuring SMBH mass and λ_{Edd}**

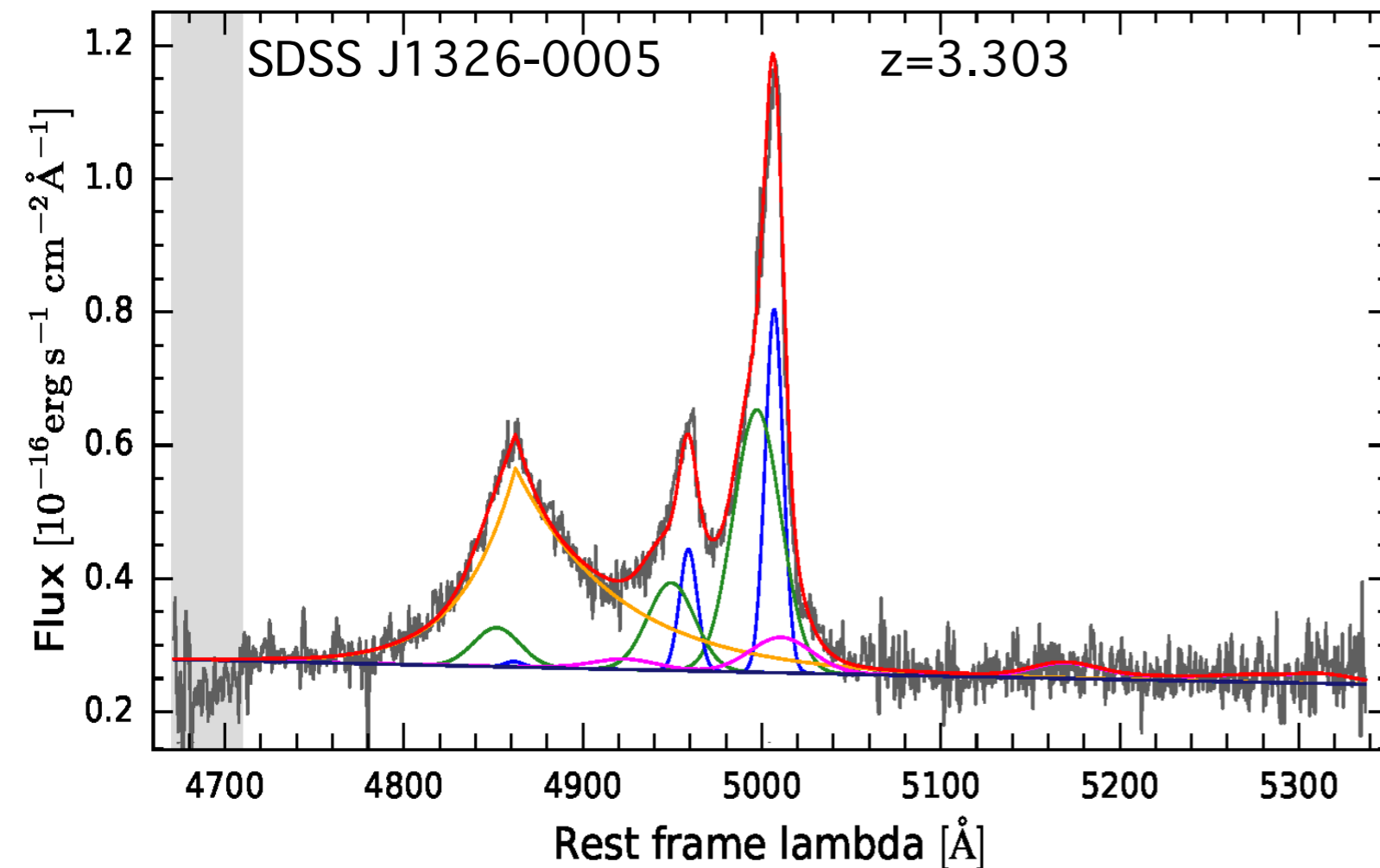
*... see talk by Giustina Vietri
on tomorrow*



Testing AGN feedback at its extreme

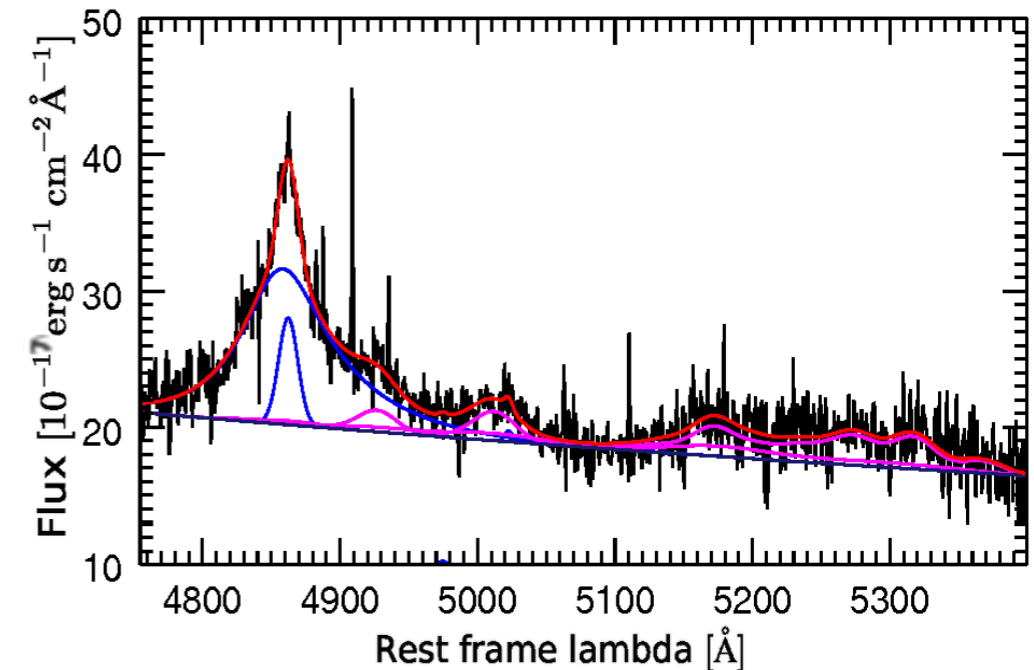
LBT view of WISSH Quasars

30% presence of [OIII] emission



... see Giustina's talk

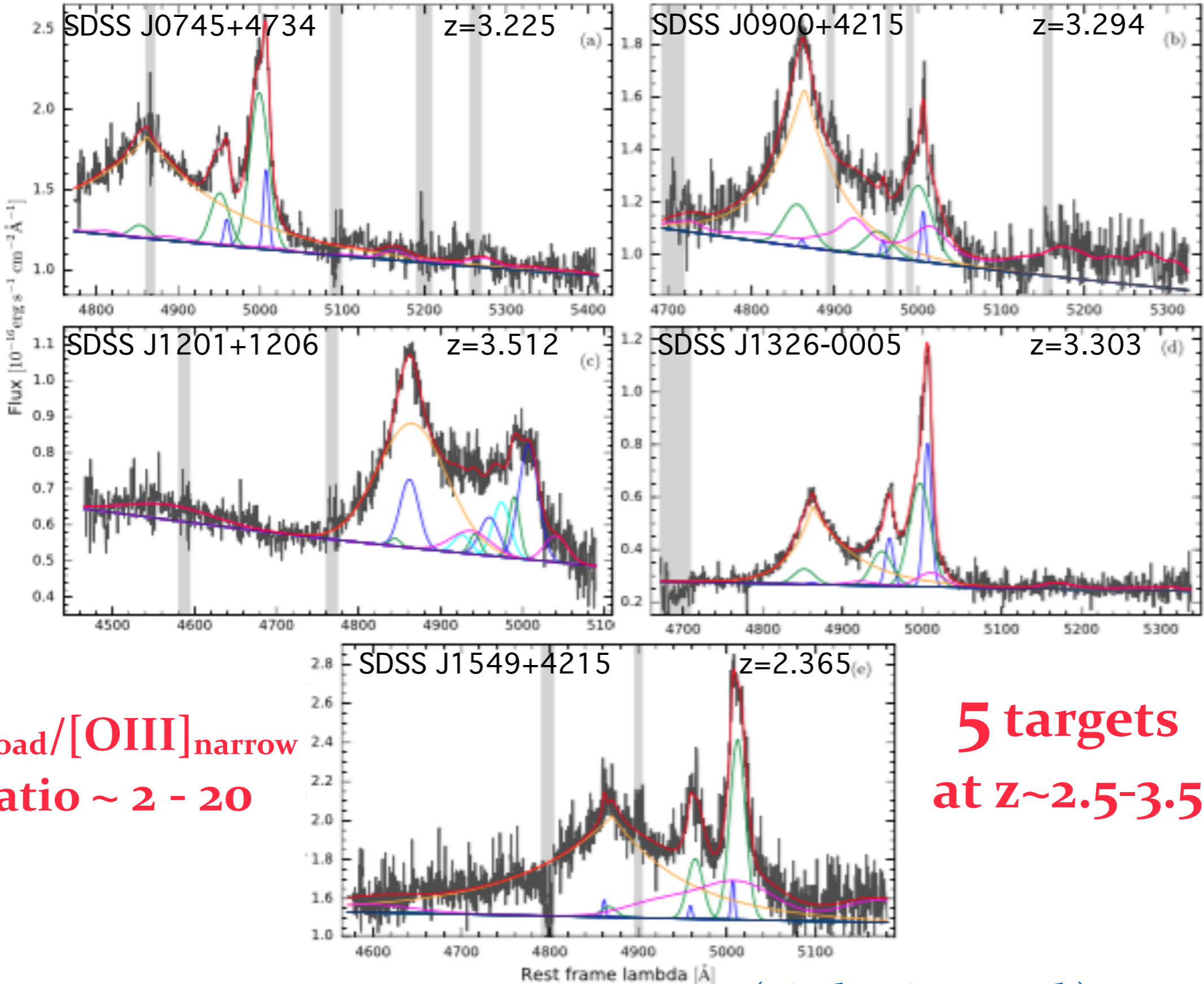
70% lack of [OIII] emission



Studying [OIII] outflows in Type I quasars

- Non-standard spectra: blended [OIII] and $H\beta$ profiles, strong FeII emission
- Broad blue-shifted [OIII] profiles, indicative of outflows

Prominent [OIII] emission in WISSH quasars

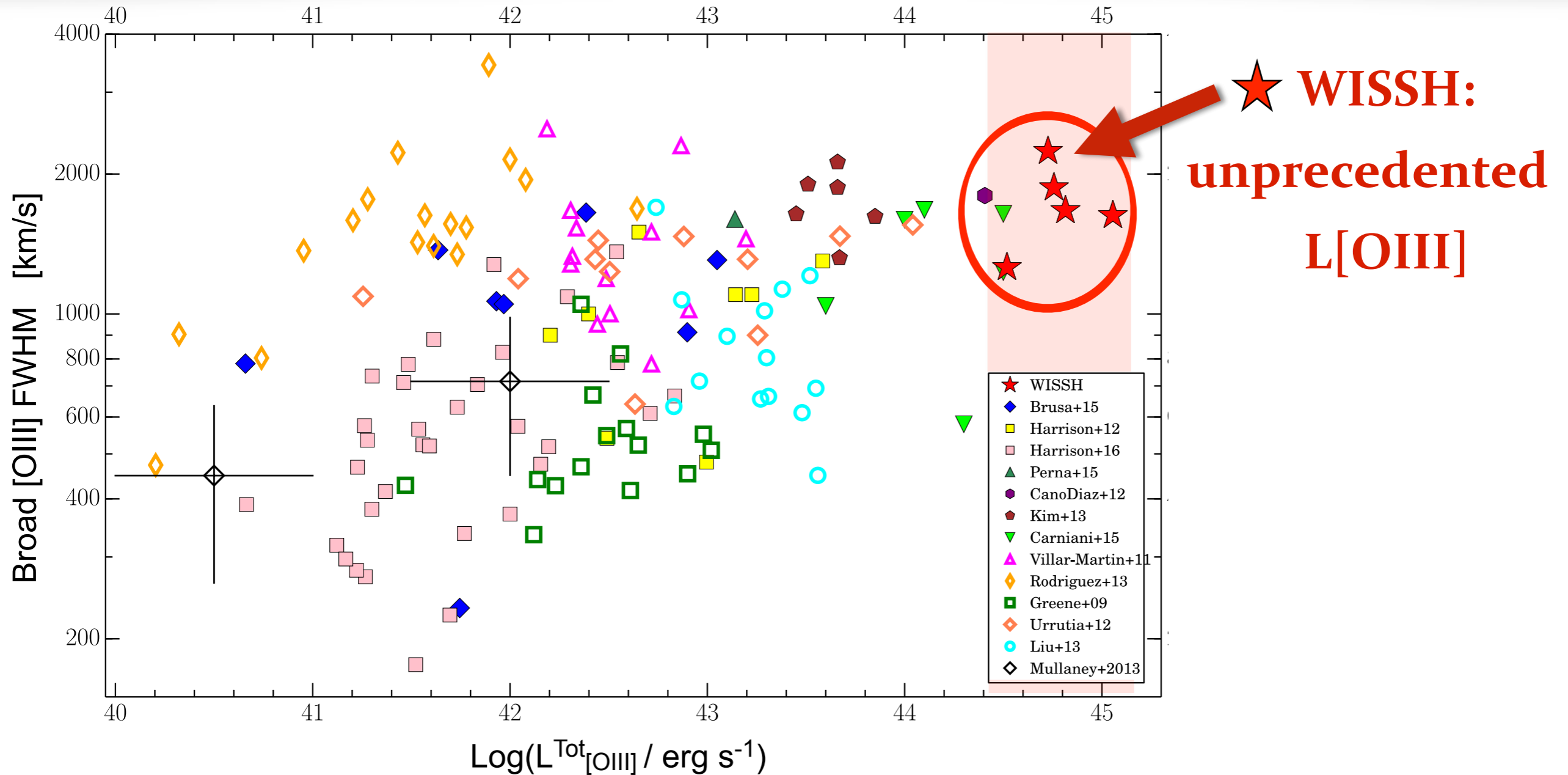


$[OIII]_{\text{broad}}/[OIII]_{\text{narrow}}$
flux ratio $\sim 2 - 20$

5 targets
at $z \sim 2.5-3.5$

(Bischetti+2016 sub)

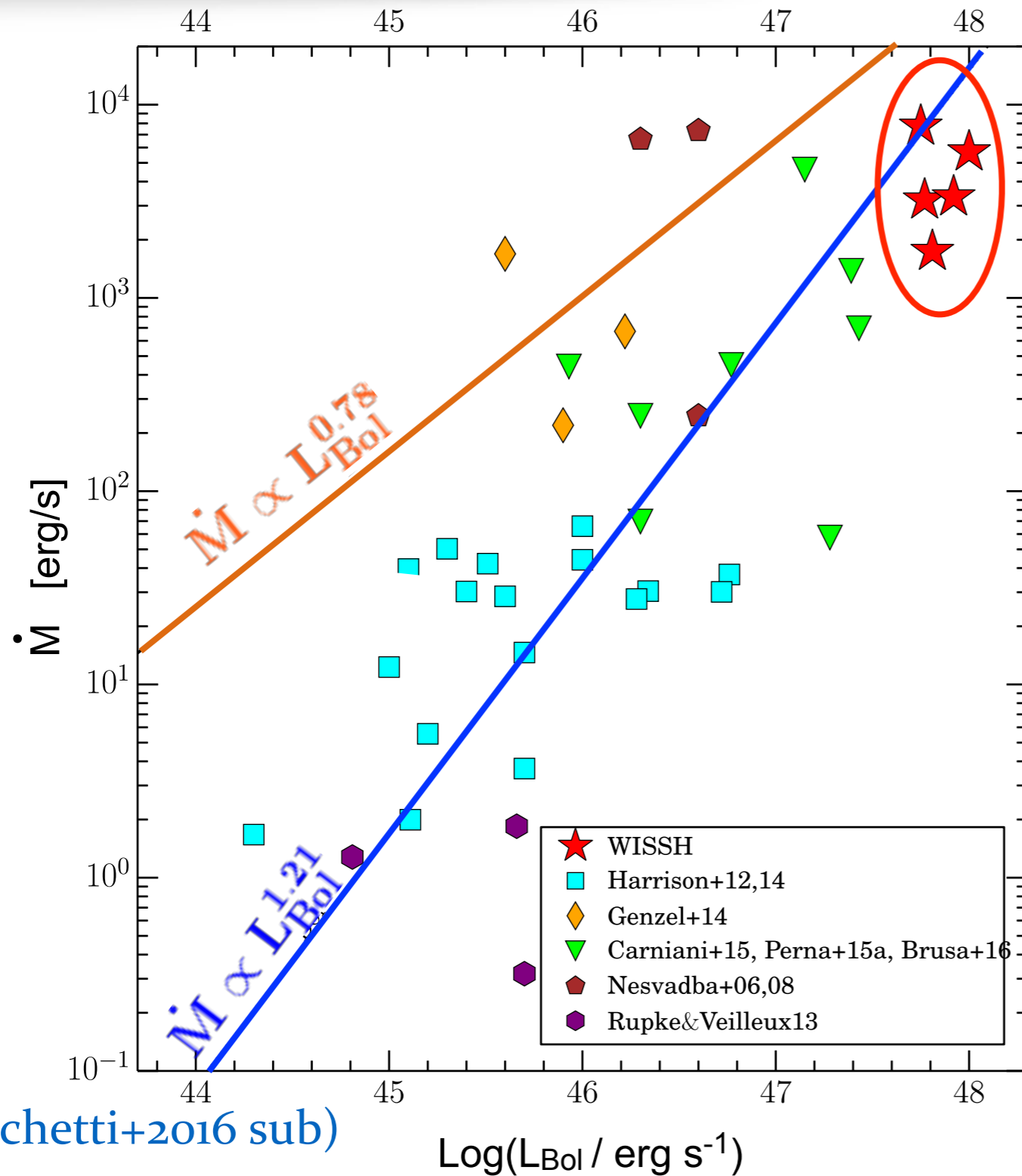
Powerful [OIII] outflows in WISSH Quasars



Very broad [OIII] lines
 $\text{FWHM}_{[\text{OIII}]} \sim 1200 - 2200 \text{ km/s}$
Very strong [OIII] lines
 $L_{[\text{OIII}]} > 10^{44} \text{ erg/s}$

High $L_{[\text{OIII}]}$ correspond to large FWHM
Hint of a forbidden area...?

Powerful [OIII] outflows in WISSH Quasars



$$L_{[\text{OIII}]}^{\text{broad}} \rightarrow M_{\text{ion}}$$

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

$$v_{\text{max}} = \Delta v + 2\sigma$$

$$\dot{M} \sim 1800 - 7700 M_{\odot} / \text{yr}$$

Best fit relations:

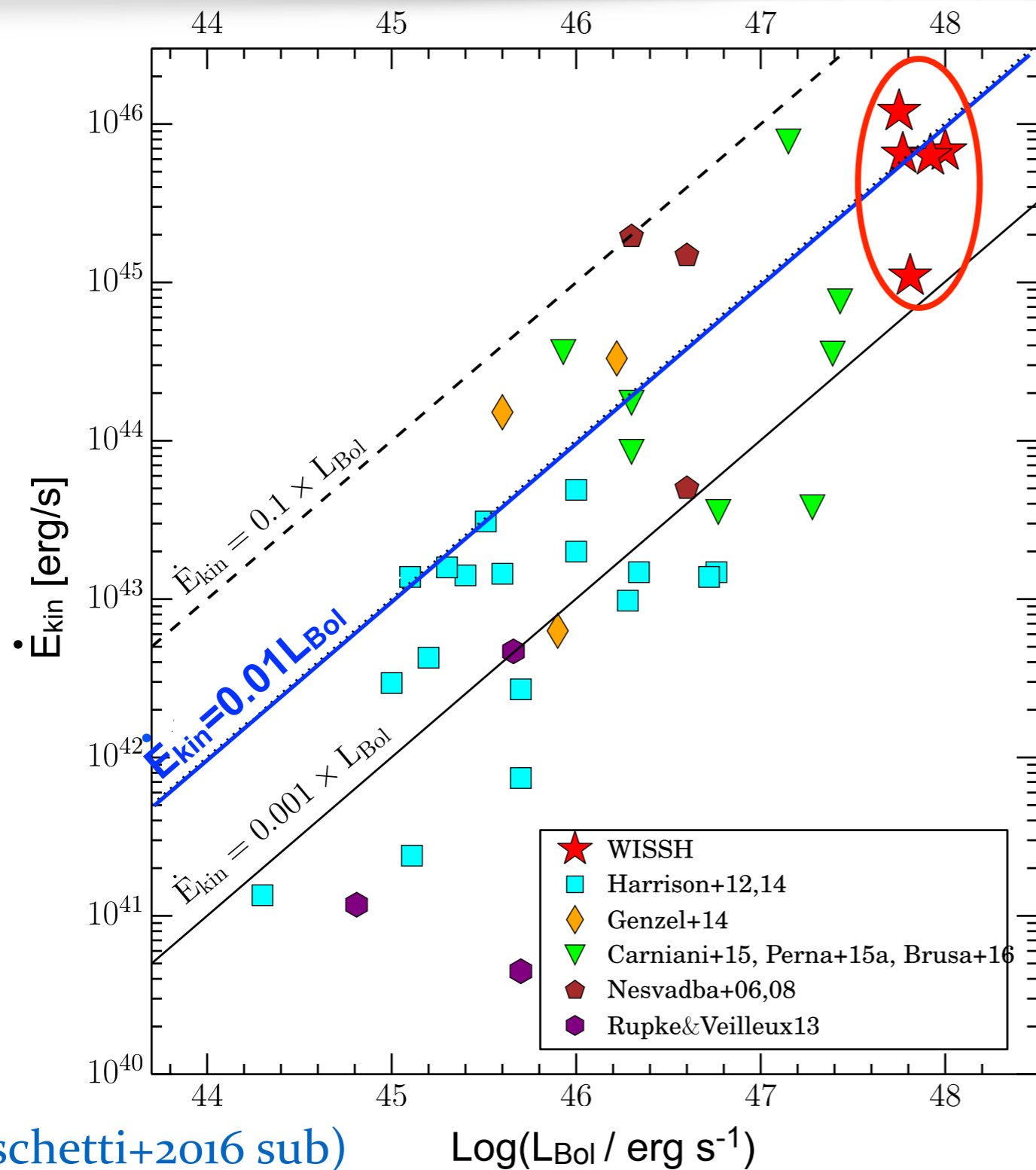
— ionised outflows

— molecular outflows

(Fiore+2016 sub)

At the highest luminosity ionised outflows may trace a larger fraction of the total outflowing gas

Powerful [OIII] outflows in WISSH Quasars



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

$$\dot{E}_{kin} \sim 10^{45} - 10^{46} \text{ erg/s}$$
$$\sim 1 - 3 \% L_{Bol}$$

Consistent with
predictions for an
efficient AGN feedback

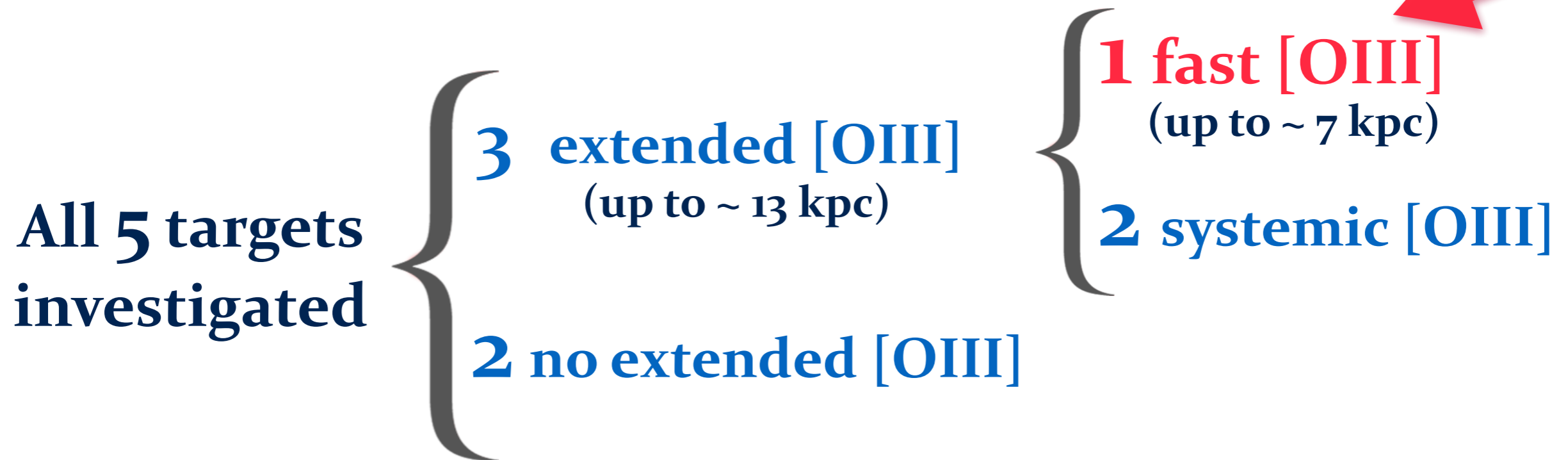
(e.g. Faucher-Giguère & Quataert 2012)

(Bischetti+2016 sub)

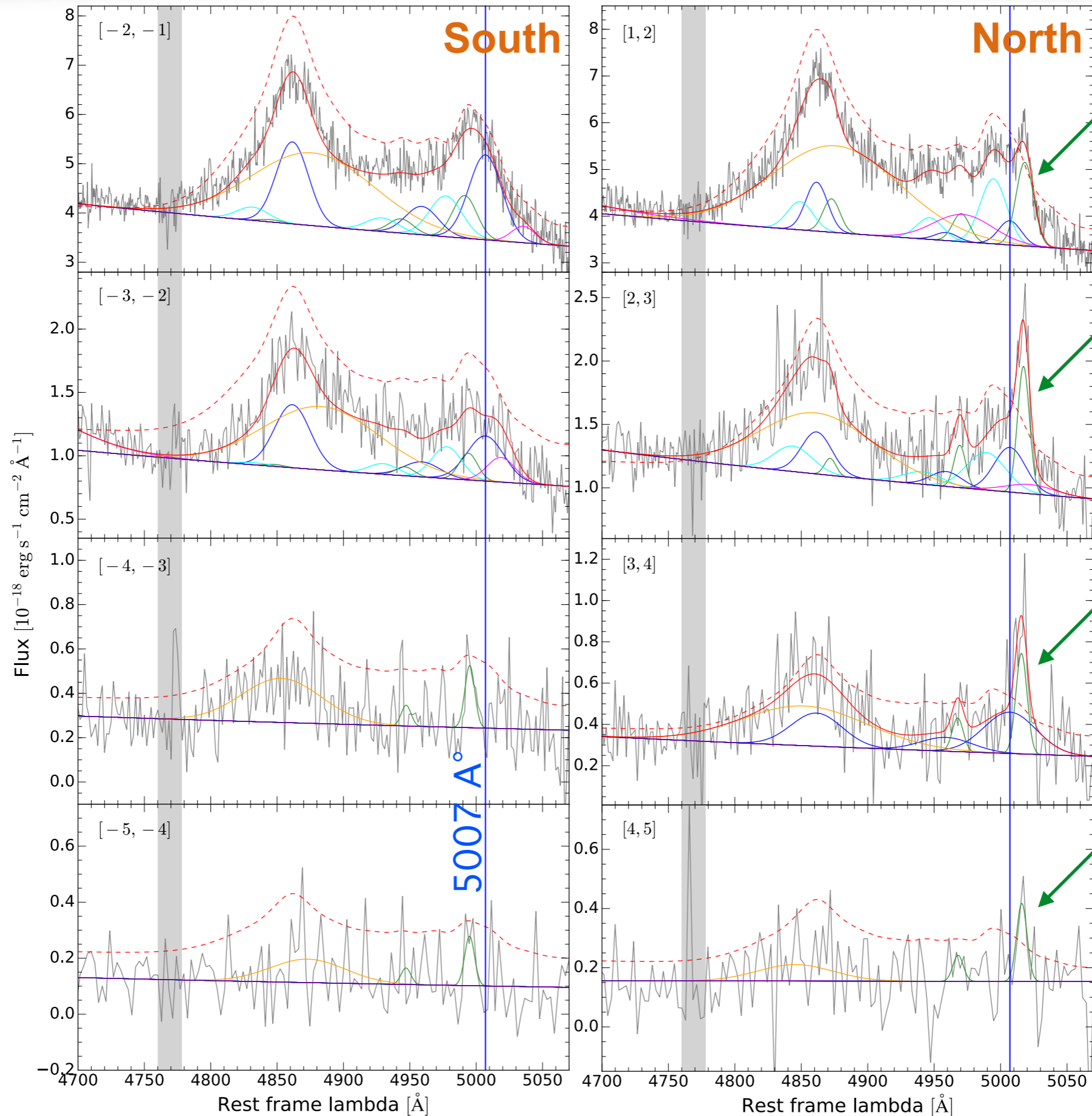
At the highest luminosity ionised outflows may reach
larger fraction of L_{Bol}

Near-slit spectroscopy of WISSH Quasars

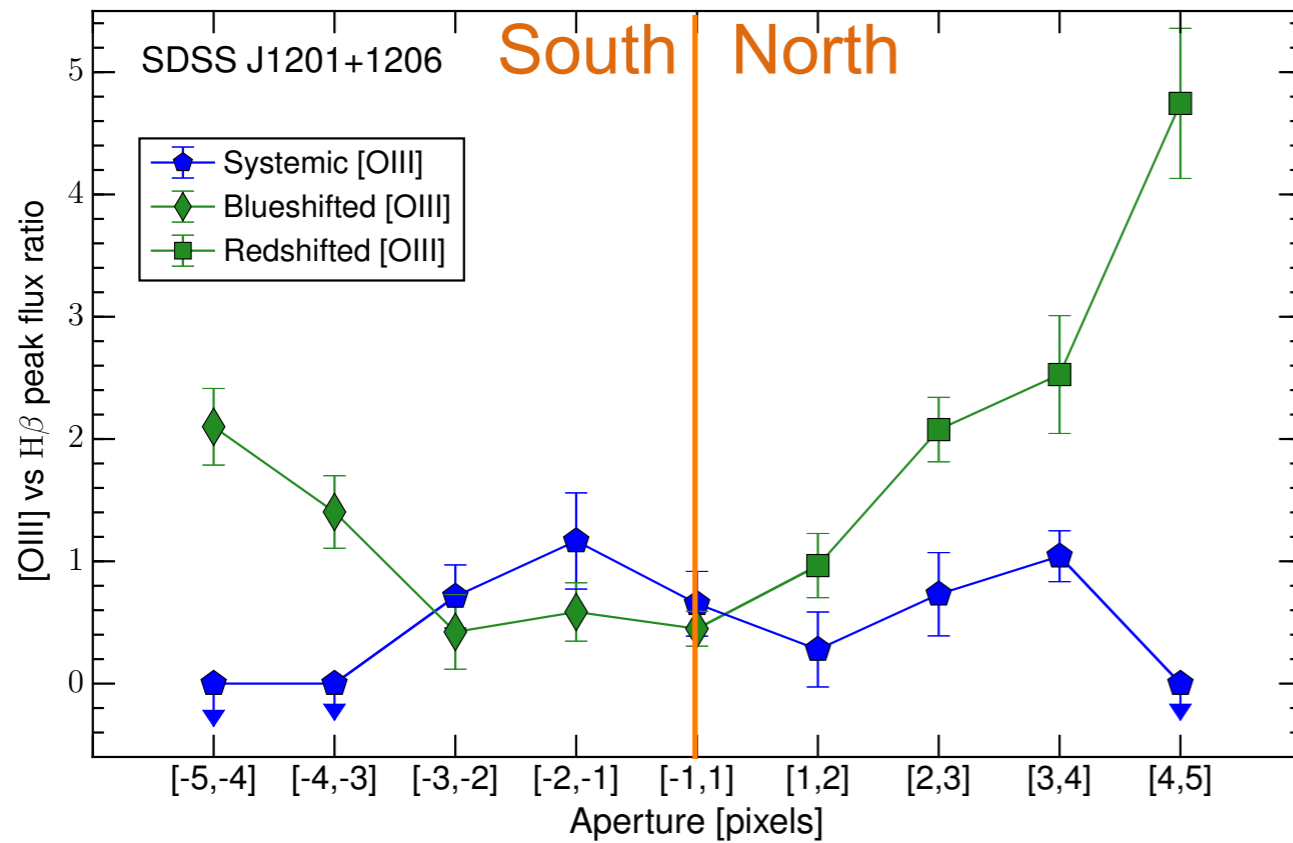
- Presence of extended emitting gas investigated by near-slit spectroscopy
- 1D spectra at increasing offset distances from the AGN
- Possible spatially extended [OIII] should be enhanced (Perna et al. 2015a)



The case of SDSSJ1201+1206

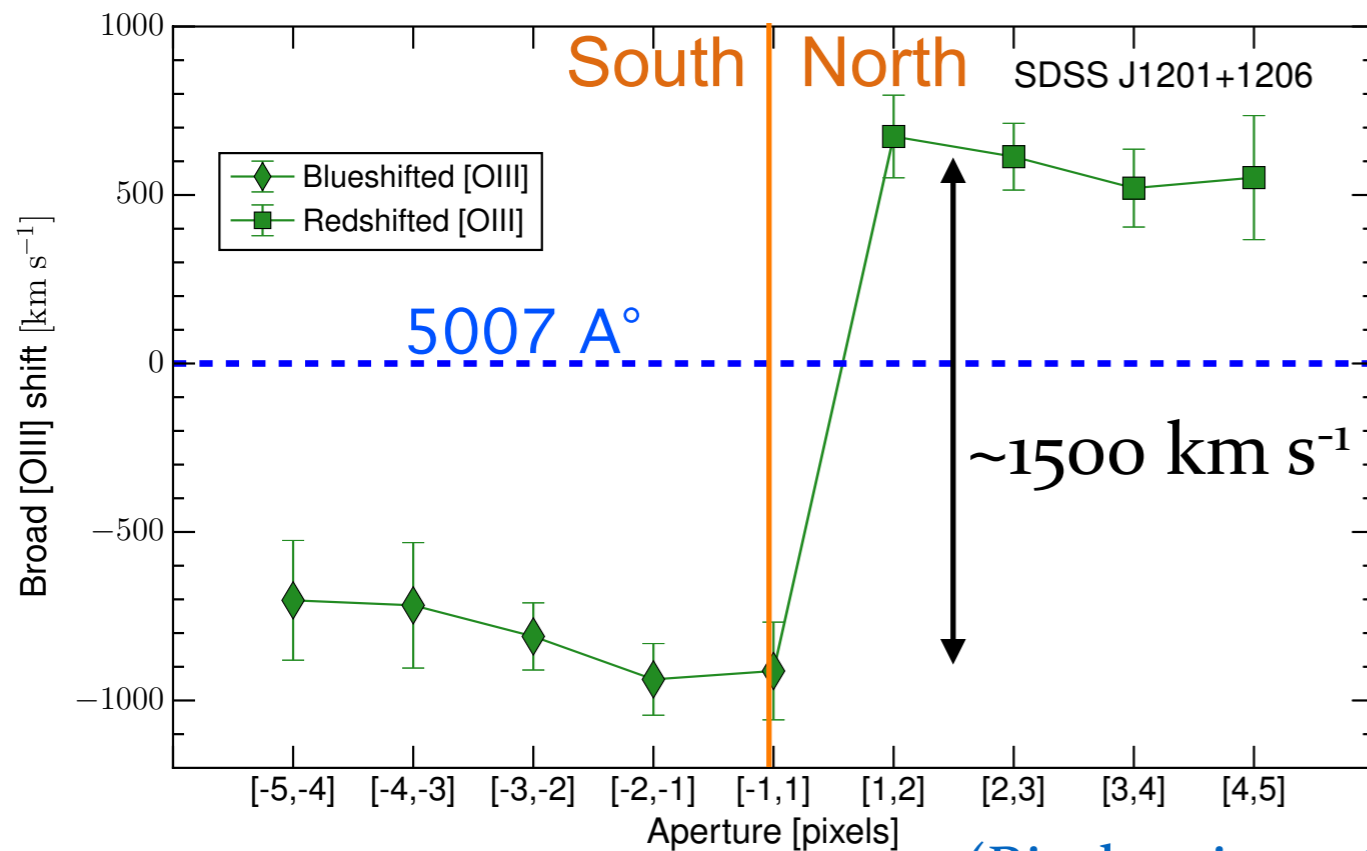


Extended fast [OIII] in SDSSJ1201+1206



An increased [OIII]/ $H\beta$ (BLR) flux ratio indicating

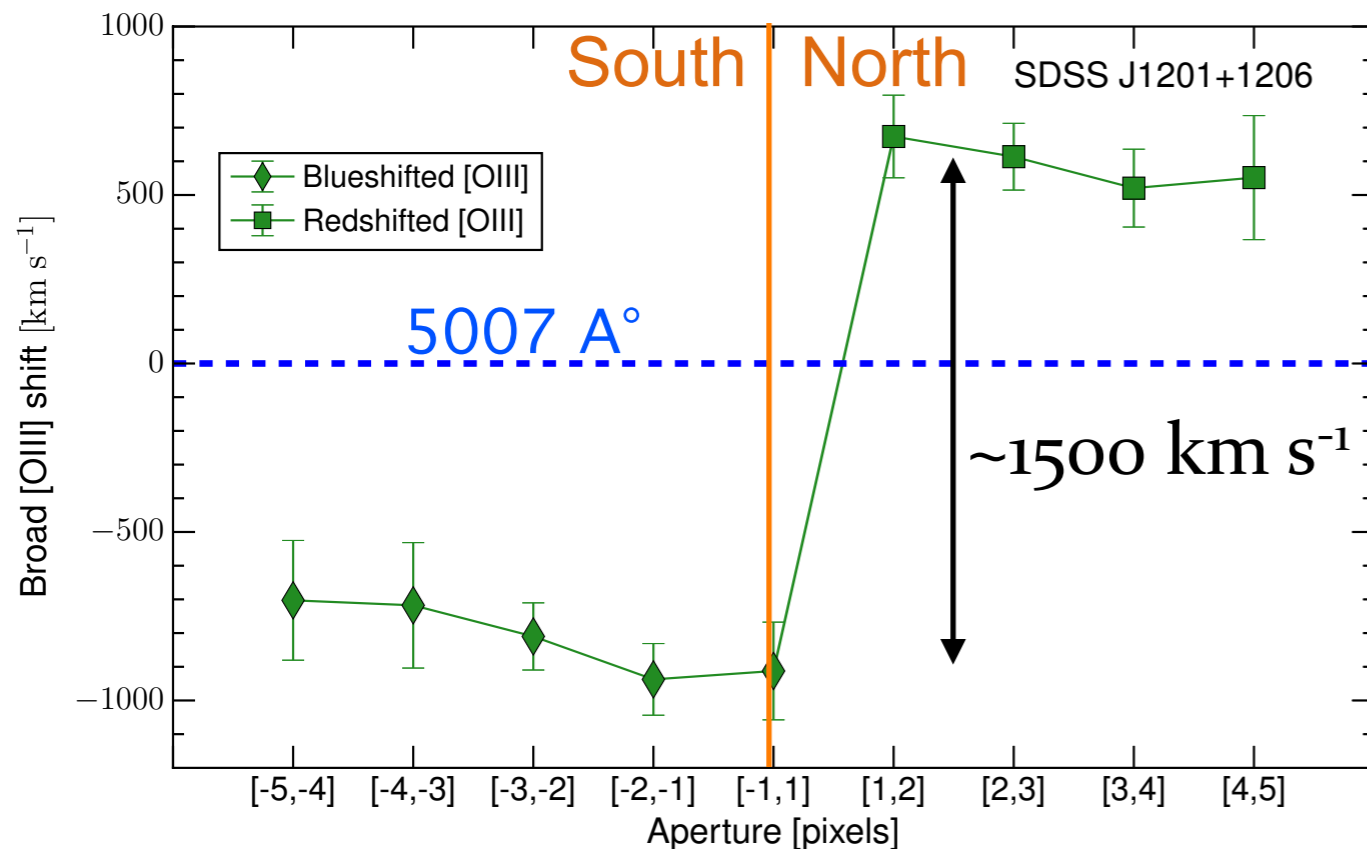
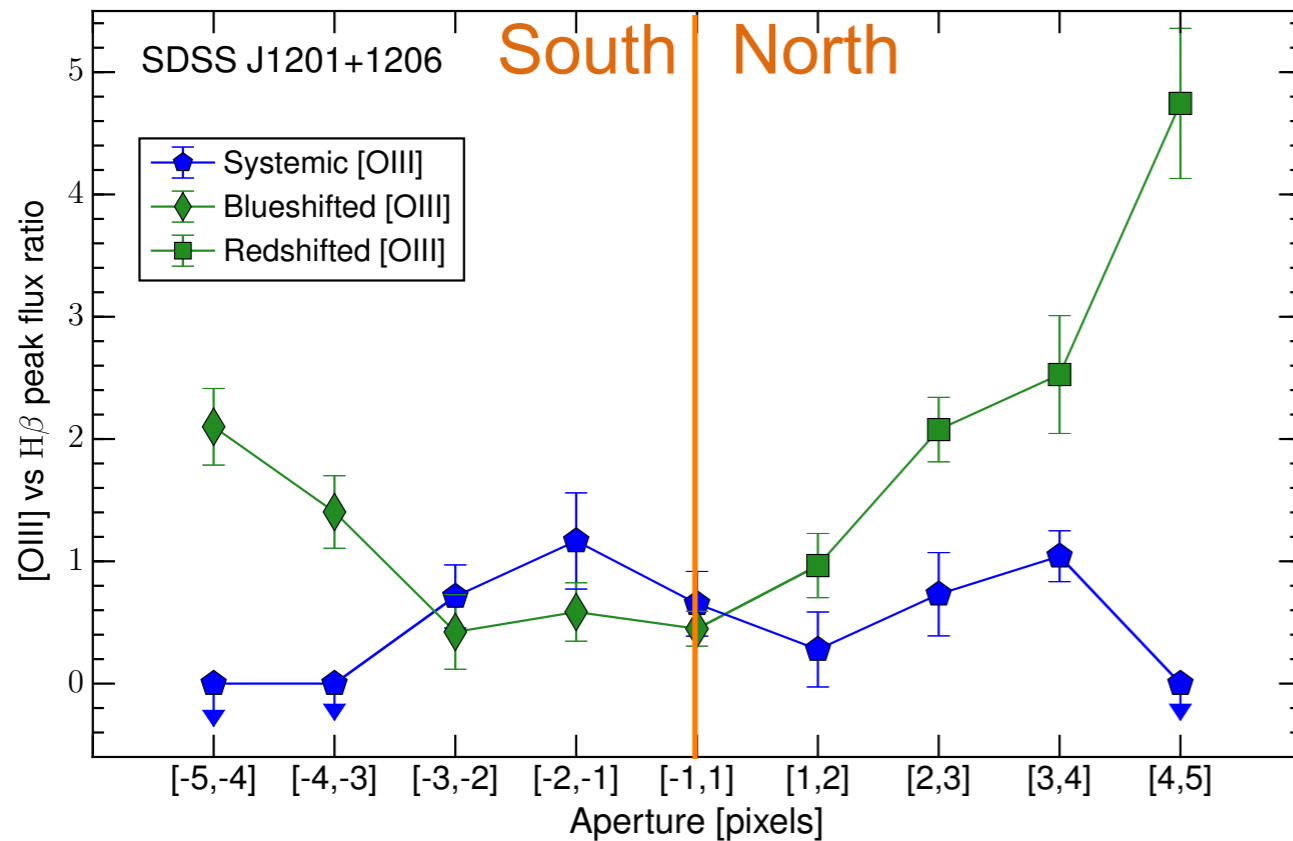
truly extended outflowing gas up to ~ 7 kpc



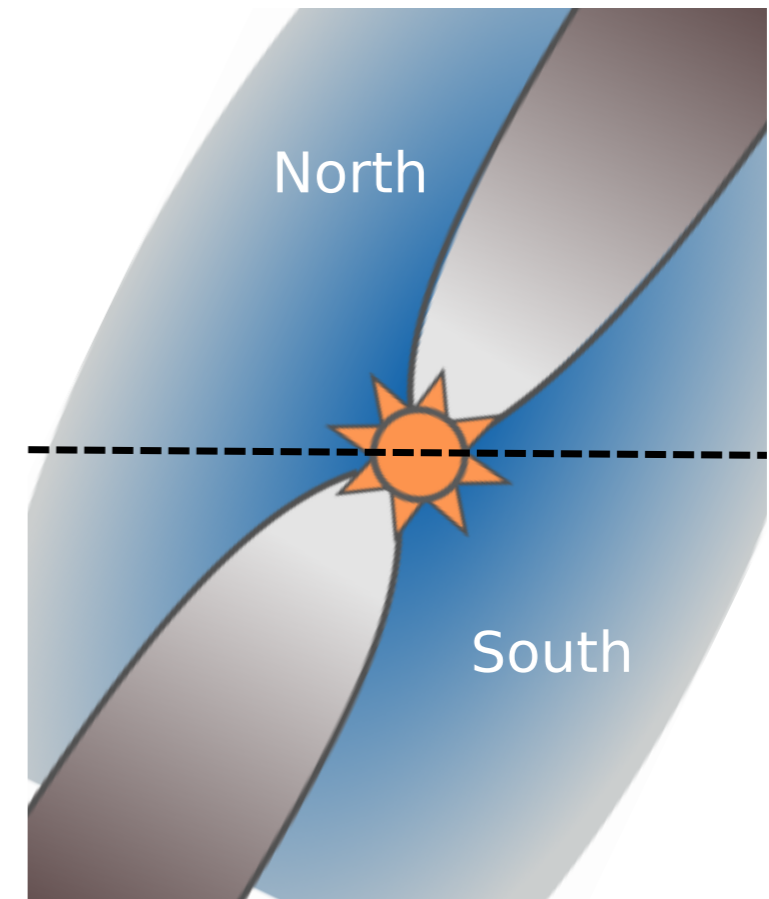
Blue/red-shifted components relative velocity of $\sim 1500 \text{ km/s}$

(Bischetti+2016 sub)

Extended fast [OIII] in SDSSJ1201+1206



Such a scenario can be likely interpreted as a **Bipolar Outflow**



IFU/SINFONI data incoming...

Conclusions

- Hyperluminous quasars are potentially the best targets to hunt for powerful AGN driven outflows → WISSH quasars sample built up to observe AGN feedback at its extreme

Results from LBT observations: 5 [OIII] targets

- **Broad [OIII]** (FWHM ~ 2000 km/s) indicative of outflows
- Narrow [OIII] emissions weak/absent
- **Highest [OIII] luminosities observed so far** (up to 10^{45} erg/s)
- Associated **very large mass outflow rates** (up to ~8000 M_{\odot}/yr) and **kinetic powers consistent with ~ 1–3 % L_{Bol}** .
- Extended (up to 13 kpc) [OIII] in 3/5 sources. **Bipolar outflow extended up to ~ 7 kpc** in SDSSJ1201+1206

Incoming (within first half of 2017, P.I. Bongiorno) VLT/SINFONI IFU data of J1326-0005 and J1201+1206 will allow to accurately constrain the morphology and effects on the host galaxy ISM in these hyper-luminous sources.