

# LAEs at $z=2-3.5$ Probed by HETDEX Survey

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# Introduction

## $\text{Ly}\alpha$ emitters (LAEs):

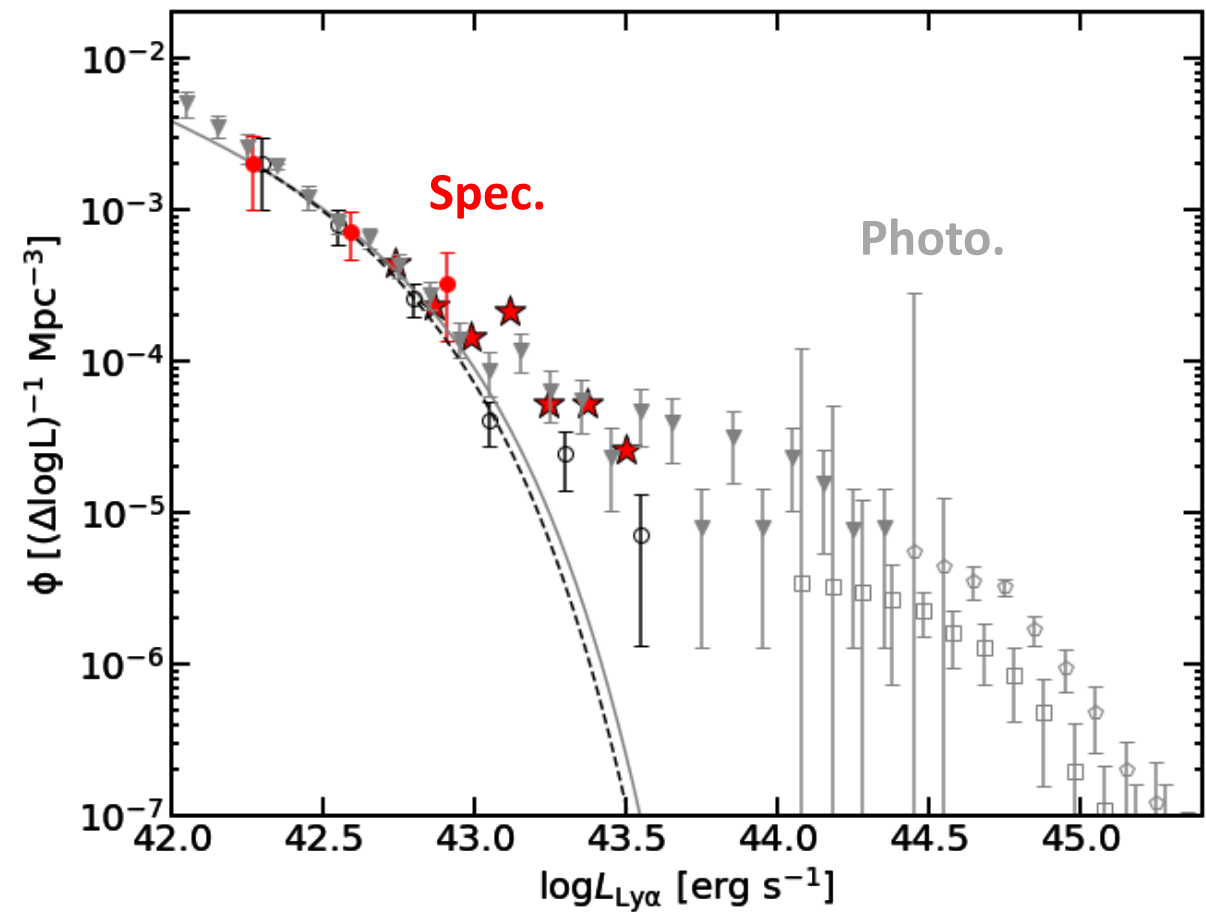
- Strong  $\text{Ly}\alpha$  w/ faint continuum.
- Probe low mass gal. at high-z.

## Luminosity function (LF):

- Traces gal. formation & evolution

## $\text{Ly}\alpha$ LF (z=2-3):

- Bright end hump?
- AGN?

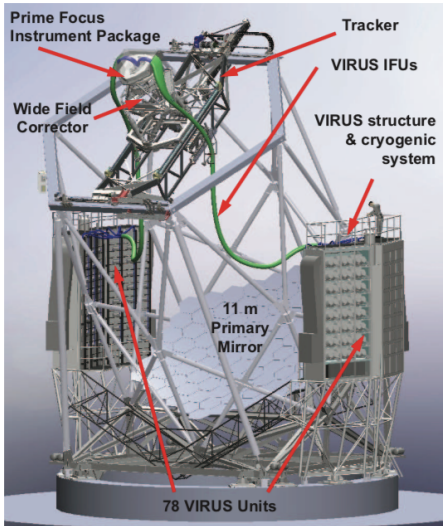


Our recent work (Zhang et al., in press):

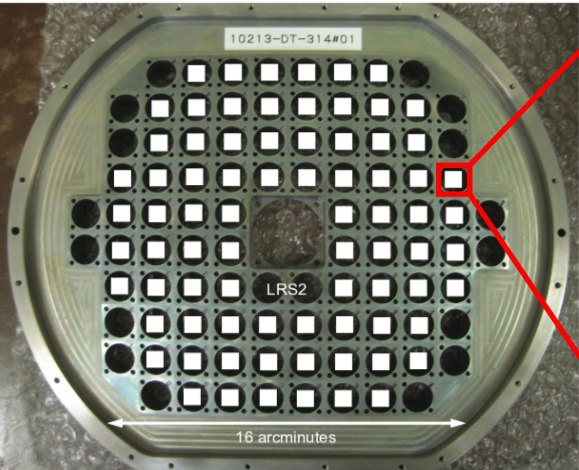
- 1. Determine LFs of LAEs at  $z \sim 2-3$
- 2. Characterize the objects at the bright end of  $\text{Ly}\alpha$  LF.

# Hobby-Eberly Telescope Dark Energy Experiment (HETDEX):

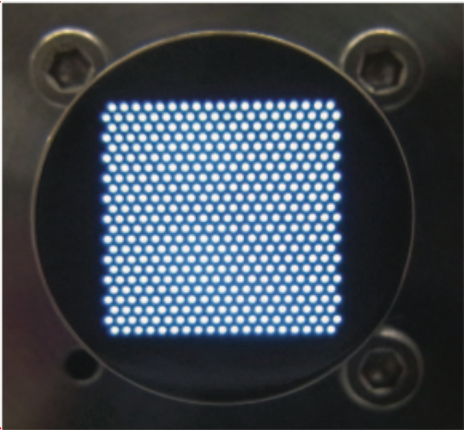
- Blind integral field spectroscopic (IFS) survey (PI: Gebhardt)
- Spectral range: 3500-5500 Å → Ly $\alpha$  at z=2-3.5
- Internal data release 2.1 (iHDR2.1): August 2020



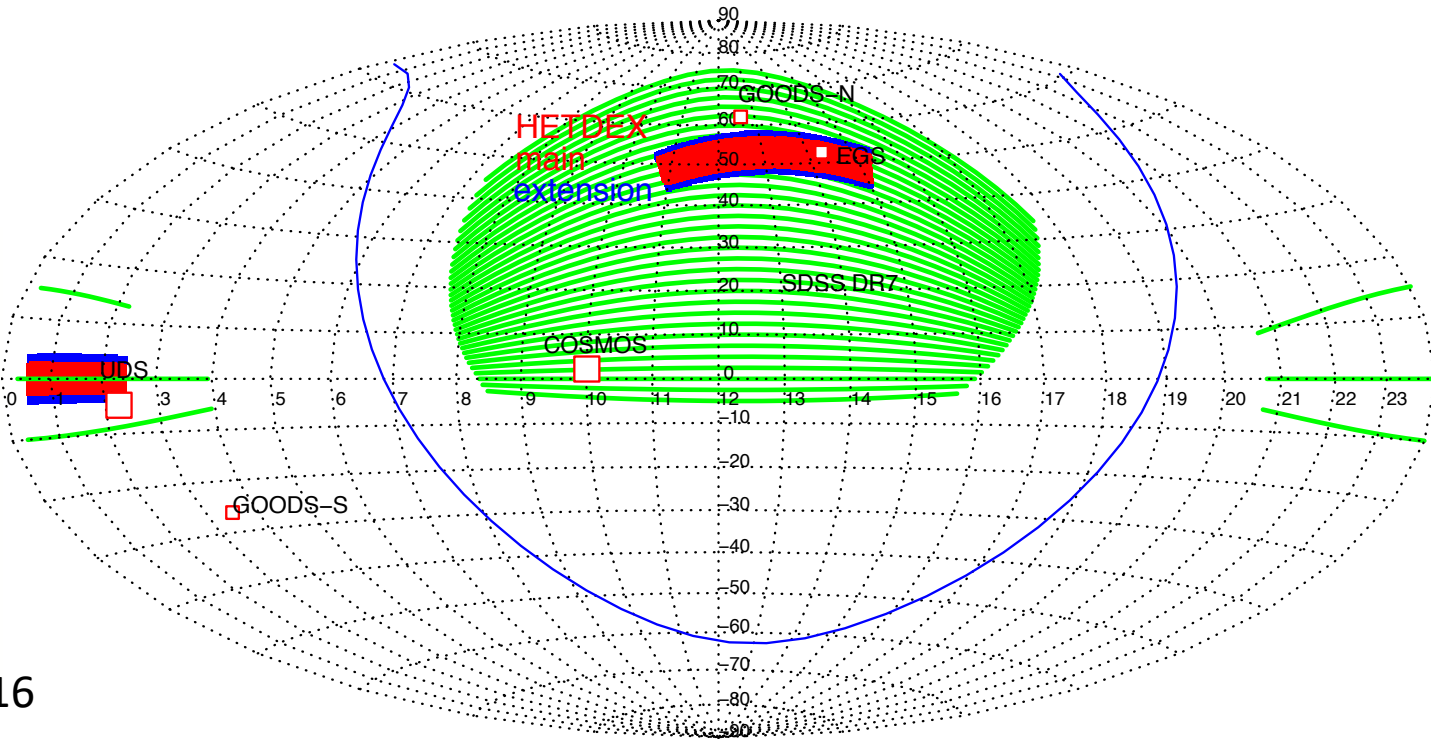
10-m HET<sup>Hill+16</sup>

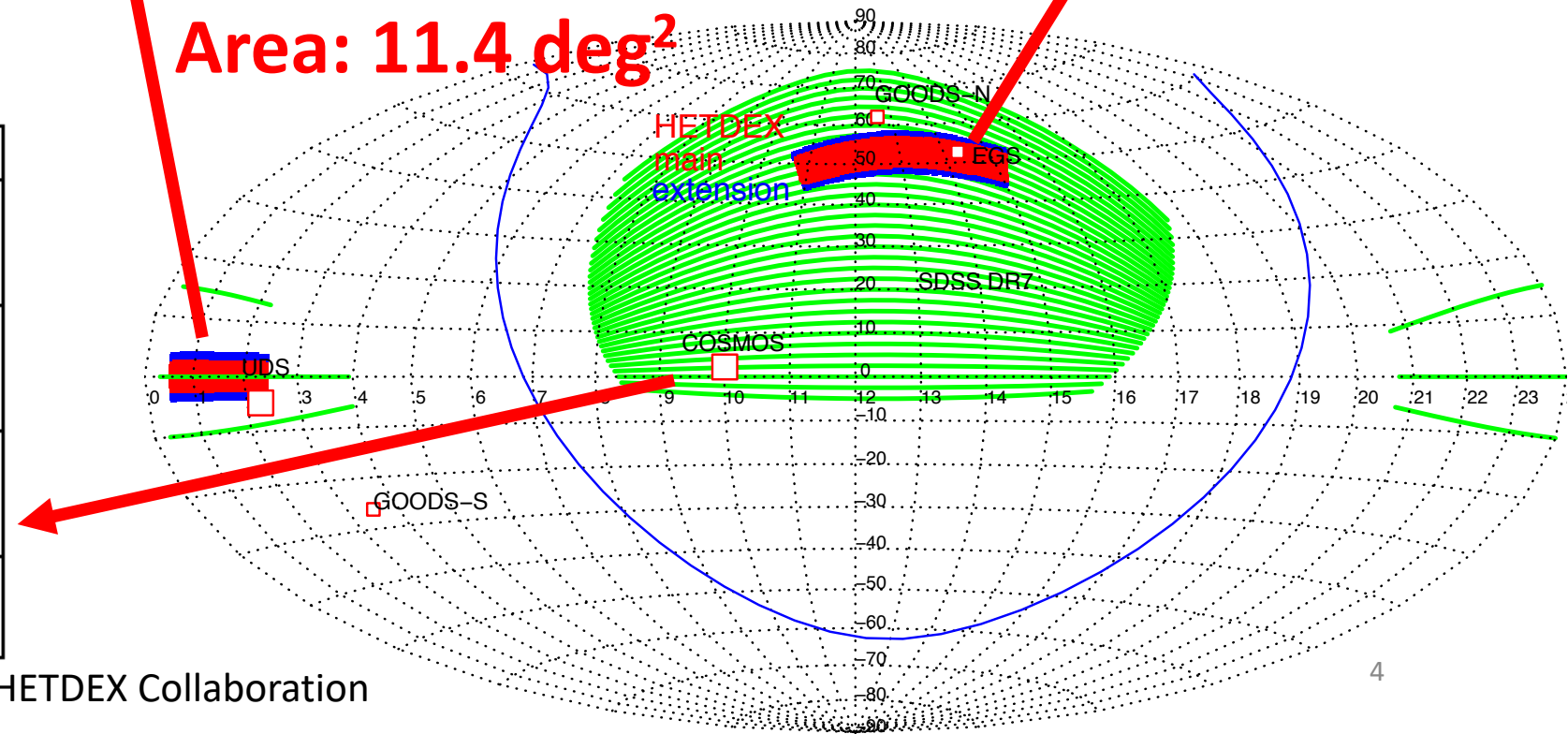
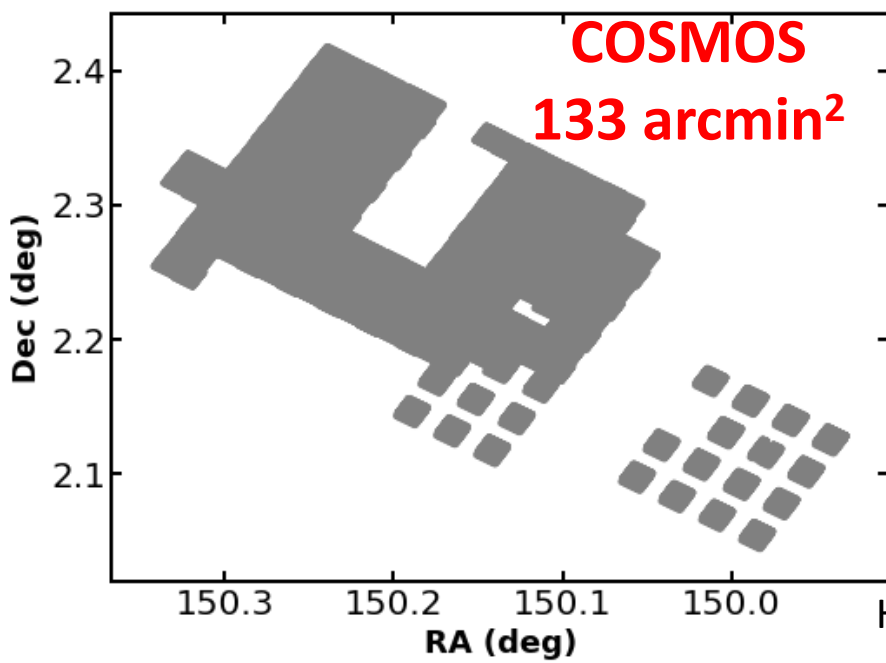
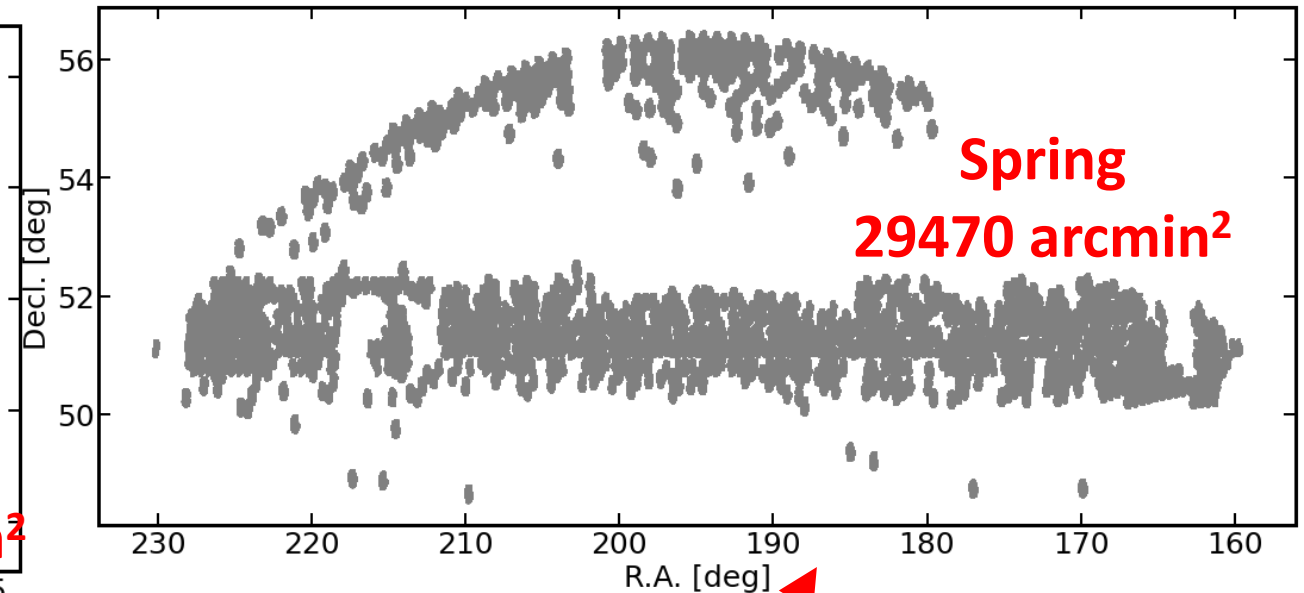
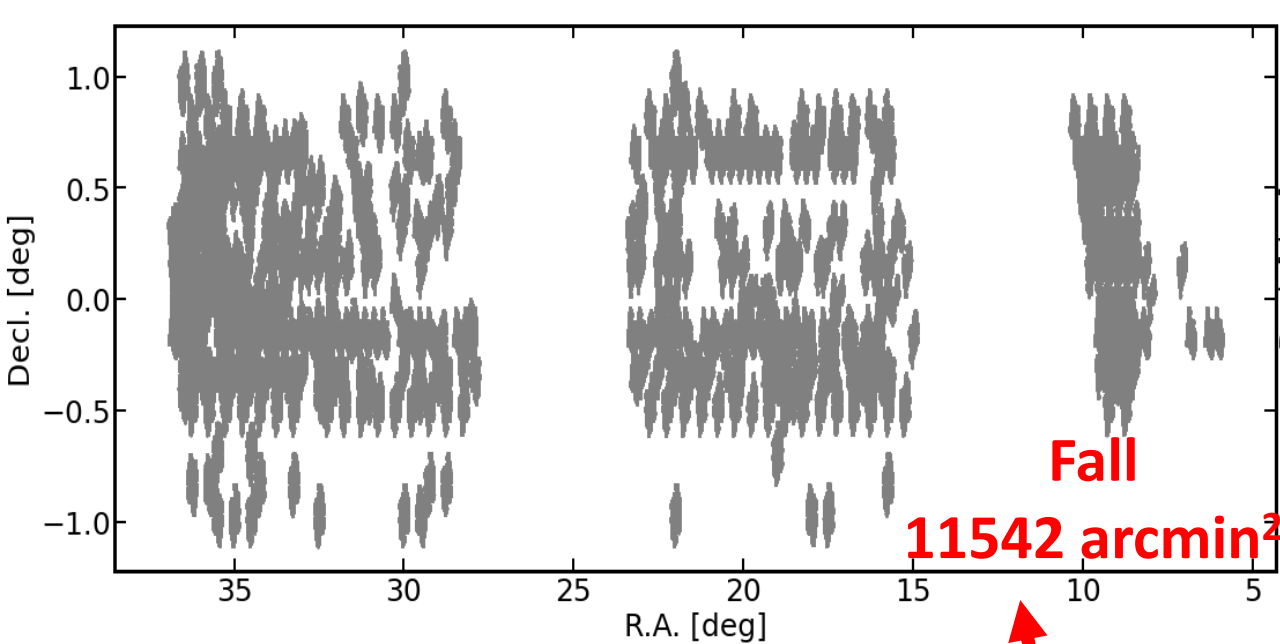


76 IFUs



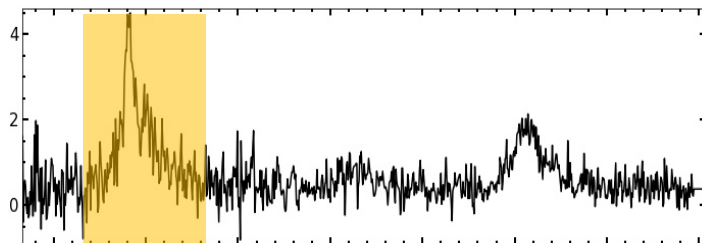
448 Fibers  
(1.''5 diameter)  
<sup>Hill+16</sup>





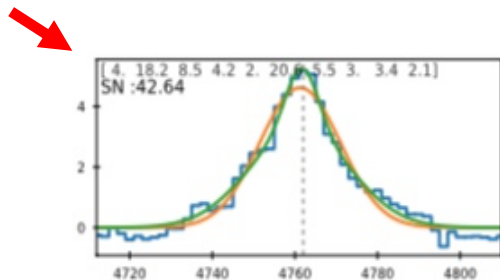
# LAE Samples

## HETDEX spectrum

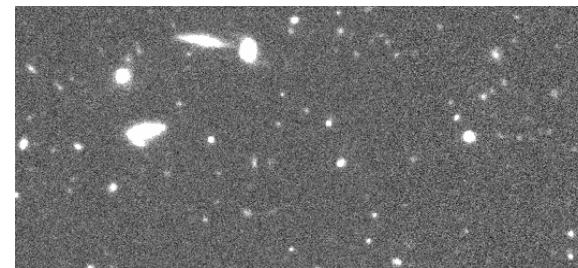


Line

detection



## HSC *r*-band image



+

- HSC-SSP (PDR2) + HETDEX-HSC

$$r_{5\sigma} \sim 25.8(\text{Wide}) \quad r_{5\sigma} \sim 25.2$$

$$EW_0 > 20 \text{ \AA}$$

LAE  
selection

Narrow line (NL, FWHM < 1000 km/s)

Broad line (BL, FWHM > 1000 km/s)

Remove [OII] 3727 contamination  
w/ Bayesian probability ratio (Leung+17)

$$N(\text{NL}) = 16194$$

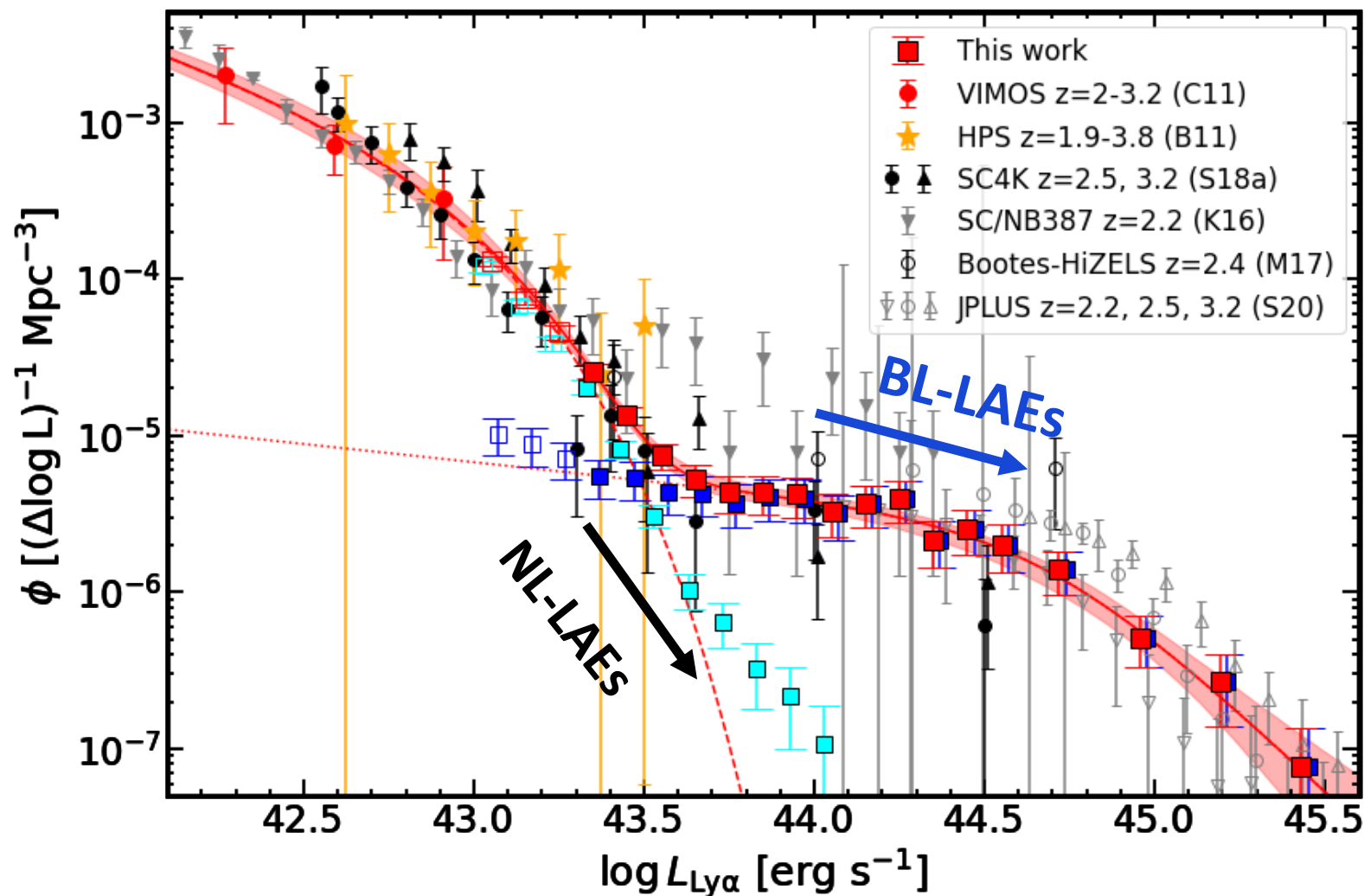
$$N(\text{BL}) = 2126$$

$$N(\text{total}) = 18320$$

$\text{Ly}\alpha$  LF

$$V_{\text{max},i} = \omega \int_{z_{\text{min}}}^{z_{\text{max}}} C_i(L, z) \frac{dV}{dz} dz$$

$$\phi(\log L) = \frac{1-f_{\text{contam}}}{\Delta(\log L)} \sum_i \frac{1}{V_{\text{max},i}}$$



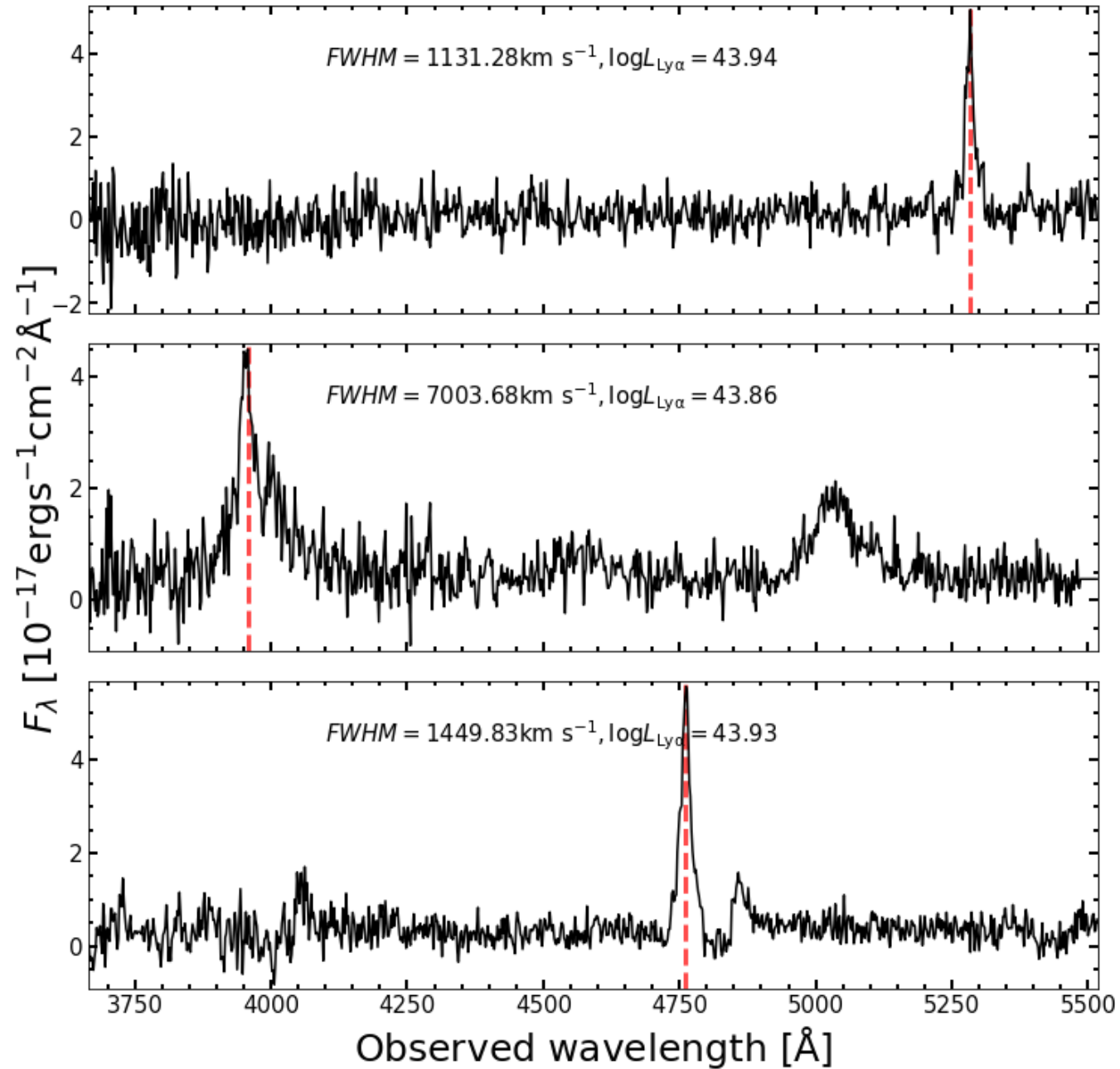
Bright-end hump: **spec. confirmed**



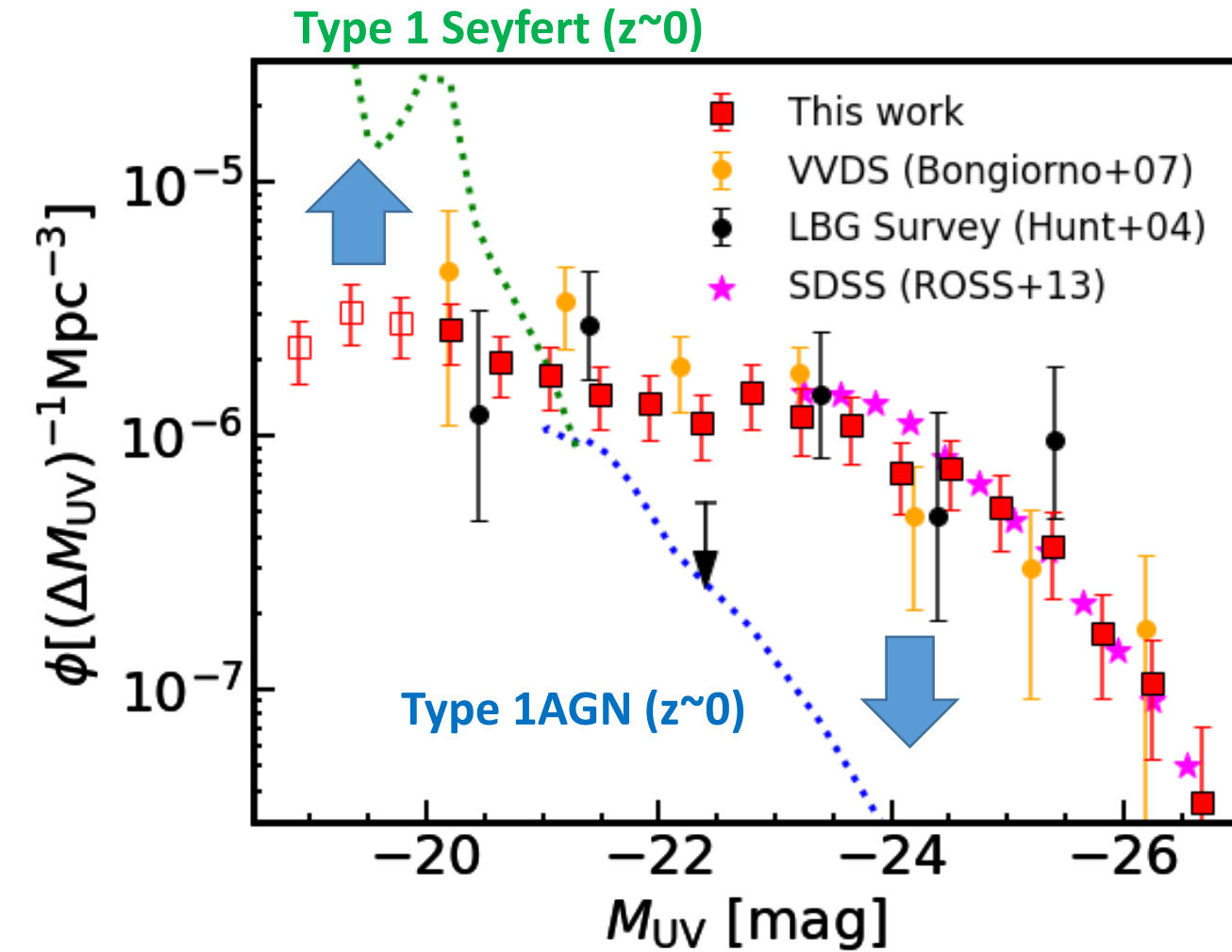
Dominated by Type 1 AGNs



# HETDEX AGN



# Type 1 AGNs UV LF( $z \sim 2 \rightarrow z \sim 0$ )



Bright end:

- Agrees well with previous obs.
- Number density decreases towards  $z \sim 0$

Faint end:

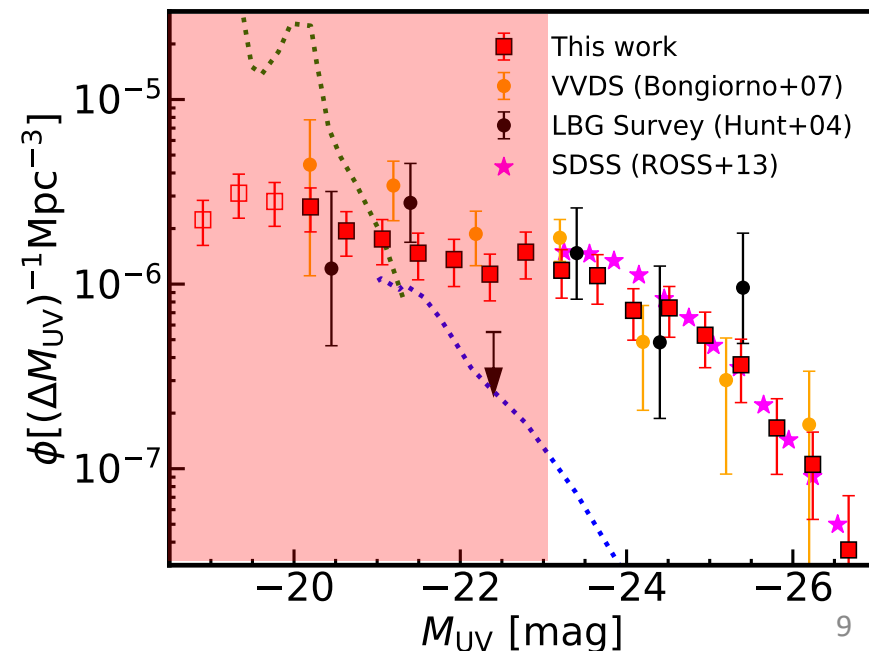
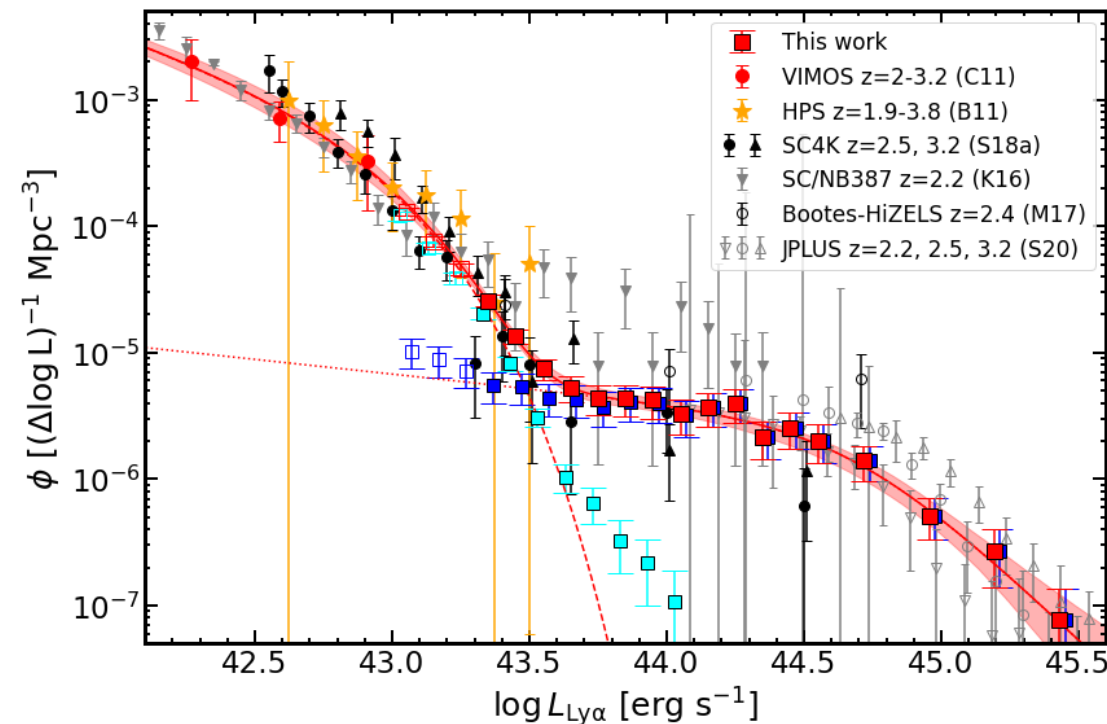
- Extends to  $M_{uv} \sim -20$
- Number density increases towards  $z \sim 0$ .  
→ AGN downsizing



# Summary of Zhang+21

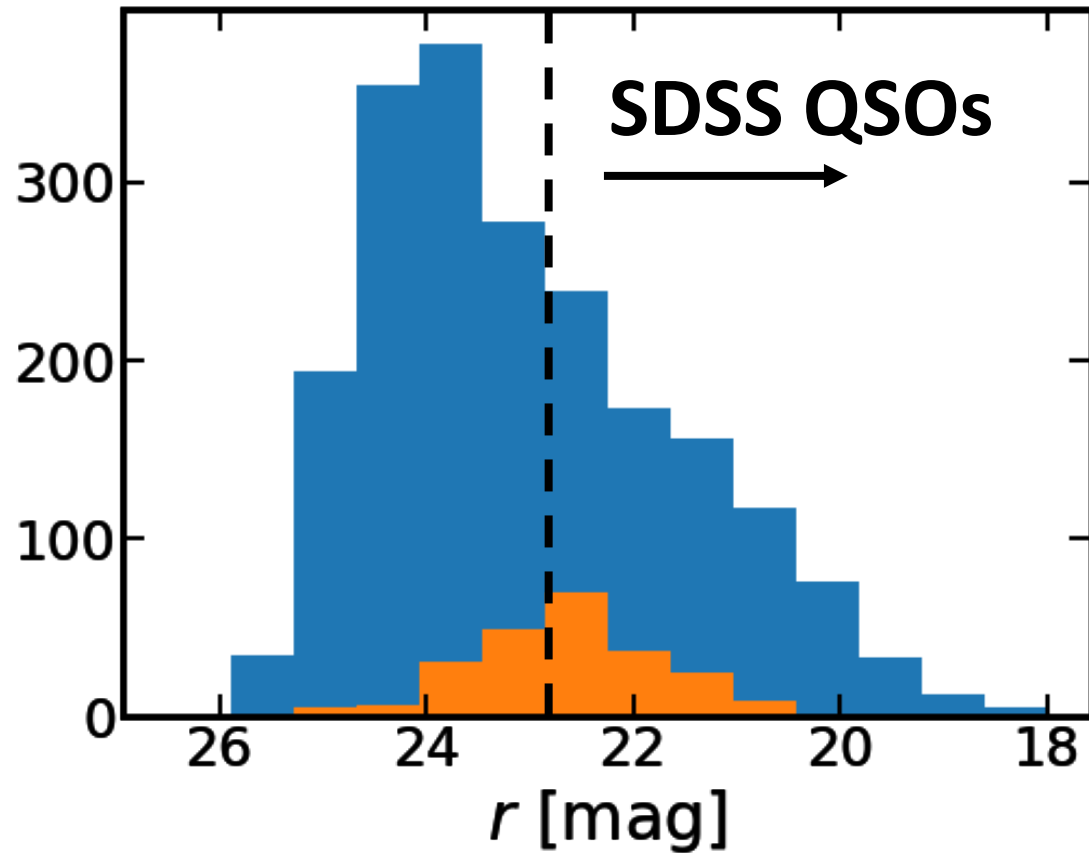
18320 LAEs (w/ 2126 type 1 AGNs) at  $z=2-3.5$  from HETDEX spec. data

- $\text{Ly}\alpha$  LF (SF gal. + AGN):
  - Bright-end hump of  $\text{Ly}\alpha$  LF confirmed (dominated by type 1 AGNs).
- UV LF (AGN):
  - From  $z=2$  to 0: Faint(bright) end increases(decreases)  
→ Consistent w/ downsizing effect

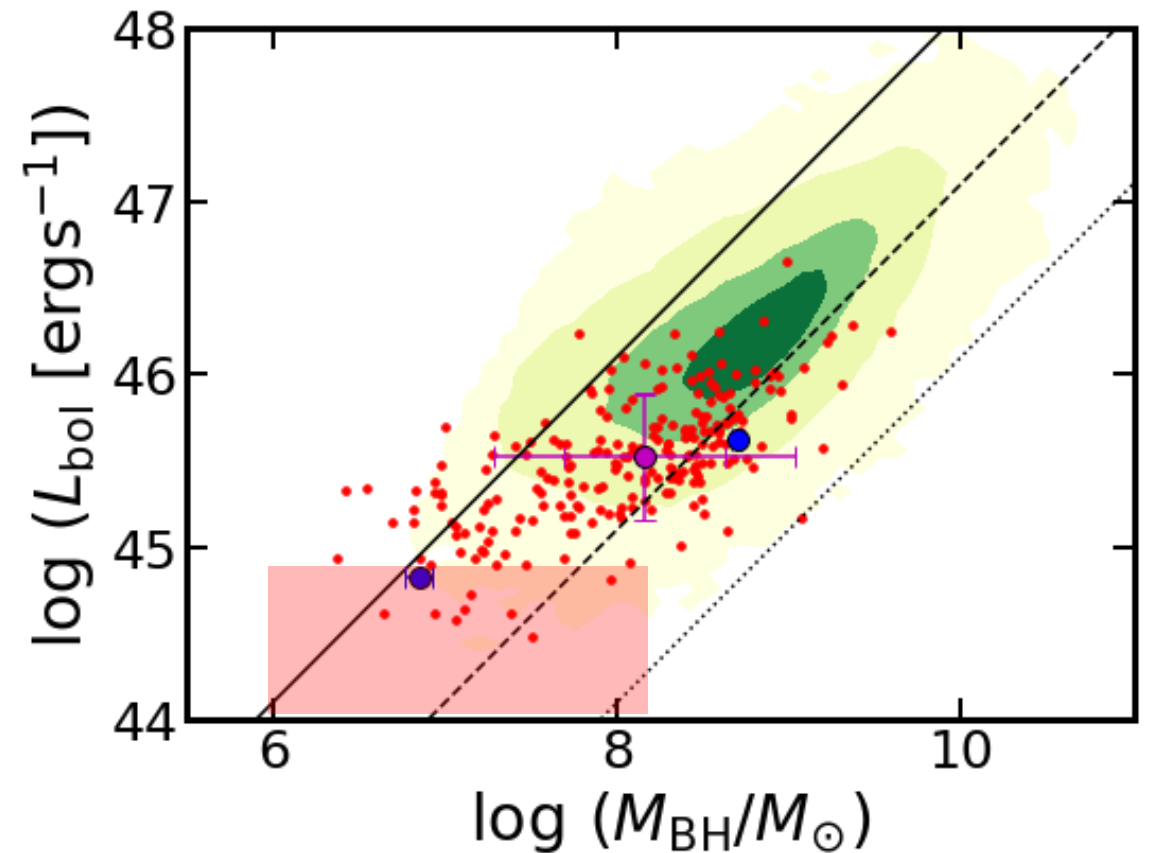


# Future Plans: Faint AGN Accretion

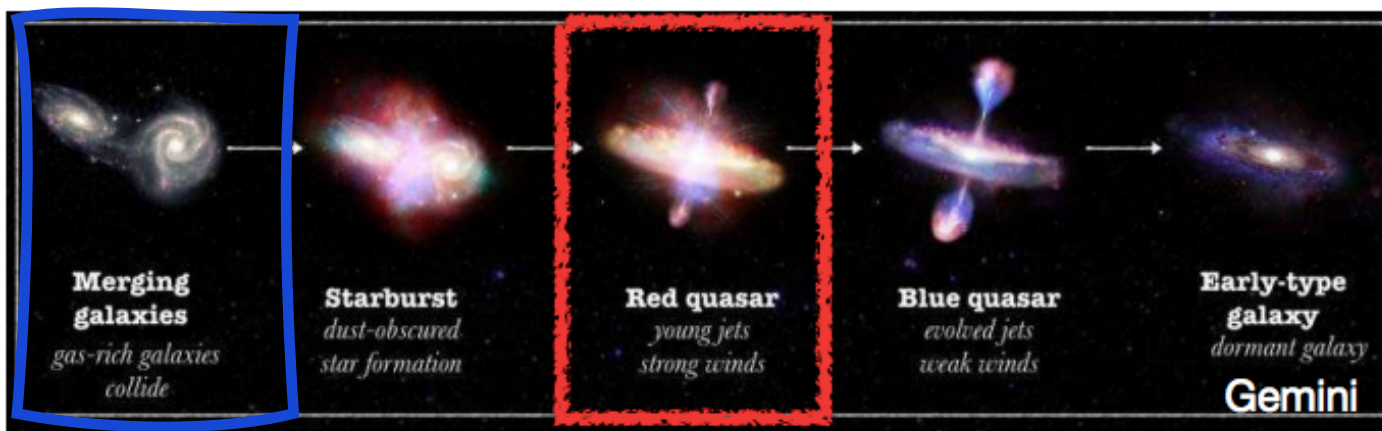
2051 type 1 AGN (contaminants removed)  
1624 without SDSS spectra



BH masses of 224 HETDEX AGN w/ CIV

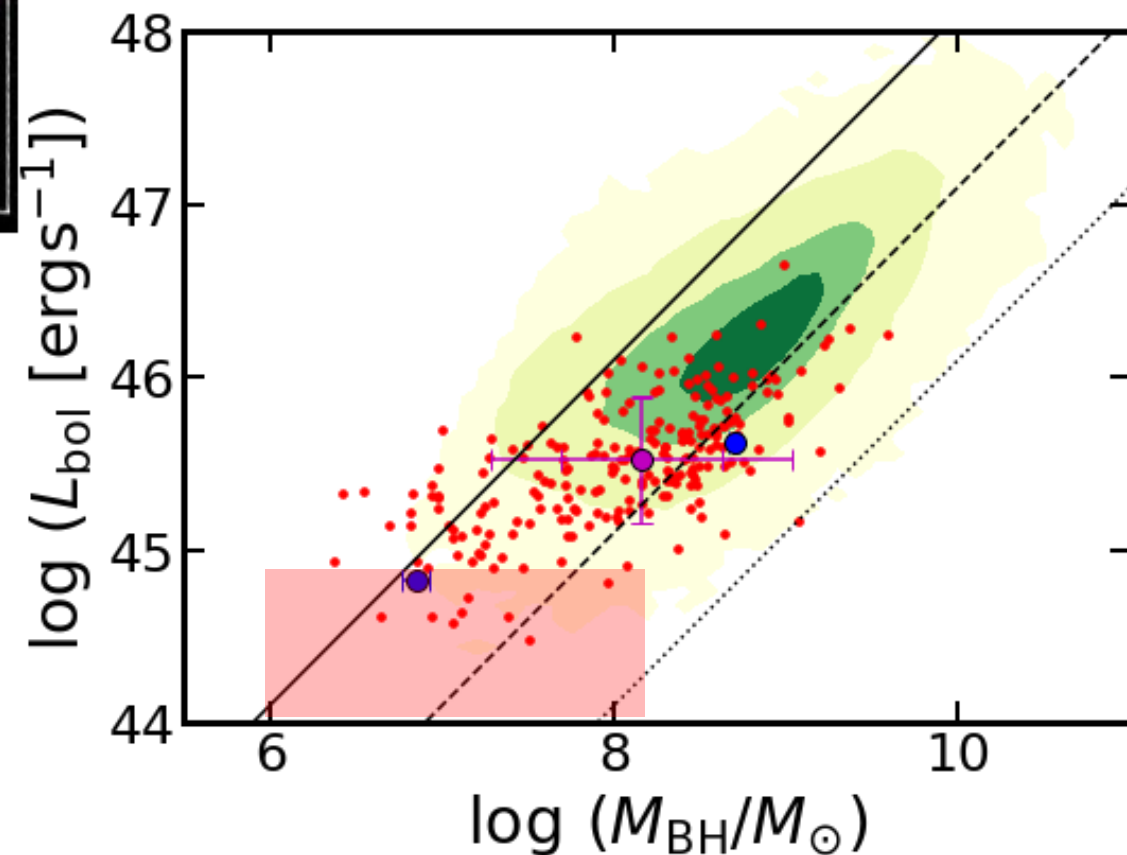


# Future Plans: Faint AGN Merger



Finding rare objects with:

1. AGN pairs: merging stage
2. Red AGN: transition phase?



Thank you!