Galaxy/AGN Evolution at Cosmic Noon: Lyα and UV Luminosity Functions measured by HETDEX and HSC

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Subaru UM 2021, 2022/01/13

Zhang et al. (2021), ApJ, 922, 167

Introduction

Lyα emitters (LAEs):

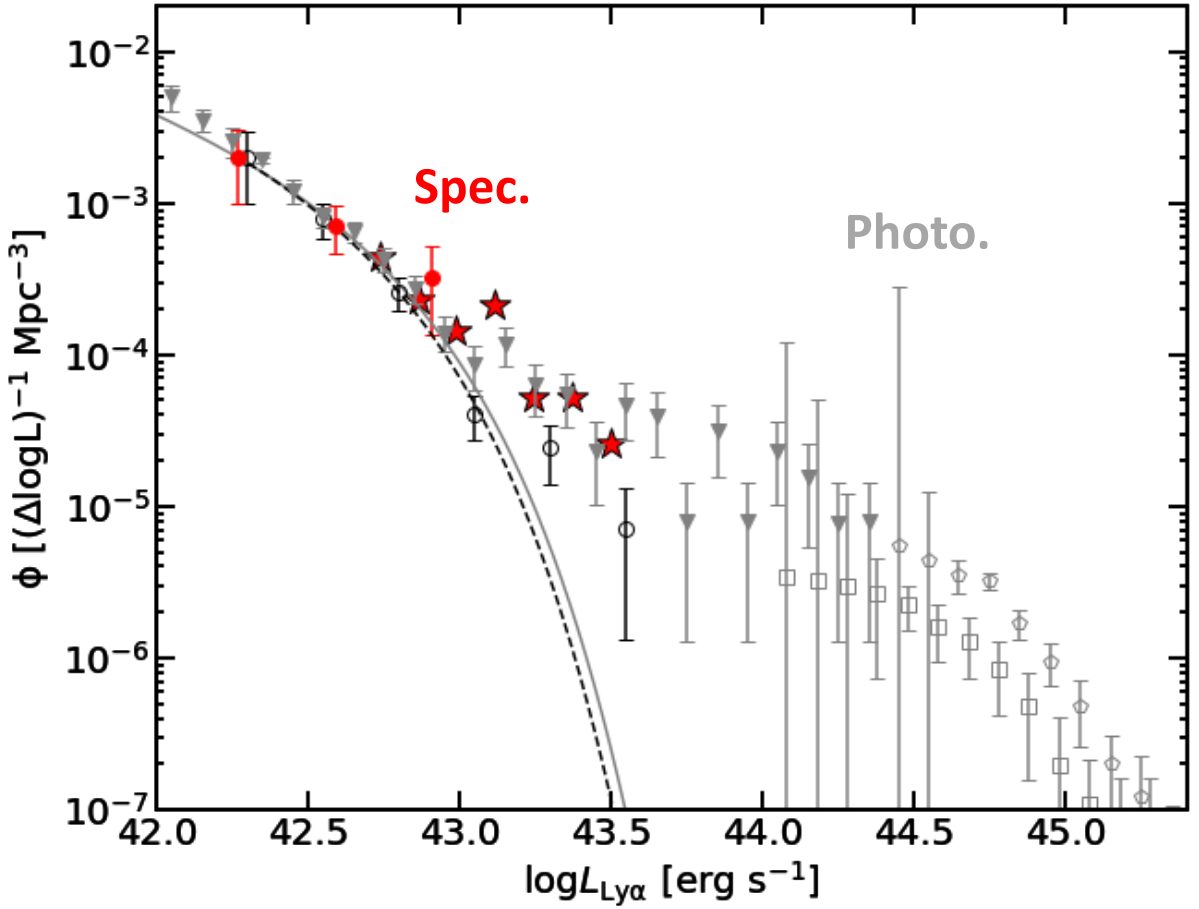
- Strong Lyα w/ faint continuum.
- Probe low mass gal. at high-z.

Luminosity function (LF):

- Traces gal. formation & evolution

Lyα LF (z=2-3):

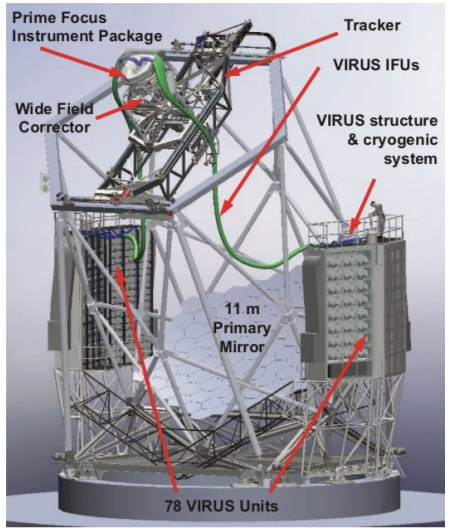
- Bright end hump?
- AGN?



This work:

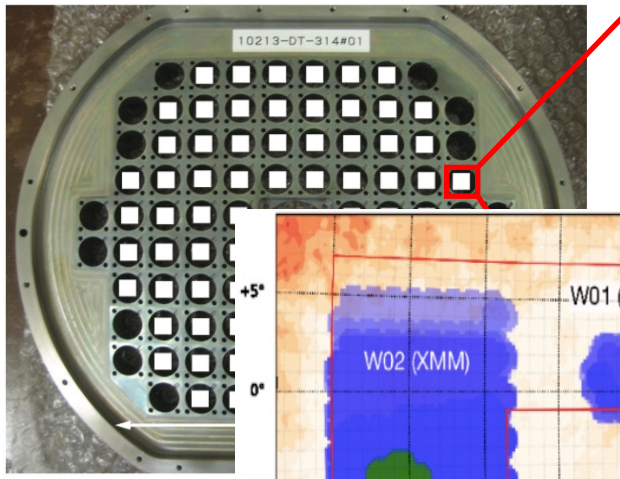
- ➢1. Determine LFs of LAEs at z~2-3
- ➢2. Characterize the objects at the bright end of Lyα LF.

Hobby-Eberly Telescope Dark Energy Experiment (HETDEX):

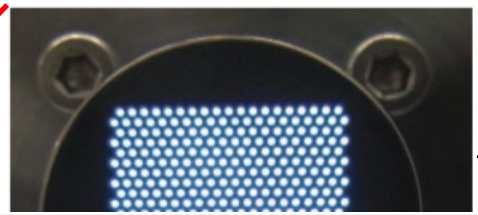


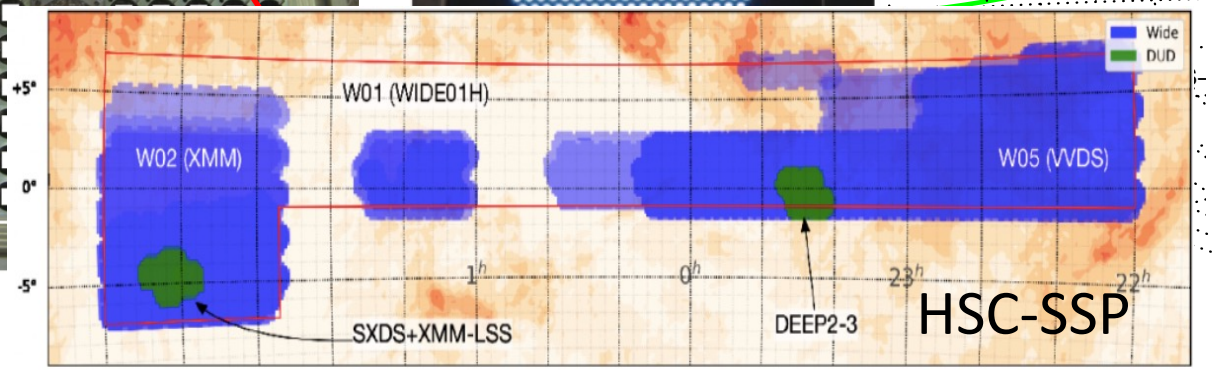
10-m HET Hill+16

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

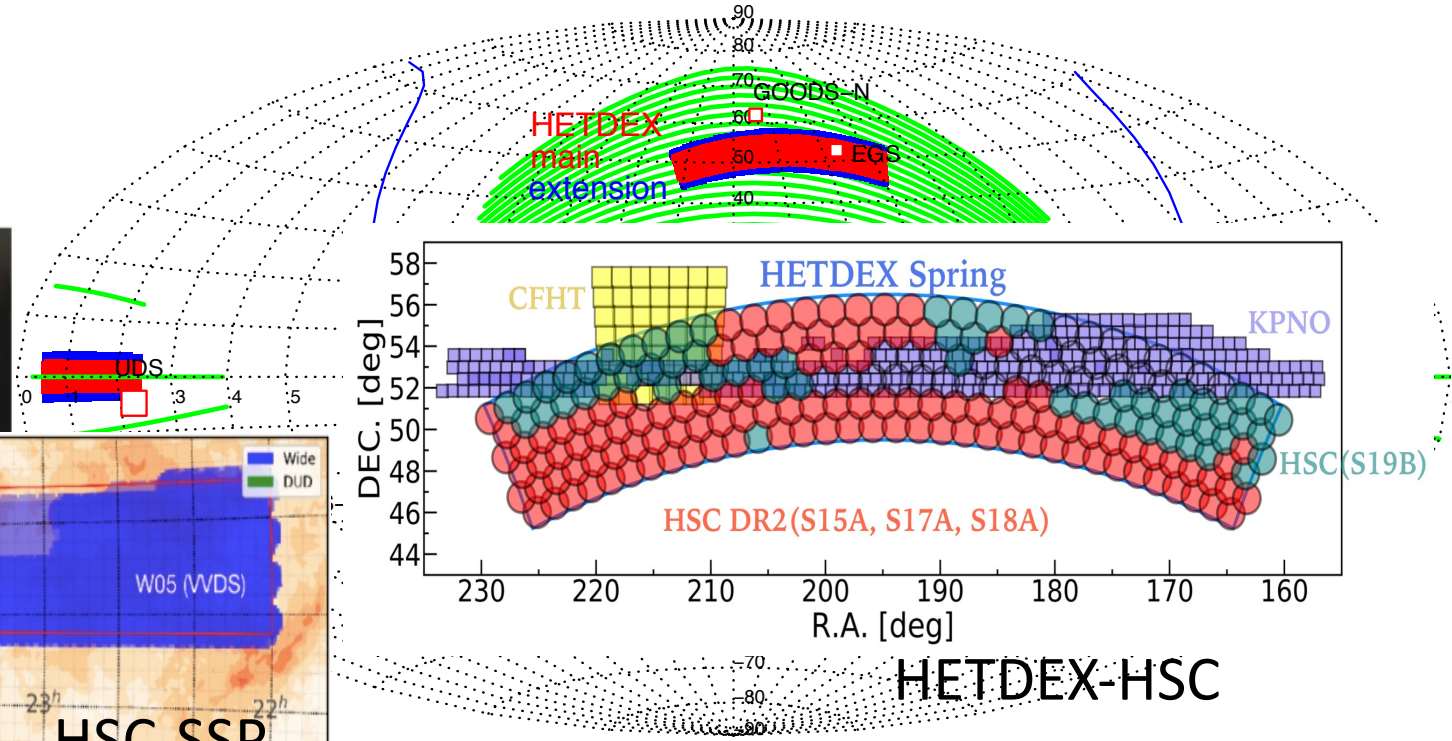


76 (1.5 diameter)

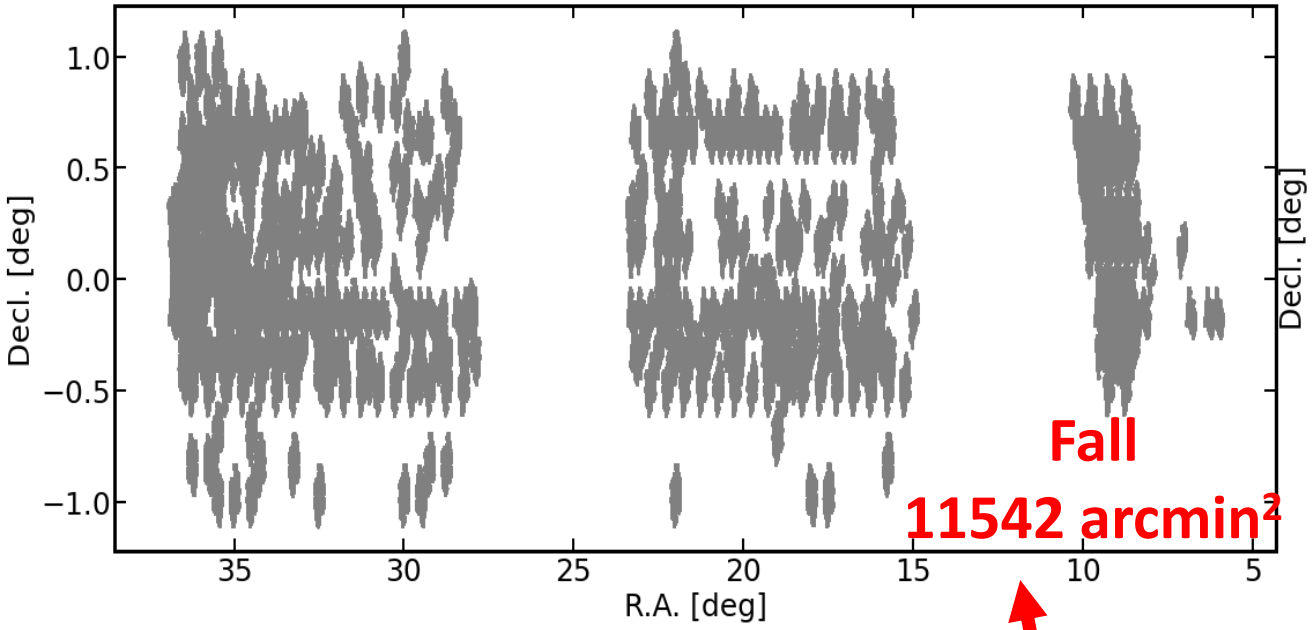


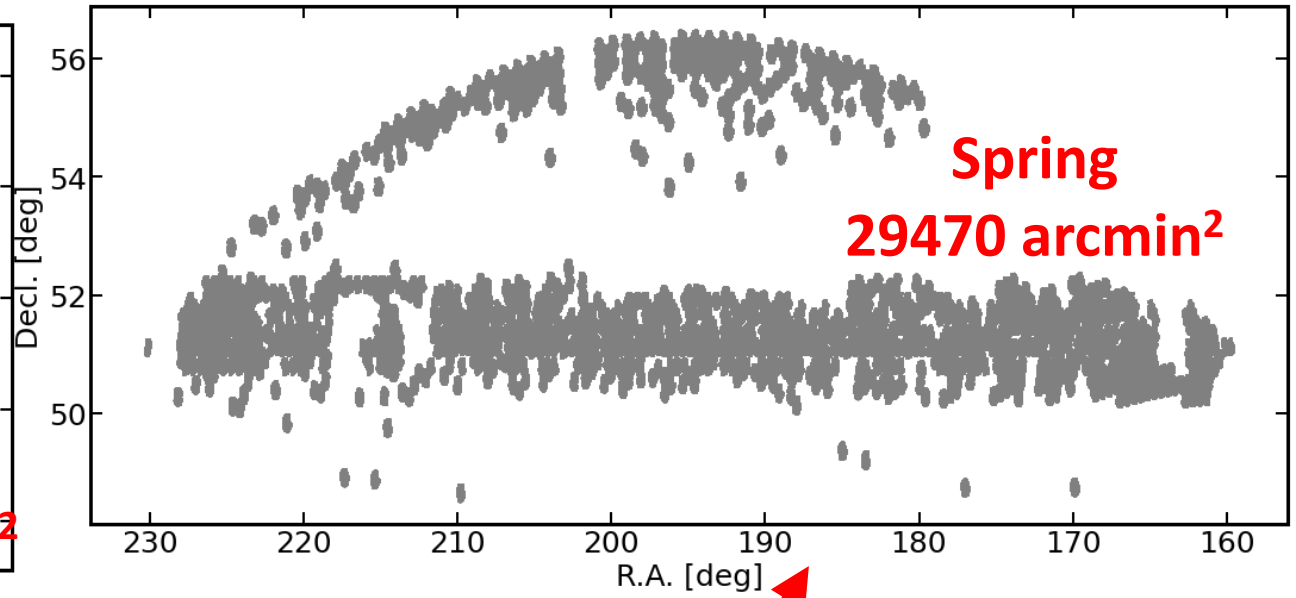


HSC-SSP

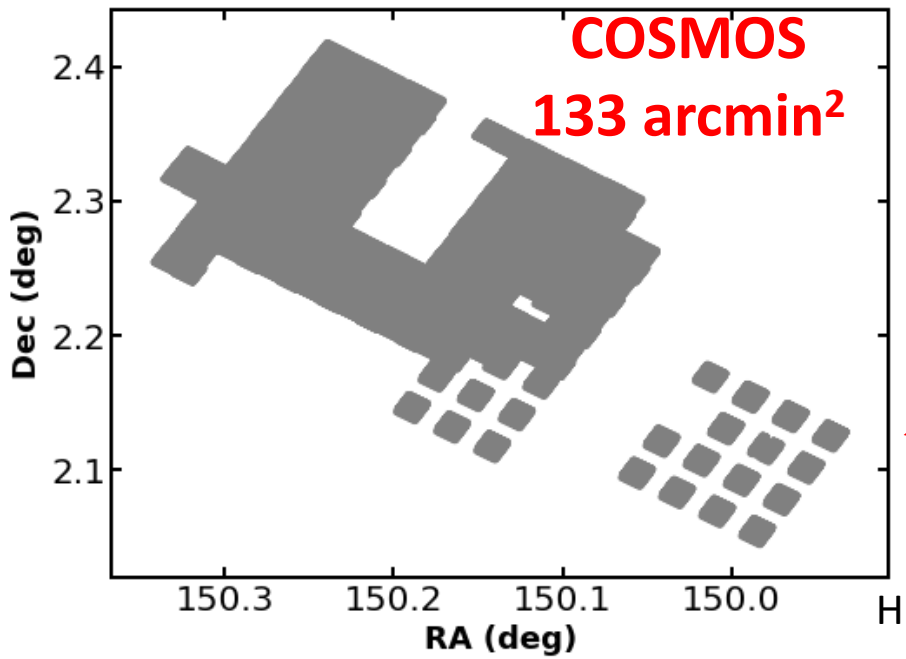


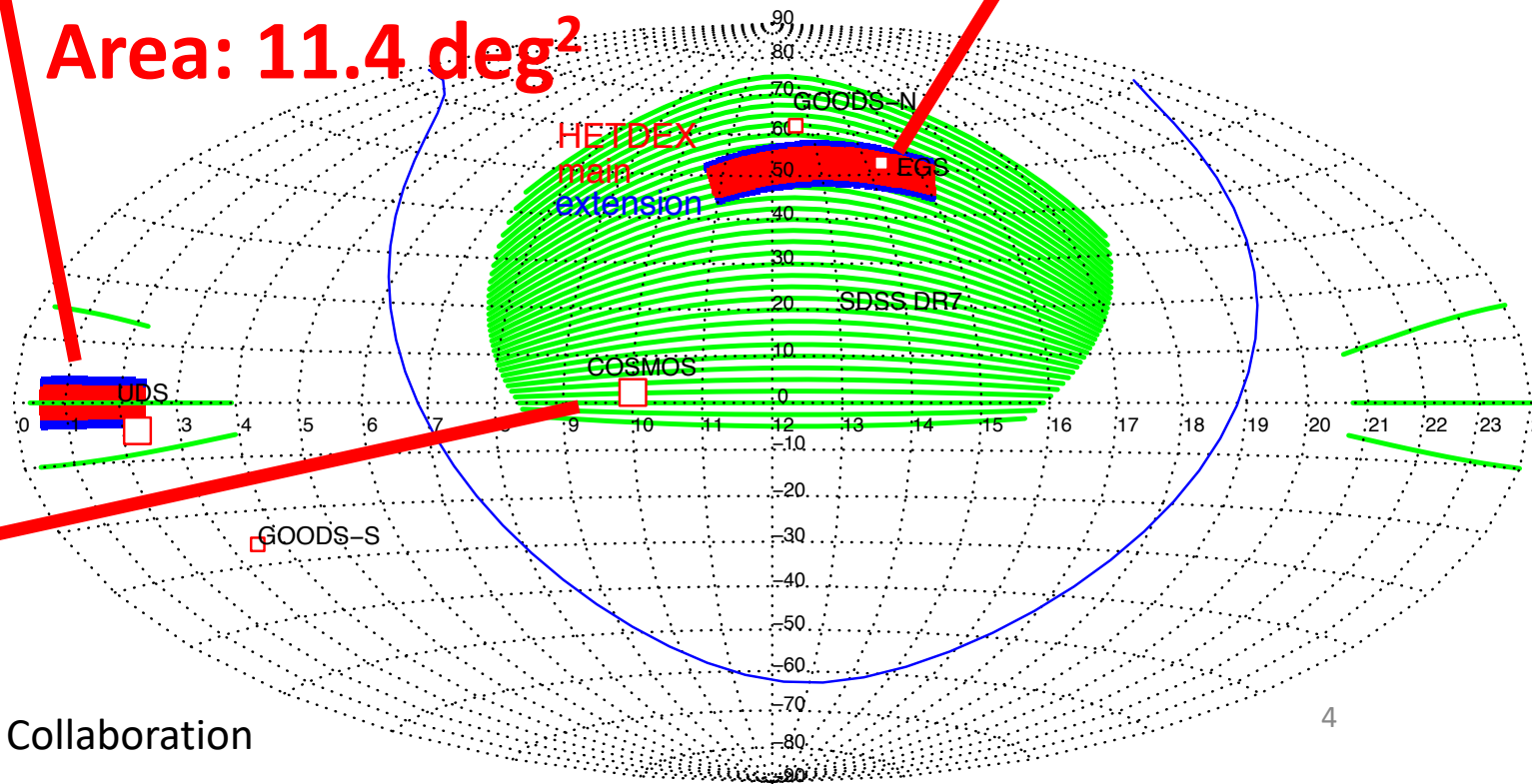
HETDEX-HSC





Area: 11.4 deg²



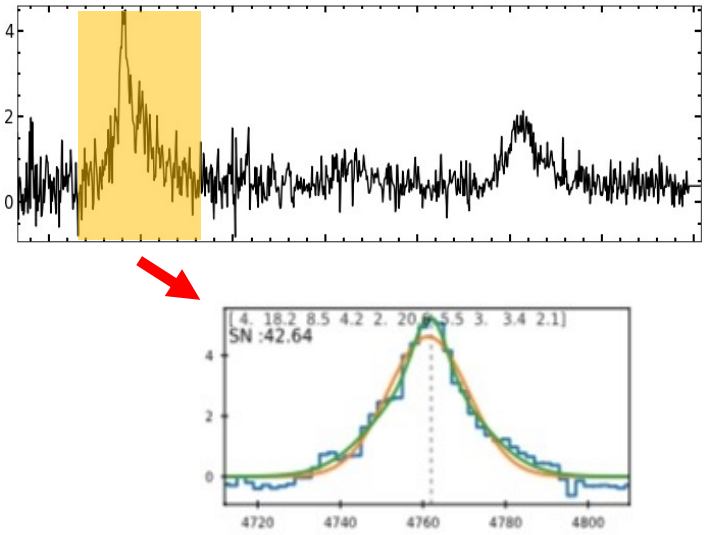


HETDEX Collaboration

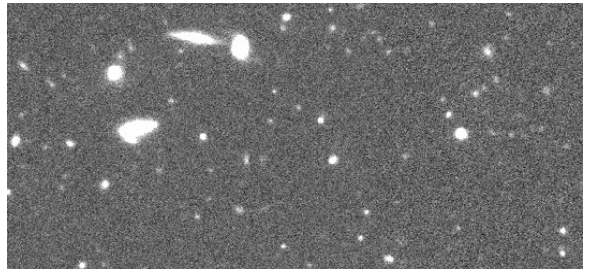
LAE Samples

Line detection

HETDEX spectrum



HSC *r*-band image



- HSC-SSP + HETDEX-HSC

  $r_{5\sigma}$ ~ 25.8(Wide) $r_{5\sigma}$ ~ 25.2

EW_0 > 20 Å

LAE seletion

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

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

Remove [OII] 3727 contamination

w/ Bayesian probability ratio (Leung+17)

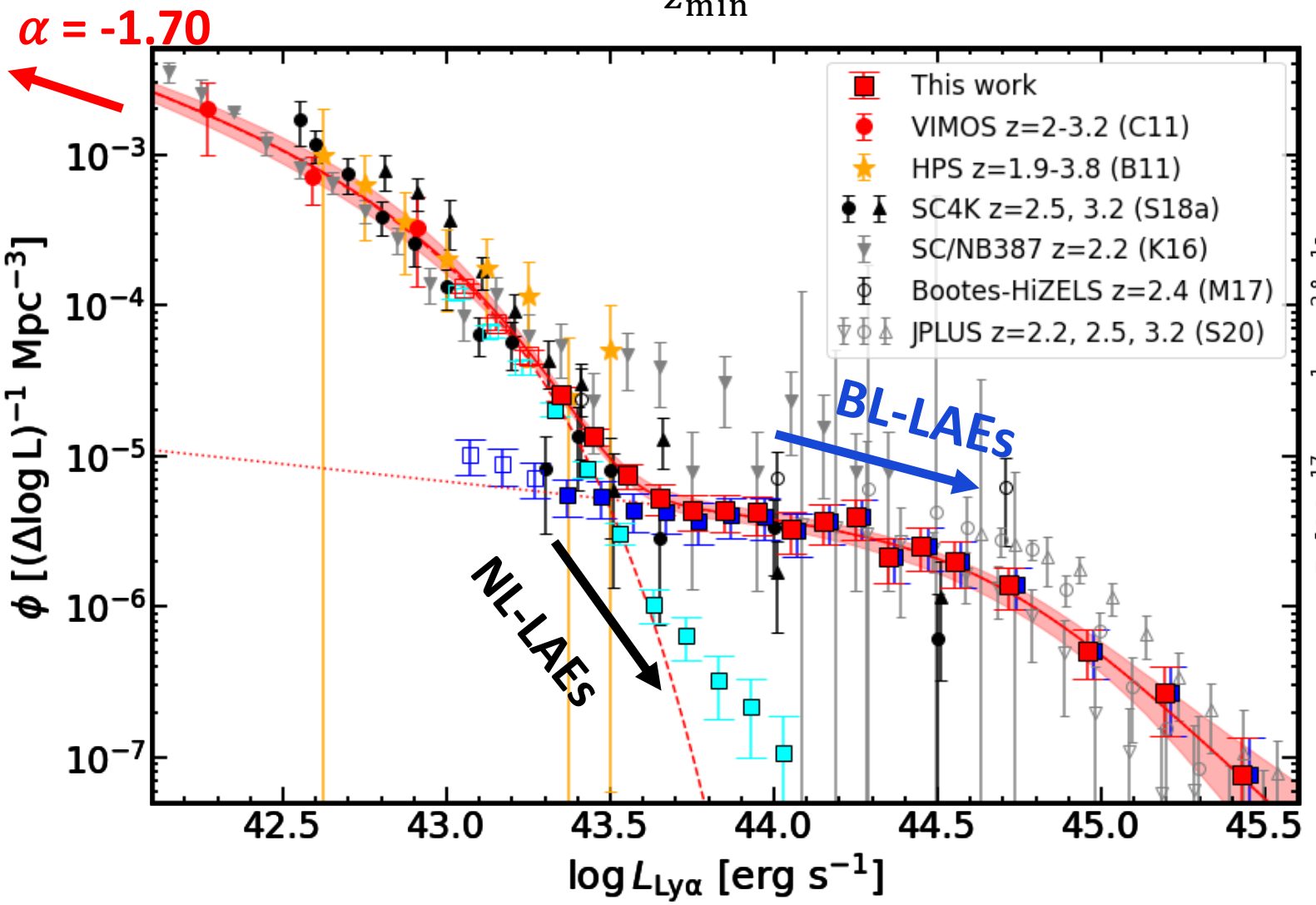
N(NL) = 16194

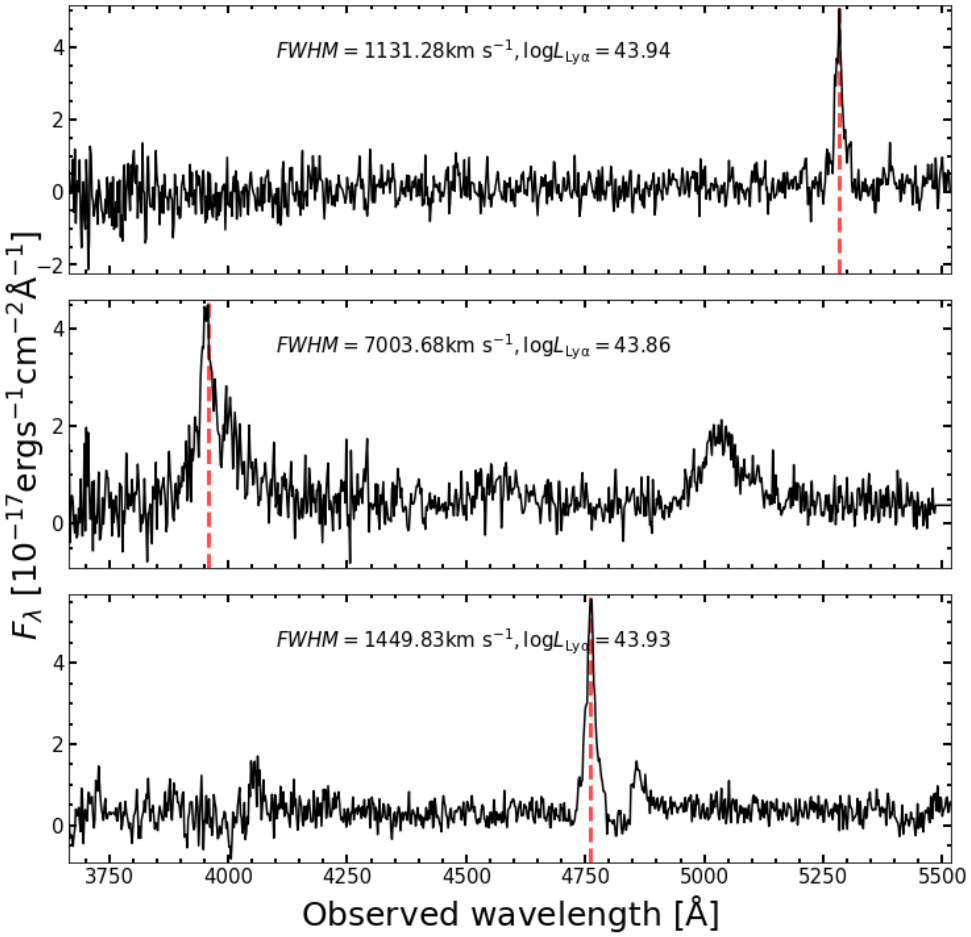
N(BL) = 2126

N(total) = 18320

Lyα LF

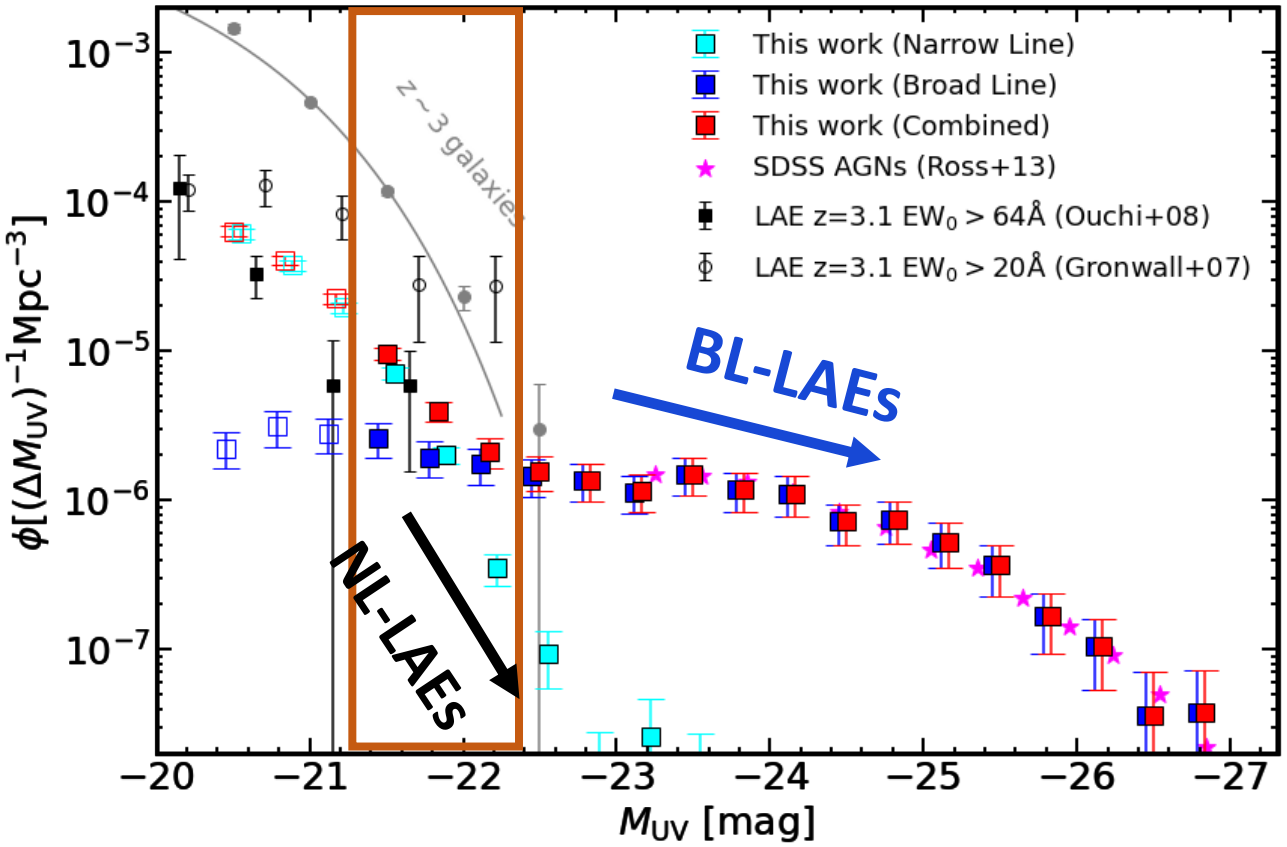
$$V_{\mathrm{max},i} = \omega \int_{z_{\mathrm{min}}}^{z_{\mathrm{max}}} C_i(L,z) \frac{\mathrm{d}V}{\mathrm{d}z} \mathrm{d}z \qquad \phi(\log L) = \frac{1-f_{\mathrm{contam}}}{\Delta(\log L)} \sum_i \frac{1}{V_{\mathrm{max},i}}$$

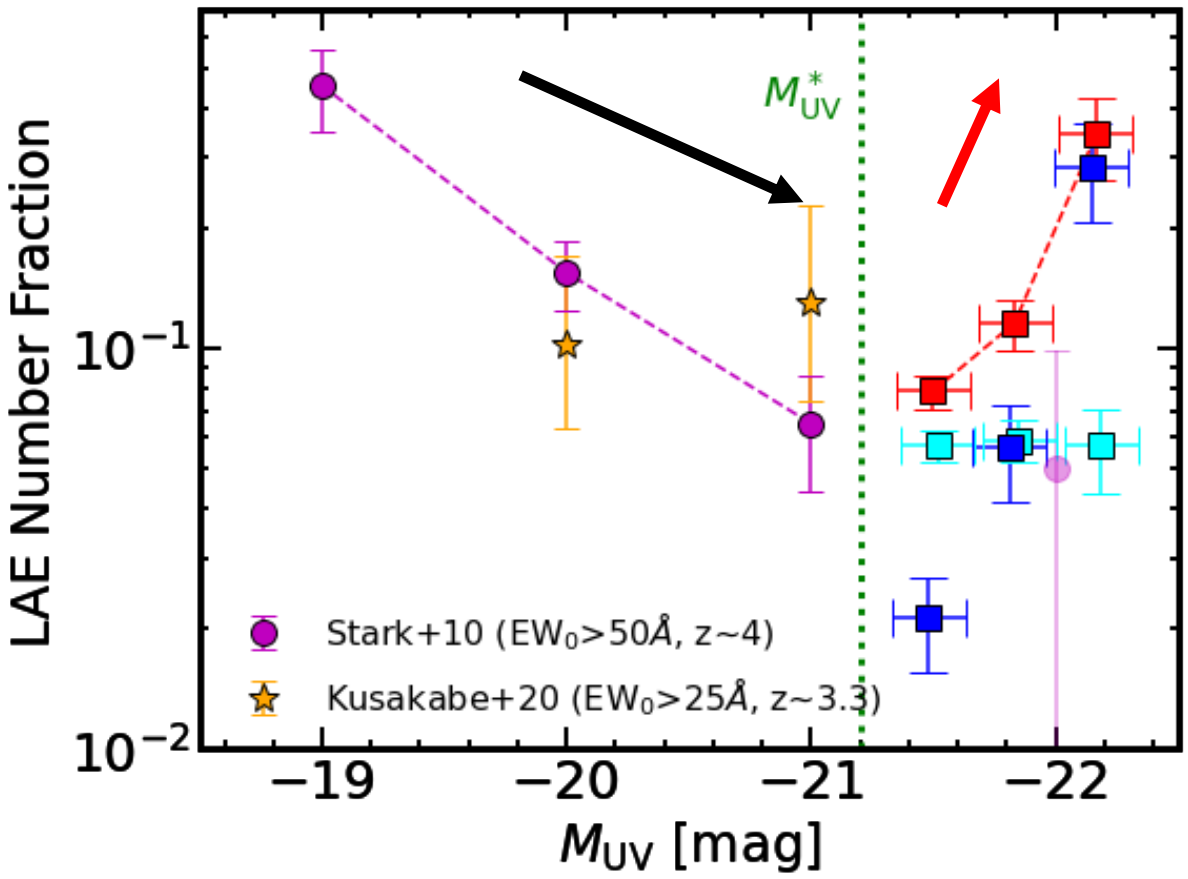




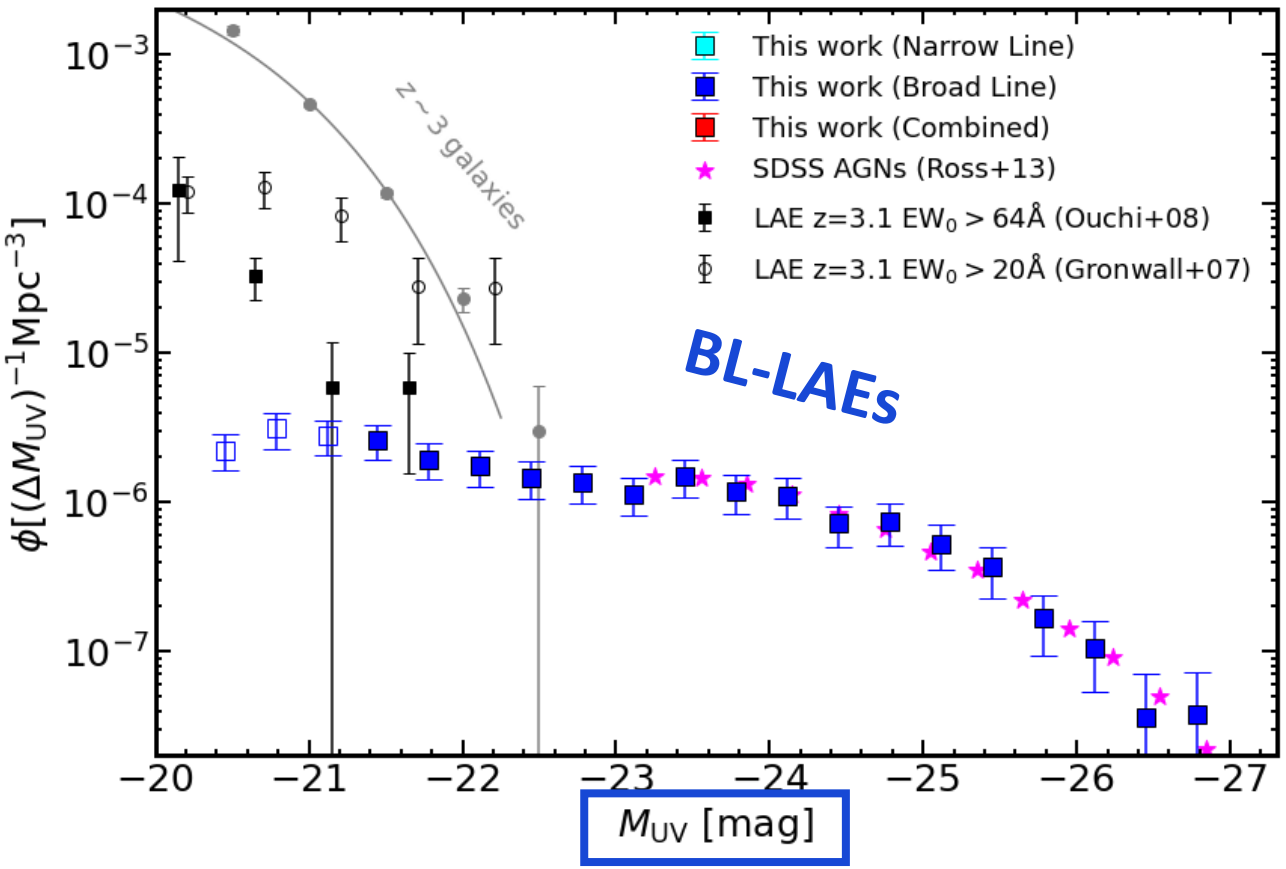
Bright-end hump: spec. confirmed ← **Dominated by Type 1 AGNs**

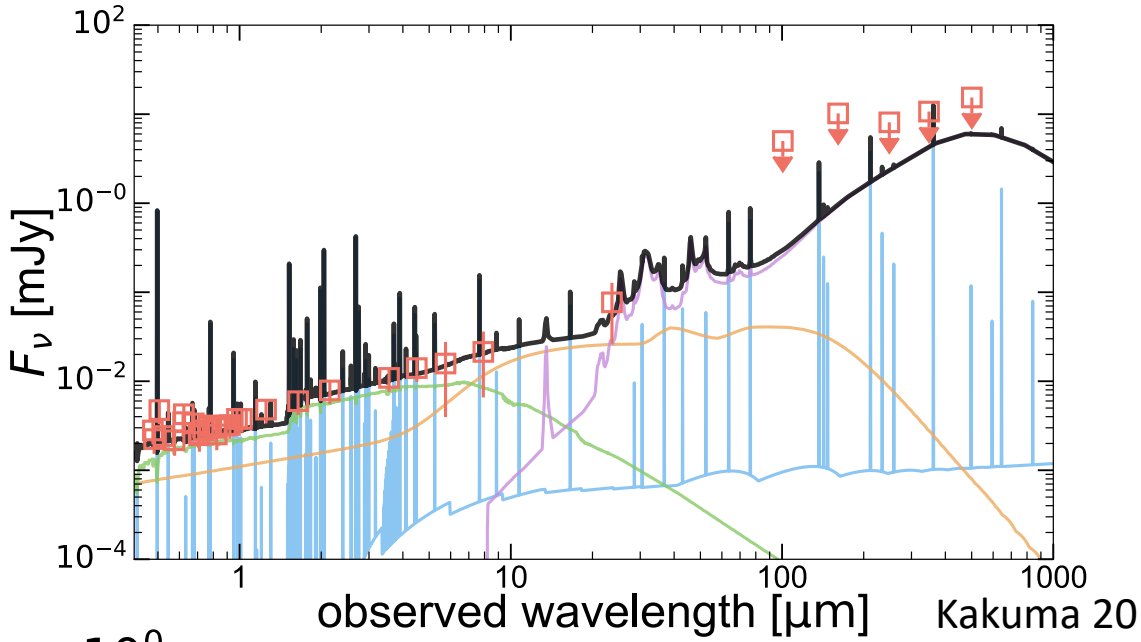
UV LF of LAEs

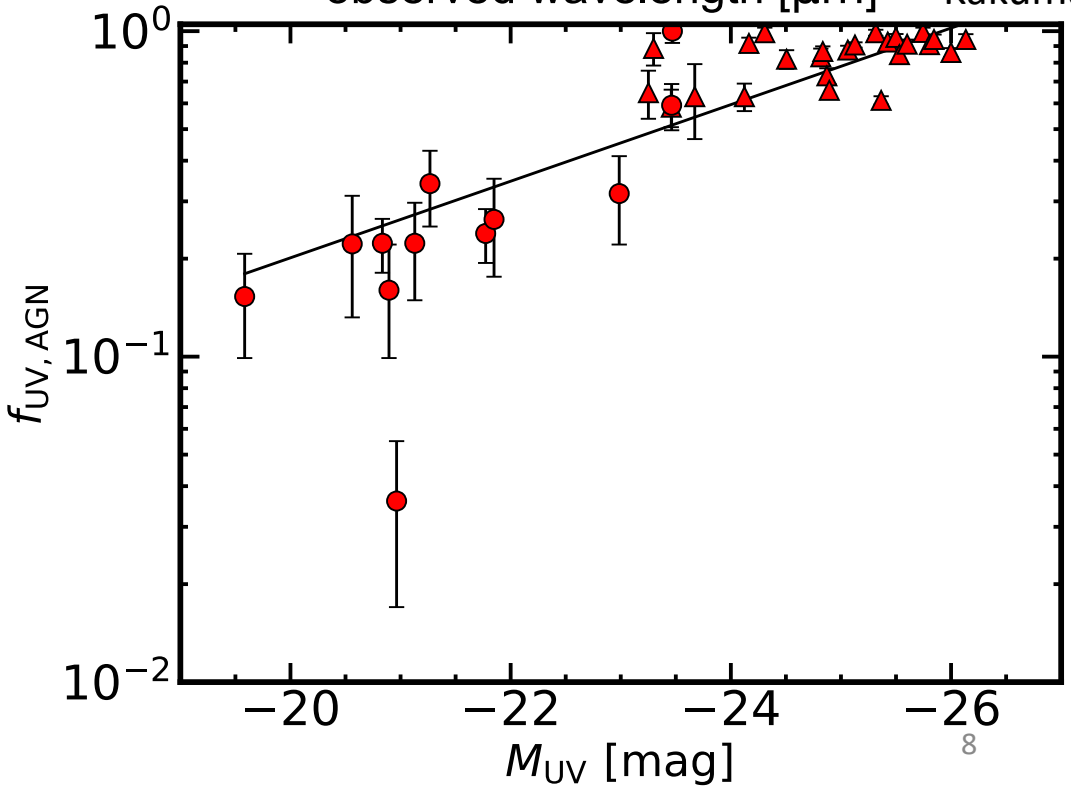




LAE number fraction increases at $M_{uv} < M^*_{uv}$



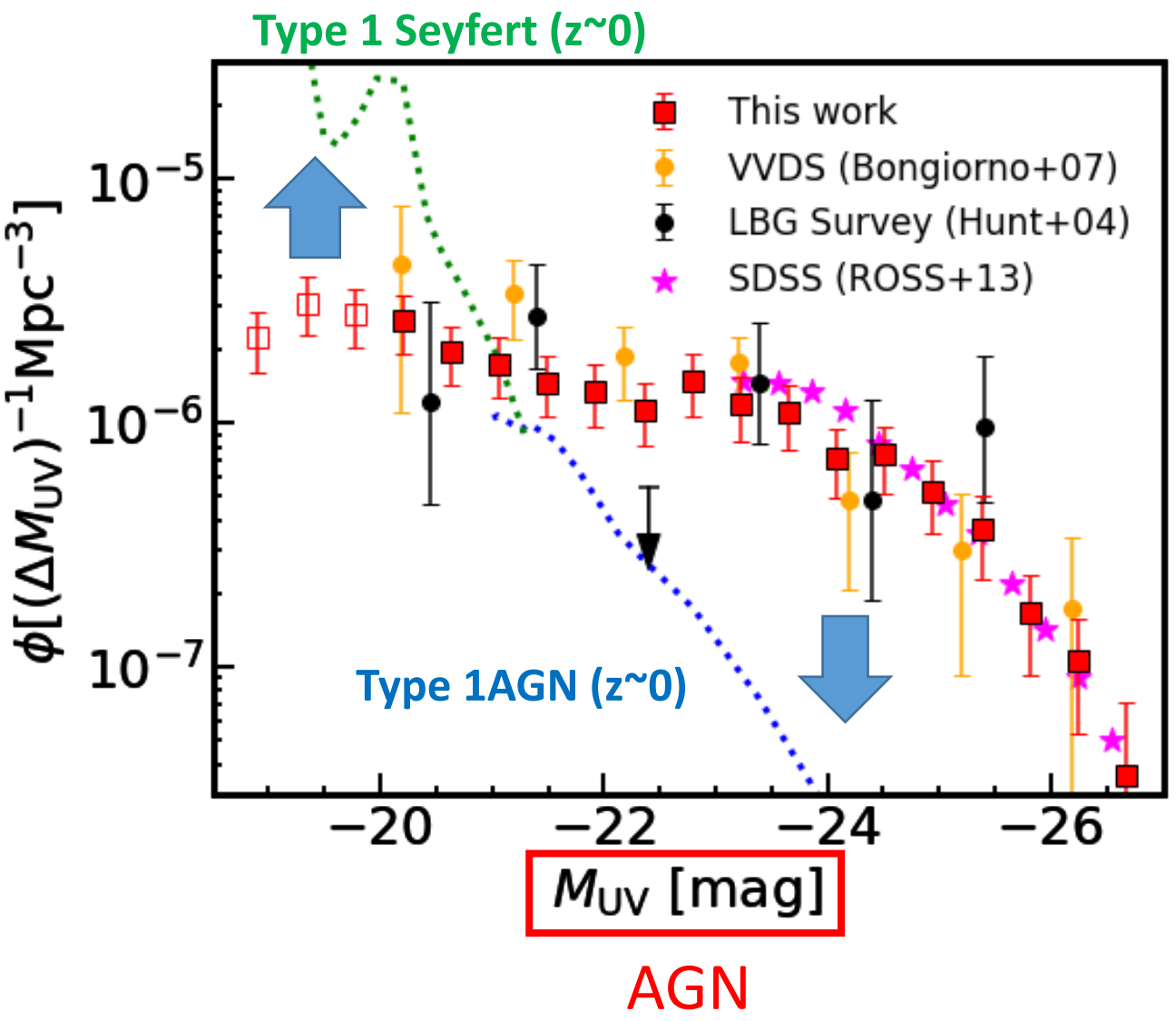




Total: Stellar + AGN

$$\mathrm{Flux}_{\mathrm{AGN}} = f_{\mathrm{UV,AGN}}\,\mathrm{Flux}_{\mathrm{total}}$$

Type 1 AGNs UV LF(z~2 → z~0)



Bright end:

- Agrees well with previous obs.
- Number density decreases towards *z*~0

Faint end:

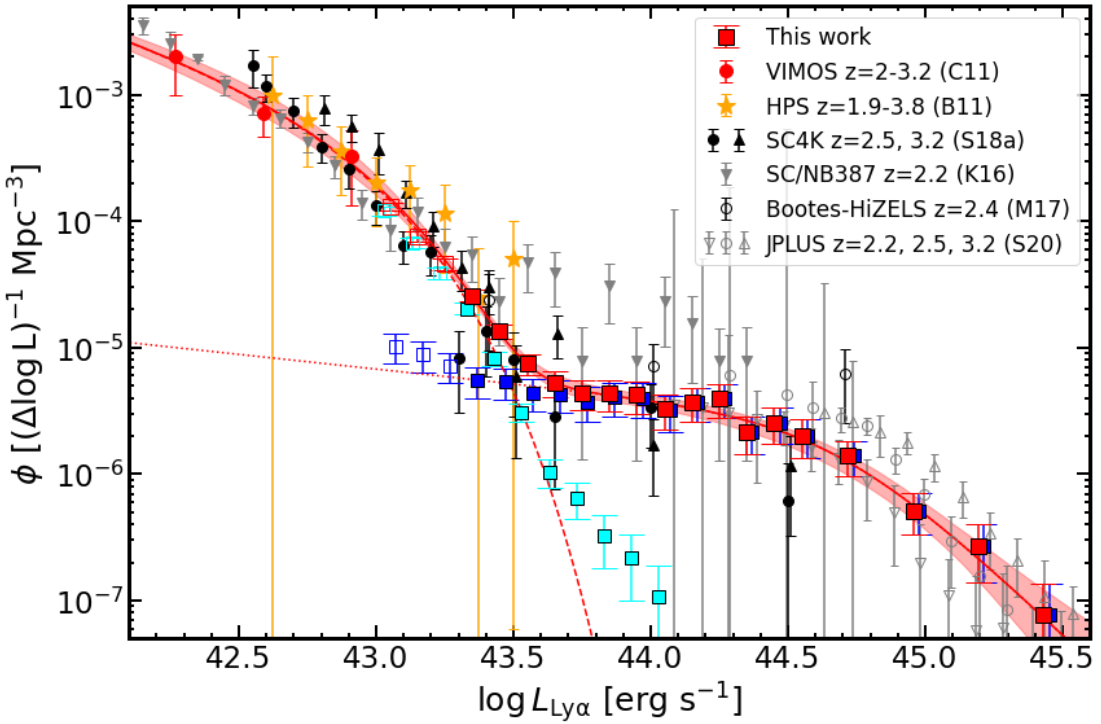
- Extends to M_{uv} ~ -20
- Number density increases towards *z*~0.
  → AGN downsizing

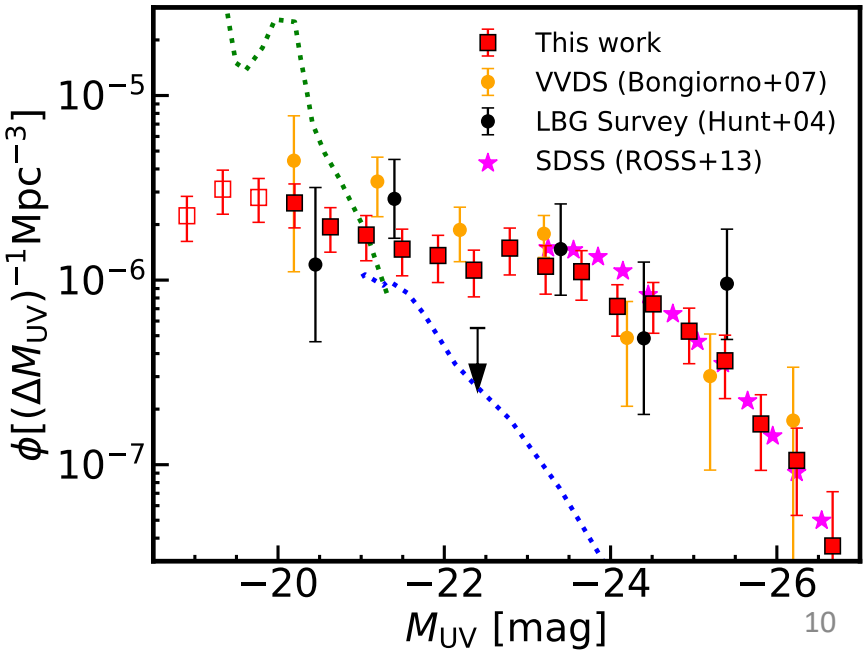
Summary

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

- Lyα LF (SF gal. + AGN):
  - Bright-end hump of Lyα 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: SMBH growth at early stages

Keck LRIS follow-up (PI: K. Nakajima)

- 30-min exposure
- Broad CIV detected at >10σ