Ultra-Faint Lyman-\(\alpha\) Emitters with MUSE

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The Current State of High-Z Galaxy Counts

- Hundreds of $z > 4$ photometric candidates from e.g. CANDELS
- Faint galaxies dominate number counts at all redshifts

(NASA)

(Bouwens+15)

(no lensing)
THE CURRENT STATE OF HIGH-Z SPECTROSCOPY

➤ Hundreds of z > 4 photometric candidates from e.g. CANDELS
➤ Faint galaxies dominate number counts at all redshifts
➤ But relatively few spectroscopic confirmations
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Neutral Fraction of IGM

Robinson+13
(also Finkelstein+12, Bouwens+12)
MUSE SPECTROSCOPY

➤ MUSE at the VLT
➤ R~3000
➤ 4650-9300 Å
➤ 1’x1’ Integral Field Unit
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- ~20 hours in the HDFS (Bacon+15)

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The MUSE UDF Program

- MUSE UDF program has two components:
- “Deep” (30 h; 1.5e-19) and “Mosaic” (9x10 h; 3e-19)
- Matches footprint of deepest HST imaging
THE FULL MUSE UDF PROGRAM

➤ Data release: redshifts and line fluxes for 1338 sources (Inami+17)

➤ ~ x10 more spec-z’s than all previous surveys in the UDF
HIGH-EW LAES IN THE UDF

➤ Bacon+17, Maseda+18b: 102 “HST-undetected” LAEs in the UDF

➤ $z = 2.9 - 6.7$

<table>
<thead>
<tr>
<th>Filter</th>
<th>$AB_{5\sigma}$</th>
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<tbody>
<tr>
<td>F606W</td>
<td>29.6</td>
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<td>F775W</td>
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<td>F850LP</td>
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<td>F105W</td>
<td>30.1</td>
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<td>F125W</td>
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9 sq. arcmin!
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WHY ARE THESE SOURCES POTENTIALLY INTERESTING?

➤ Plausibly high-EW LAEs (> 300 Å)

➤ Can only occur with young ages (< 10 Myr), very low metallicities, and/or top-heavy IMFs
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PHOTOMETRIC STACKS

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➤ $M_{UV} \sim -15$

➤ Blue continuum slopes
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PHOTOMETRIC STACKS

- Effect of Ly-α visible
- \( M_{\text{UV}} \sim -15 (M^* < 10^{7.5} M_\odot) \)
- Blue continuum slopes

- F435W  F606W (Lyα)  F775W  n = 54
  \( z > 2.4 \)  \( z > 2.4 \)  \( z > 2.4 \)
  \( m > 33.3; 0.8\sigma \)  \( m = 31.3; 6.3\sigma \)  \( m = 31.2; 6.9\sigma \)

- F606W  F775W (Lyα)  F850LP  n = 22
  \( 2.4 < z < 5.6 \)  \( 2.4 < z < 5.6 \)  \( 2.4 < z < 5.6 \)
  \( m > 33.7; -0.8\sigma \)  \( m = 30.6; 6.2\sigma \)  \( m = 31.1; 4.1\sigma \)

- F775W  F850LP (Lyα)  F105W  n = 4
  \( 5.6 < z < 6.8 \)  \( 5.6 < z < 6.8 \)  \( 5.6 < z < 6.8 \)
  \( m > 32.5; -0.2\sigma \)  \( m = 31.0; 1.8\sigma \)  \( m = 30.5; 2.4\sigma \)
PHOTOMETRIC STACKS

➤ Effect of Ly-α visible

➤ $M_{UV} \sim -15$

➤ Blue-ish continuum slopes
Sample: 32 HST-undetected LAEs

$3.829 < z < 4.955$ (H$\alpha$ in 200h IRAC GREATS data; Labbé+15)

$M_{1500} = -15.2; \text{EW}_{\text{Ly} \alpha} > 500 \, \text{Å}$

Lam et al. (accepted)
STAY TUNED FOR OUR NEWEST UDF OBSERVATIONS

>150 hours
w/ GL-AO

(R.Bacon)
HIGH-EW LAES IN THE UDF

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CONCLUSION AND OUTLOOK

➤ Abundant population of high-EW LAEs in the UDF
  ➤ \( M_{UV} \) as faint as -15 on average
  ➤ Efficient producers of ionizing photons?
  ➤ We should expect this and more with JWST