Slitless Spectroscopy at Cosmic Dawn with Roman

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Deep Slitless Spectroscopy from Space

Slitless spectroscopy from space for EoR science: Above the OH airglow; spatial resolution boosts S/N ratio.

Lyman alpha galaxies are small at all redshifts.

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Barton et al 2004

Malhotra et al 2012, 
ApJL 750, L36, figure 2

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Fig. 1.—"Windows" in the J-band night-sky spectrum. The black line indicates the transmission of the night sky (scale on right). We plot the night-sky spectrum at two resolutions (R = 1000, red line; R = 300, blue line) to indicate regions below 0.1 of the mean background (blue shading for moderate resolution, red shading for high resolution). At moderate resolution, only a small number of windows are available.
Results from deep HST grism

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GRAPES: HUDF, G800 10 orbits x 4 PAs
PEARLS: G800, 8 fields to 5 x 4 PAs
FIGS: G102, 4 fields 8x5PAs
(Deep Imaging data from HST)
Deep HST slitless grism data
Malhotra et al. 2005

GRAPES spectrum with model LBG at z=5.83
Z=11 galaxy (Oesch et al. 2016)
Z > 7 Ly-α lines in FIGS.


Tilvi et al. 2016
z=7.51; simultaneous line & break

Larson et al. 2018
z = 7.45, high equiv. width
Spectroscopy unbiased to Lyman \( \alpha \):

Real HST grism spectra from the GRAPES and PEARS projects. Composite \( z \sim 5 \) LBG spectra for the full GRAPES sample (top), and those without LyA (middle) and with LyA (Bottom). [Rhoads et al 2009].
NEED FOR MULTIPLE POSITION ANGLES

A Spiral galaxy at z=0.3

Direct image  |  Dispersed image
Spectroscopically identified objects:

from 600 to $6.7 \times 10^{10}$ pc
Improving Photo-z’s
Pharo et al. 2018, (Ryan et al. 2007)

Improve photo-z’s from 3% to 2% scatter
Four orients: 0, 8, 90, 98 degrees orient to disentangle overlapping spectra.

Good agreement demonstrates good wavelength and flux calibration.
• $\sigma_z = 0.006$ for ACS grism, with $R = 100$ (Xia et al 2011).

• This improves for $R \sim 200$ WFC3 G102.

• Expect further improvement with $R \sim 500$ WFIRST grism.

**Figure 3.** Redshift differences between the spectroscopic and the grism redshifts as a function of the spectroscopic redshifts. The accuracy of the grism redshift is measured to be $\sigma_z = 0.006$.  

*(From Xia et al, 2011)*
Worry about errors

- Random (known) errors ---- from testing
- Systematics (known) ----- from simulations (?)
- Systematics (unknown at present) – open mind.

“It ain’t what you don’t know that gets you into trouble. It's what you know for sure that just ain't so.” – Mark Twain.