Galaxies at High Redshift and Their Evolution Over Cosmic Time
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Wide-Field Slitless Spectroscopy with JWST's NIRISS

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Abstract. The Near Infrared Imager and Slitless Spectrograph (NIRISS) aboard the *James Webb Space Telescope (JWST)* will offer wide-field slitless spectroscopy (WFSS) with a resolving power R = 150 at wavelengths from 0.8 to 2.25 microns. In this band, NIRISS will be sensitive to Lyman α emission lines and continuum breaks in the spectra of galaxies with redshifts $6 < z < 17$, allowing it to probe the first stars and ionizing sources in the early universe. NIRISS observations of the high-redshift universe will provide a wealth of information on foreground objects, creating a unique library of optical emission-line spectra from the faintest galaxies at lower redshifts. To explore its ability to identify and characterize galaxies at all redshifts, we have modeled a NIRISS observation of a massive strong-lensing galaxy cluster and analyzed the synthetic images using standard software tools. Our simulations demonstrate that WFSS with NIRISS will provide a powerful tool for the exploration of galaxies near and far.

Keywords. techniques: spectroscopic, galaxies: high-redshift, infrared: galaxies

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To explore its ability to observe high-redshift galaxies – and our ability to identify them – we modeled a NIRISS observation of the massive lensing galaxy cluster MACS J0647+7015. Using published images, photometry, and redshifts from the CLASH survey (Postman *et al.* 2012), we constructed a series of simulated direct and dispersed images in the six filters available for WFSS with NIRISS. We added 180 simulated high-redshift ($6 < z < 15$) galaxies distributed uniformly in space, redshift, and magnitude to each image. Using Source Extractor (Bertin & Arnouts 1996), we identified 7200 galaxies in the F200W image, including 165 of our 180 high-z galaxies. The 15 missing galaxies fell on bright foreground objects. We used the aXe software package (Kümmel *et al.* 2009) to extract and calibrate the spectra from each combination of filter and grism and an automated routine to fit a simple model to each spectrum. Of the 165 high-z galaxies in our sample, 109 yield best-fit redshifts with errors $|z_{\rm fit} - z| < 0.1$, 5 yield redshifts with large error bars that include the true redshift, 5 suffer from spectral overlaps that are not properly modeled by aXe, and 46 trigger an error or warning from our fitting routine. Details are presented in Dixon & Willott (2013).

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References

Bertin, E. & Arnouts, S. 1996, *A&AS*, 317, 393
Dixon, W. V. & Willott, C. J. 2013, *STScI Newsletter*, 31(2), 28
Kümmel, M., Walsh, J. R., Pirzkal, N., Kuntschner, H., & Pasquali, A. J. 2009, *PASP*, 121, 59
Postman, M. *et al.*, *ApJS*, 199, 25