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Spectroscopy from Photometry: A Population of Extreme Emission Line Galaxies at $1.7 \lesssim z \lesssim 6.7$ Selected with JWST Medium Band Filters

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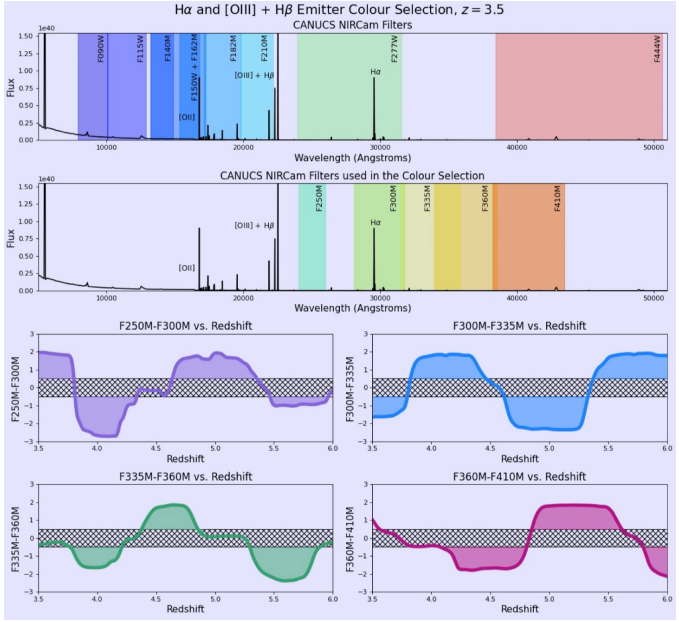
ABSTRACT

We use JWST/NIRCam medium band photometry in a single pointing of the CAnadian NIRISS Unbiased Cluster Survey (CANUCS) to identify 118 Extreme Emission Line Galaxies (EELGs) over $1.7 \lesssim z \lesssim 6.7$, selected using a set of color cuts that target galaxies with extreme [OIII] + Hβ and Hα emission. We show that our medium band color selections are able to select galaxies based on emission line EW, which is advantageous to more commonly used selections since it does not require strong continuum emission, and can select galaxies with faint or red continuum fluxes. The median EWs of our sample is $EW(\text{H}\alpha) = 893$ Å and $EW([\text{OIII}] + \text{H}\beta) = 1255$ Å, and includes some objects with $EW([\text{OIII}] + \text{H}\beta) \sim 3000$ Å. These systems are mostly compact with low stellar mass (median $\log(M_\star/M_\odot) = 8.03$), low metallicity (median $Z = 0.14Z_\odot$), little dust (median $A_V = 0.18$ mag) and high SSFR (median $SSFR = 1.18 \times 10^{-8}/yr$). Additionally, galaxies in our sample show increasing EW(Hα) and EW([OIII] + Hβ) with redshift, an anti-correlation of EW(Hα) with stellar mass, and no correlation between EW([OIII] + Hβ) and stellar mass. Finally, we present NIRSpec spectroscopy of 15 of the EELGs in our sample. These spectra confirm the redshifts and EWs of the EELGs calculated from the medium bands, which demonstrates the accuracy and efficiency of our color selections. Overall, we show that there are significant advantages to using medium band photometry to identify and study EELGs at a wide range of redshifts.

CAnadian NIRISS Unbiased Cluster Survey (CANUCS)

~ 28.9 mag in medium bands, ~ 29.4 mag in wide bands to 5σ



JWST Filters (BB, MB) + HST data: F438W, F606W

λ ~ 0.4 – 5 μm

Bottom panels: The color selection of [OIII]+Hβ and Hα from synthetic NIRCam observations of SEDs.

EW(Hα) > 500 Å

EW([OIII]+Hβ) > 1000 Å

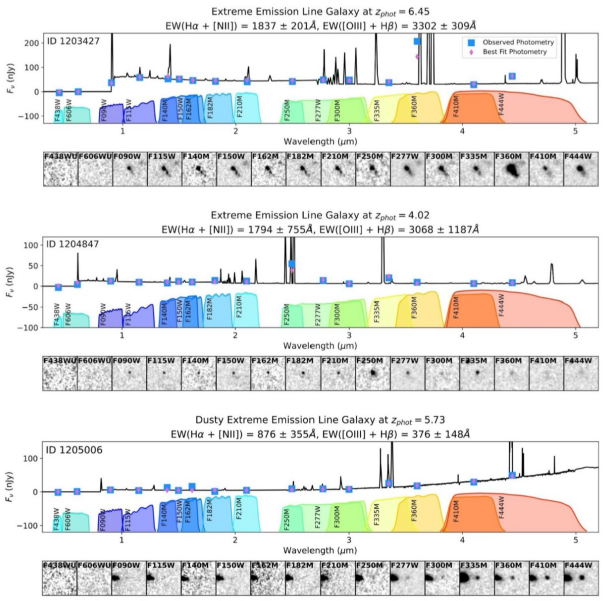
Redshift: 1.7 < z < 6.7

S/N ≥ 4 in line emission

S/N ≥ 2 on continuum

Sample:

118 objects extreme [OIII]+Hβ and Hα emission.



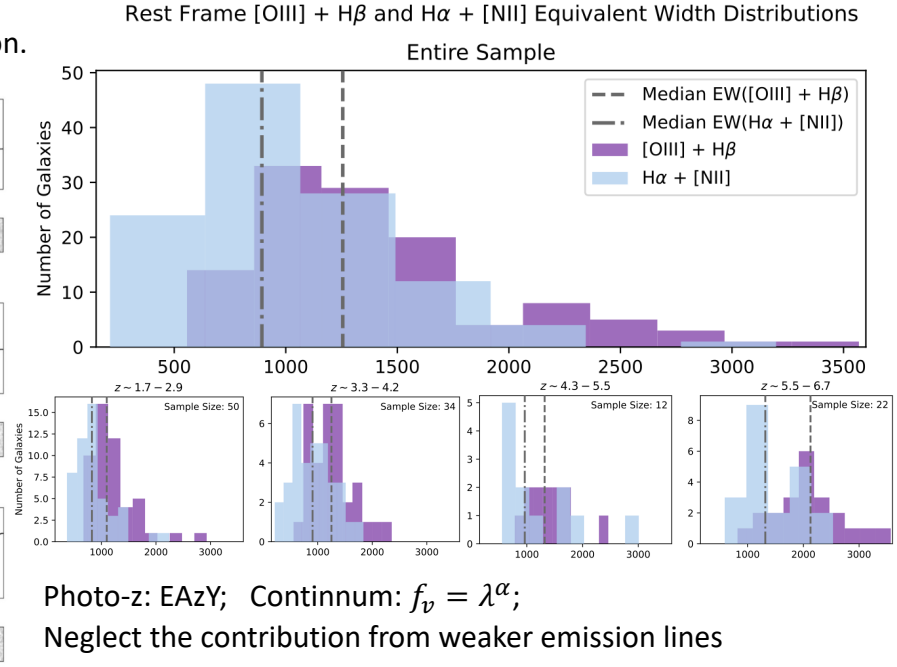
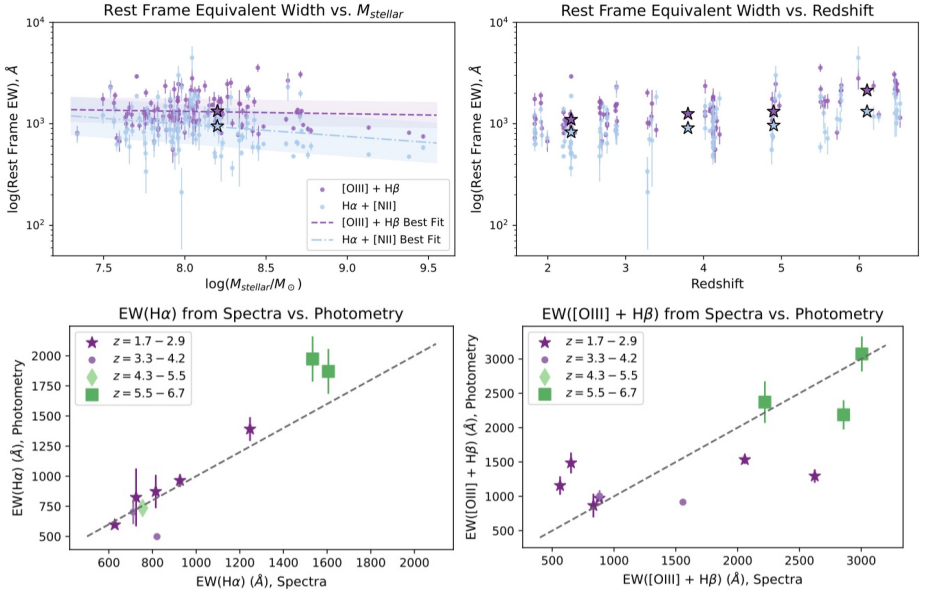


Photo-z: EAzY; Continnum: $f_\nu = \lambda^\alpha$;

Neglect the contribution from weaker emission lines

Galaxy properties: The **Dense Basis** SED fitting code

These galaxies are typically low mass (median log(M*) = 8.02), low metallicity (median Z = 0.14Z$_\odot$), with little dust attenuation (median A$_V$ = 0.18 mag), and high SSFR (median SSFR = $1.18\times10^{-8}/yr$).



Left: Anti-correlation between rest frame EW(Hα) and stellar mass; No correlation of EW([OIII]+Hβ) and stellar mass (selection biases).

Right: Increasing EW([OIII]+Hβ) and EW(Hα) with redshift,

Follow-up spectroscopy for 15 objects

A general agreement between EWs calculated from medium band photometry and from the spectra.

Unsolved issues: 1. contamination from other emission lines

2. All of the flux from emission lines falls in one filter