Assessing the Robustness of Emission Lines in the HETDEX Spectra

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Introduction

* Lyman alpha emitting galaxies (LAEs) have a strong connection to present-day galaxies

* The Hobby-Eberly Telescope Dark Energy Experiment (HETDEX) has already discovered over 100,000 LAEs that could very well represent an early phase in galaxy formation

* The collected data also contains spurious and ionized oxygen [O II] detections that require classification and quality assessment to improve the robustness of the observed galaxy samples

Background

* Lyman alpha emitters appear to be very similar to ionized oxygen emitters when observed, making it important to distinguish between the two.

* The data observed comes from HDR2.1, which is the tentative update to the second internal HETDEX Data Release of emission lines, including GOODS-N which is the best-studied field

* The emission line information was viewed using Elixir, a diagnostic tool that combines HETDEX data to aid with observations

Methods

* HETDEX emission lines in the GOODS-N field were classified as either being an LAE, an [O II] emission, or as a spurious detection

* The spurious detections were categorized as either being skyline emissions or observed due to other system errors

* Emission lines from the skyline were plotted to check if they had any commonality that would make them easier to filter out from the data
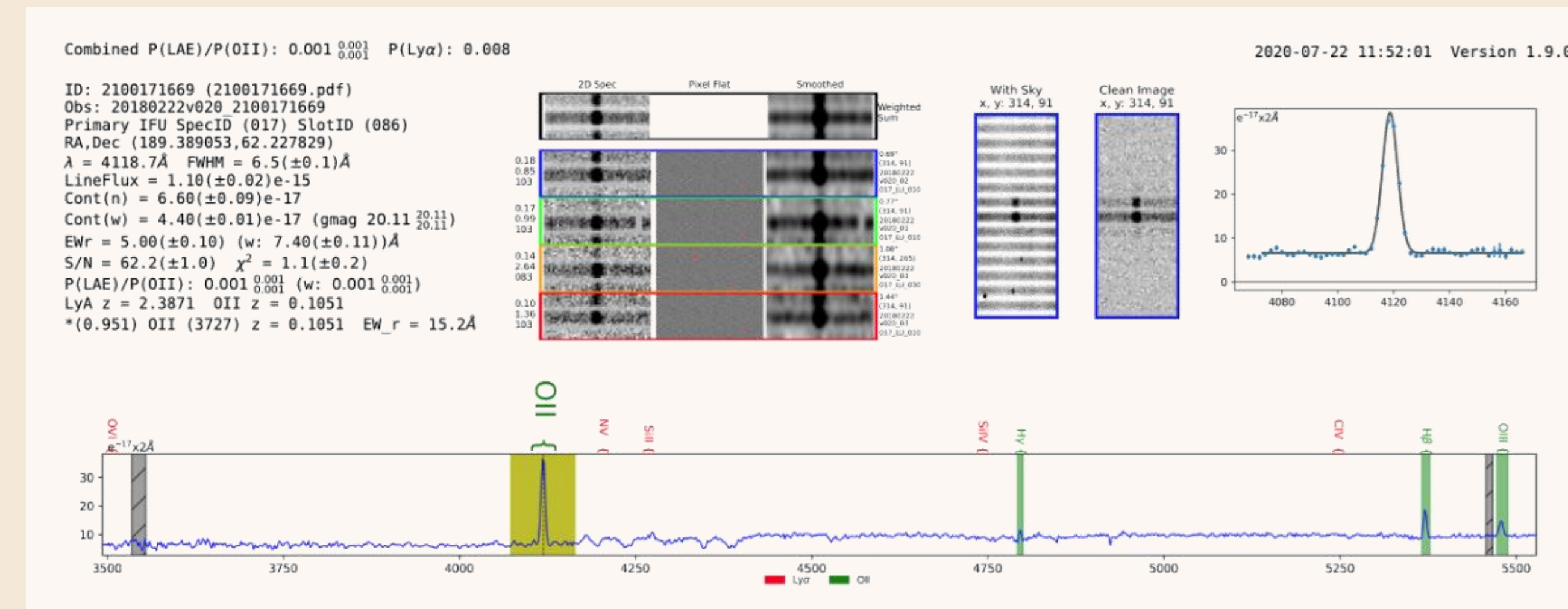
Ionized Oxygen [O II] Emission Line

Fig 1. Classification Sheet of an Ionized Oxygen Emission: The figure shows the typical information given for a detection; the top left corner shows the basic information of the detection, followed by fiber imaging of the detected object in the middle, and a zoomed in image of the spectrum at the top right corresponding with the full spectrum below. The main detection in the spectrum (highlighted in yellow) shows the [O II] emission line, while the additional detections (highlighted in green) show emission lines that correspond with the main one.
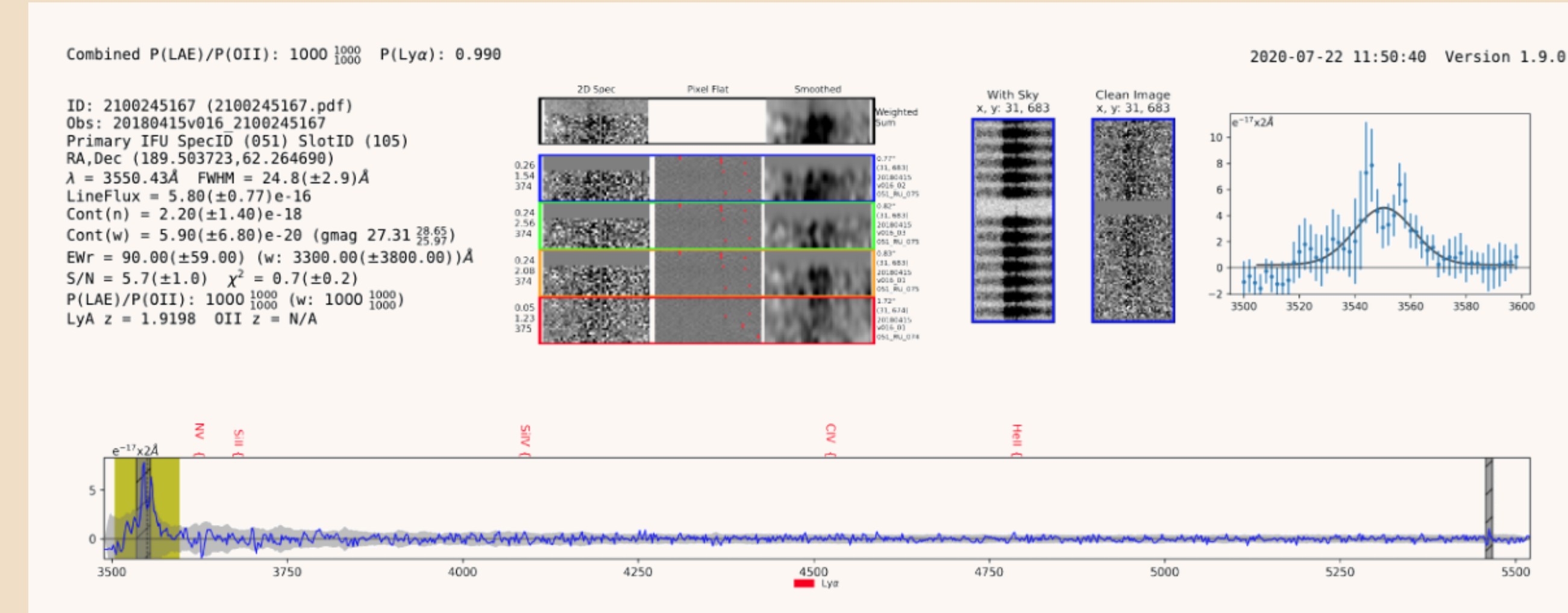
Spurious Emission Line

Fig 2. Classification Sheet of a Spurious Detection: A spurious skyline emission like the one above is due to being observed from the night-time sky rather than distant galaxies. Detections centered in the disfavored wavelength range of the spectrum (grayed out areas) are generally spurious skyline detections. Another strong indication of the detection being spurious is the unusual and unclear imaging seen in the images in the top center of the sheet.
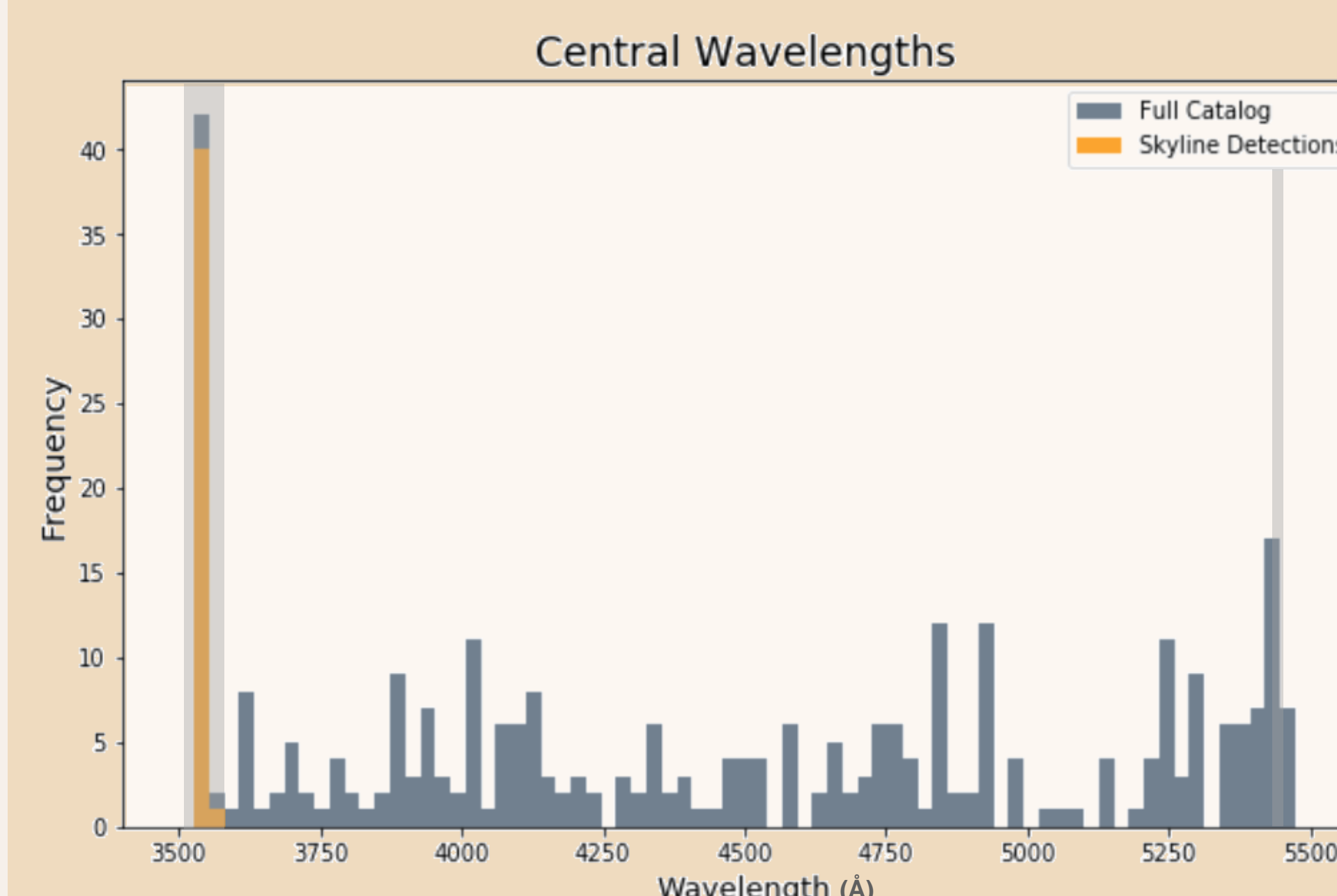
Distribution of Detections

Fig 3. Histogram of the Spread of Central Wavelengths in HETDEX HDR2.1: For the most part, the detections are evenly spread out in terms of the wavelength at which they are observed. However, there is a large clump of detections seen in orange at the left edge of the histogram. These are all in the wavelength range that covers the skyline in the emission spectrum and therefore represent spurious detections.
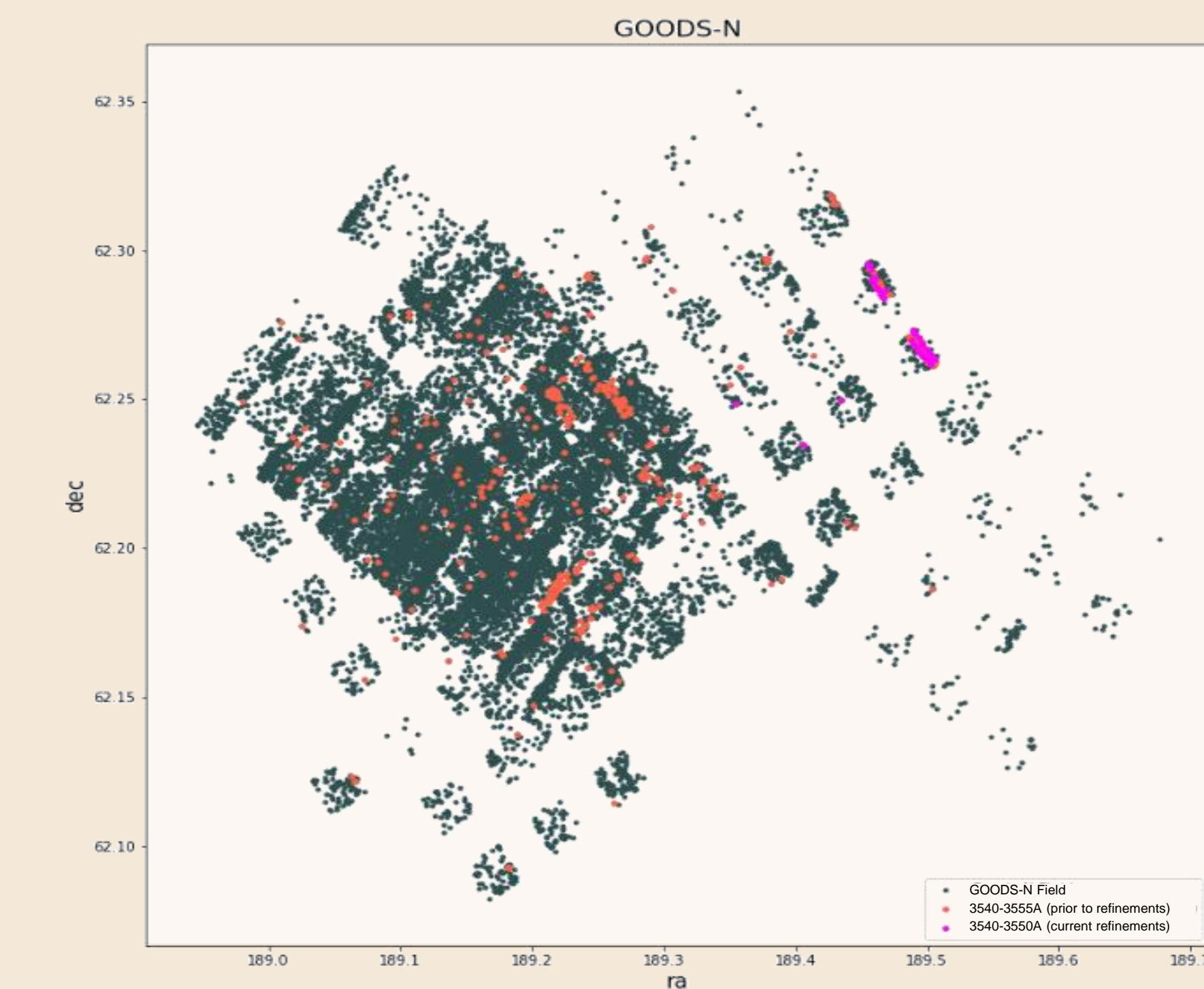
Detections in GOODS-N

Fig 4. All Detections in the GOODS-N Field: The plot shows the location in the sky of each detection from the observed GOODS-N region. The detections within the skyline wavelength bounds are seen with the orange and magenta marks. The orange detections are those from before the refinements of the HDR2.1 catalog were applied whereas the magenta ones were observed with the current HDR2.1 refinements in place and included in the catalog.

Conclusions

* The refinements of HDR2.1 remove most of the spurious skyline detections that occur majorly in clumps as well as generically

* The remaining clusters that were not successfully removed are currently being used to improve the quality of the refinements for future updates of the emission line detections catalog

Future Direction

* The information from this project will directly aid in the clustering of detected emission lines from the same source in the HETDEX spectra

* Using the information gathered from LAEs and [O II] emitters in general, researchers will be able to infer the masses of their dark matter halos as well as the properties of the dark energy that is causing the expansion of the universe to accelerate

Acknowledgments