



The CLU Nearby Galaxy Catalog: Preliminary Results

David O. Cook¹, Mansi Kasliwal¹, Angela VanSistine², Daniel A Dale³, Jessica Sutter³, Jordan Turner³, Ryan Parziale³,
1-California Institute of California. 2-University of Wisconsin, Milwaukee. 3-University of Wyoming



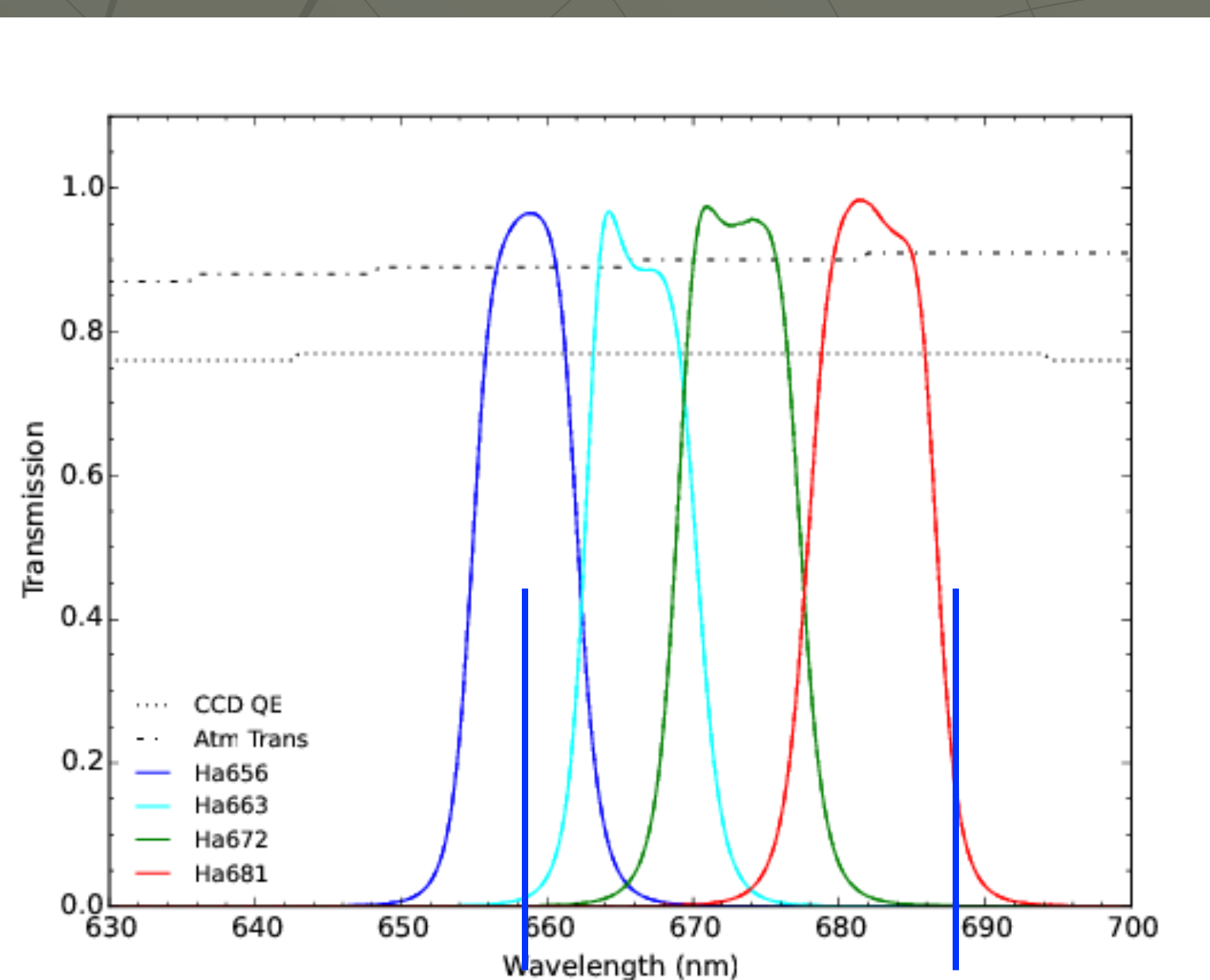
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Background

The intermediate Palomar Transient Factory (iPTF) is undertaking the Census of the Local Universe (CLU) project to complete our survey of galaxies out to 200 Mpc. CLU deploys four contiguous narrow-band filters to search for extended, emission line (H α) sources across 3 π of the sky. The estimated **5 σ limiting flux** for a point source is **3 $\times 10^{-15}$ erg s⁻¹ cm²**, which corresponds to a star formation rate (SFR) of **10^{-2.5} M $_{\odot}$ yr⁻¹ at a distance of 50 Mpc**.

The CLU galaxy catalog will help to: pinpoint future gravitational wave triggers, classify iPTF transients, and constrain the discrepancy between H α and FUV star formation rate tracers in low-mass galaxies when CLU galaxies are cross-matched to GALEX FUV sources.

Filters & Observations



$z \sim 0.0$ $z \sim 0.05$
 $D \sim 200$ Mpc

- We use 4 narrowband filters to detect emission line galaxies out to 200 Mpc.
- The observing strategy consists of 3 staggered grid patterns which overlap. Stacking all 3 grids will result in deep H α observations for 3 π of the sky. Observations are carried out with filter pairs (Ha1/Ha2 or Ha3/Ha4) each night.

Filter name	Filter λ (Å)	Filter $\Delta\lambda$ (Å)	Redshift range (#)
H α 1	6562.4	76.2	-0.0059 < z < 0.0057
H α 2	6642.4	78.5	0.0061 < z < 0.0181
H α 3	6741.5	91.7	0.0202 < z < 0.0342
H α 4	6832.3	92.0	0.0341 < z < 0.0480

Current Status of Observations

- Ha1/Ha2 – 92% complete
- Ha3/Ha4 – 90% complete

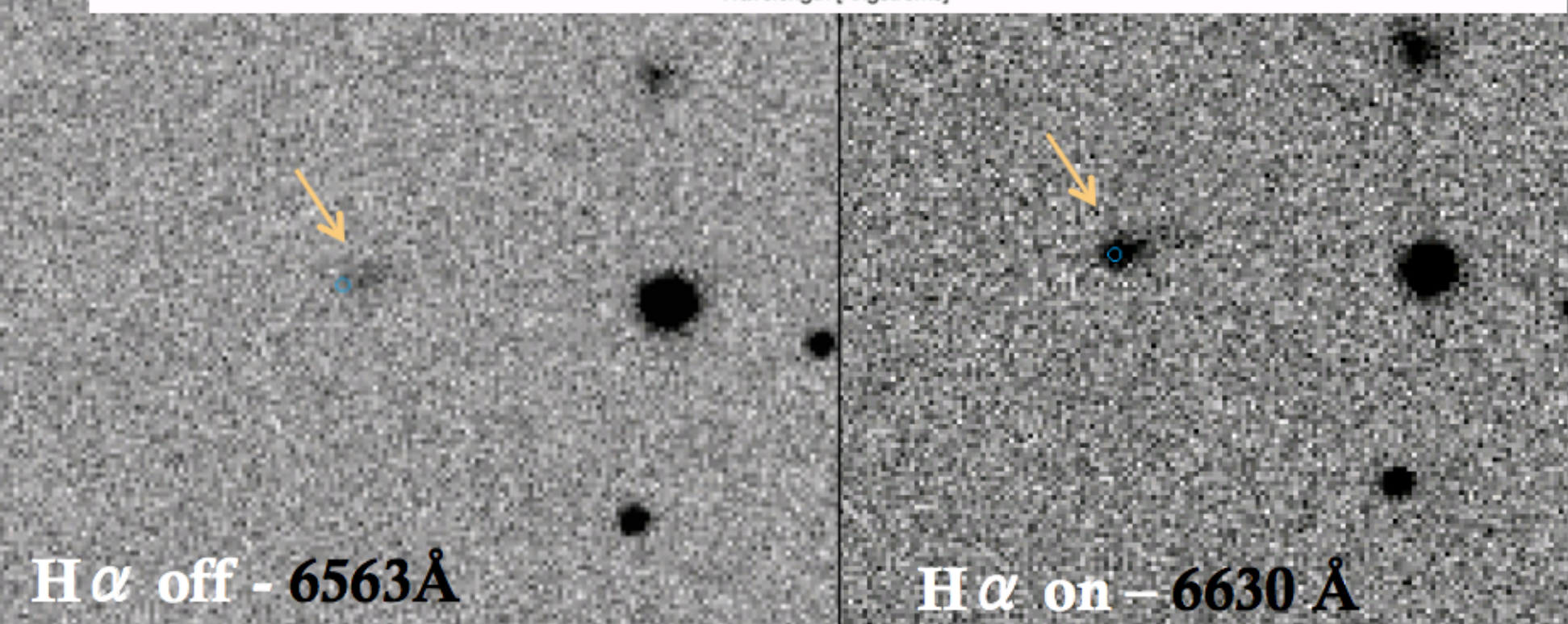
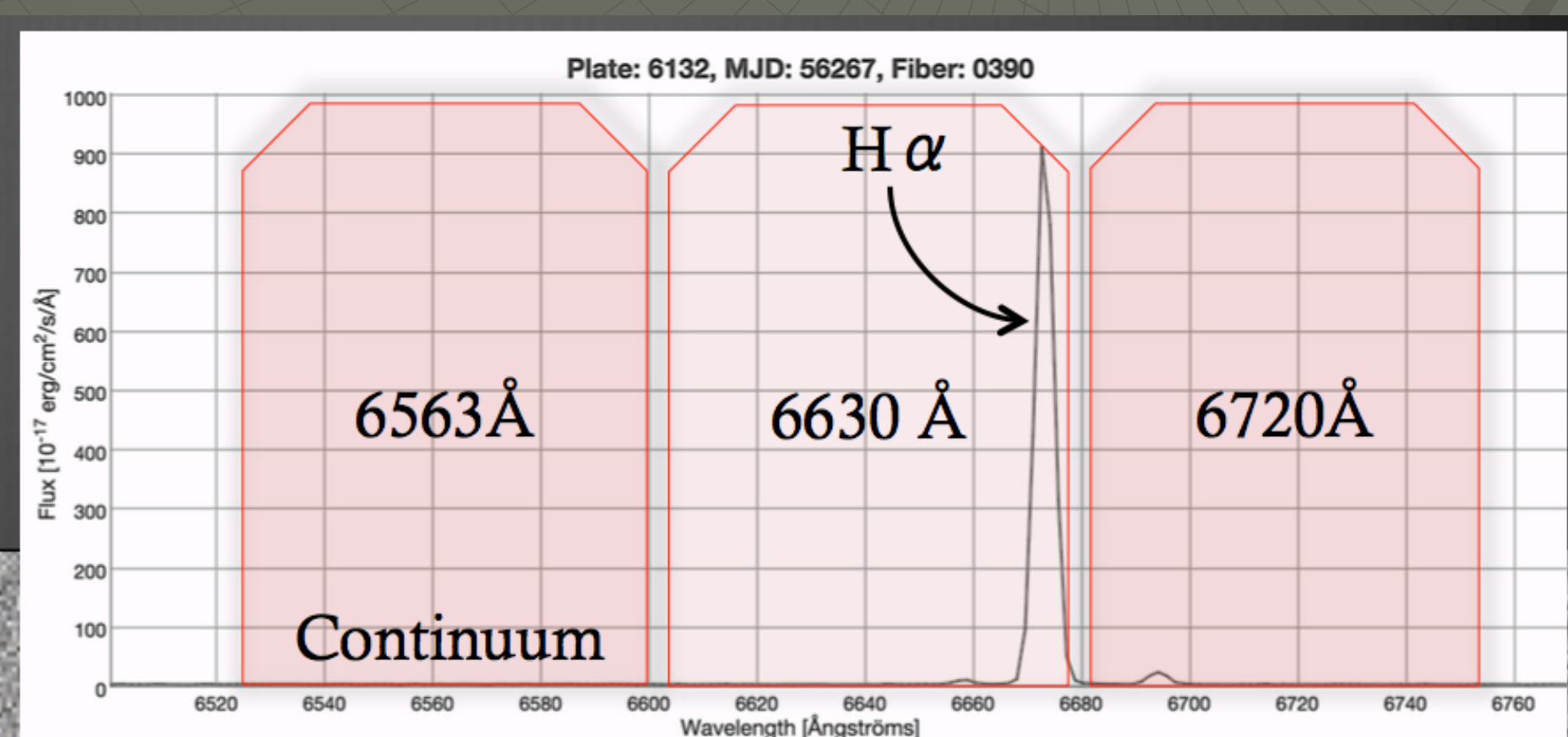
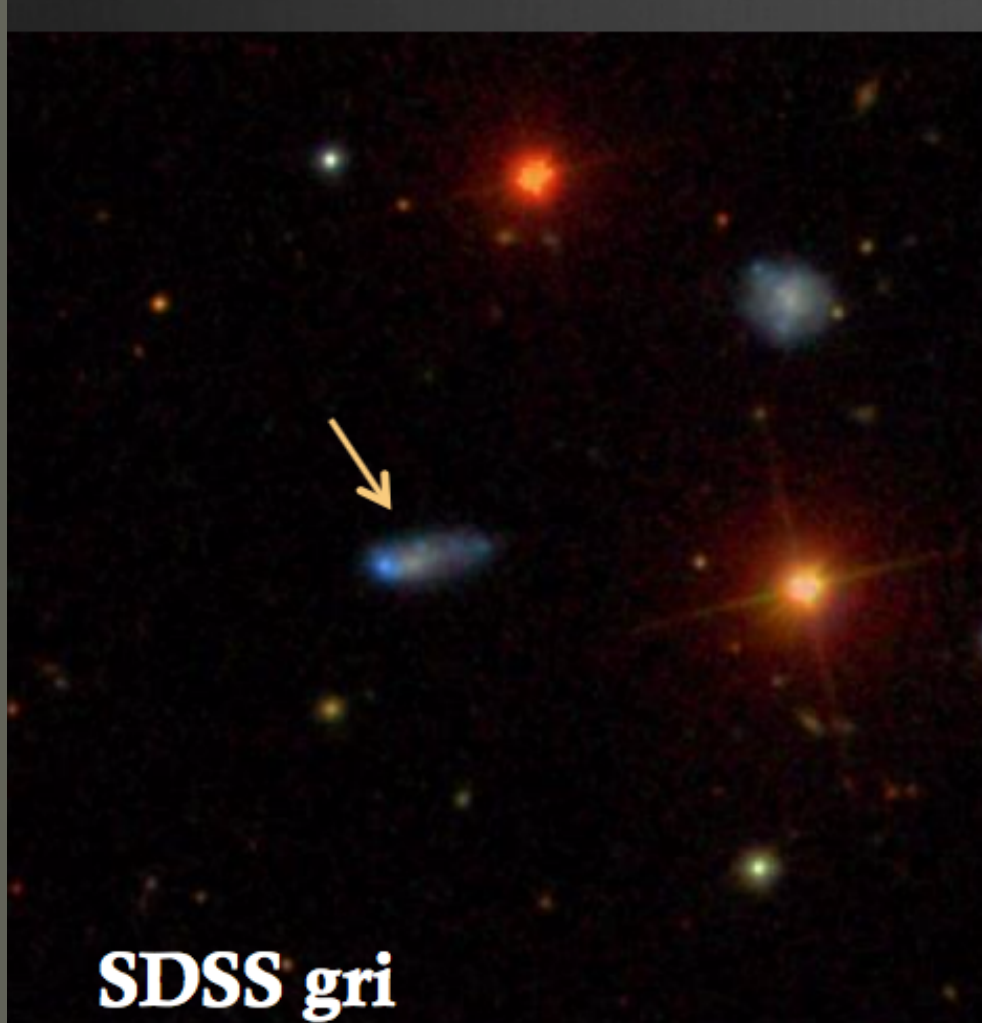
Galaxy Candidate ID Method

Top-Right: spectra of a confirmed galaxy zoomed into the H α emission line. The red boxes indicate the H α filter coverage.

Bottom: SDSS color, Ha-Off grey, Ha-On grey images.

Narrowband Strategy

- **New Galaxy** at $z \sim 0.015$
- $\text{mag}6563 - \text{mag}6630 = 1.5$
- H α EW = 865 Å



Confirmed New Galaxies

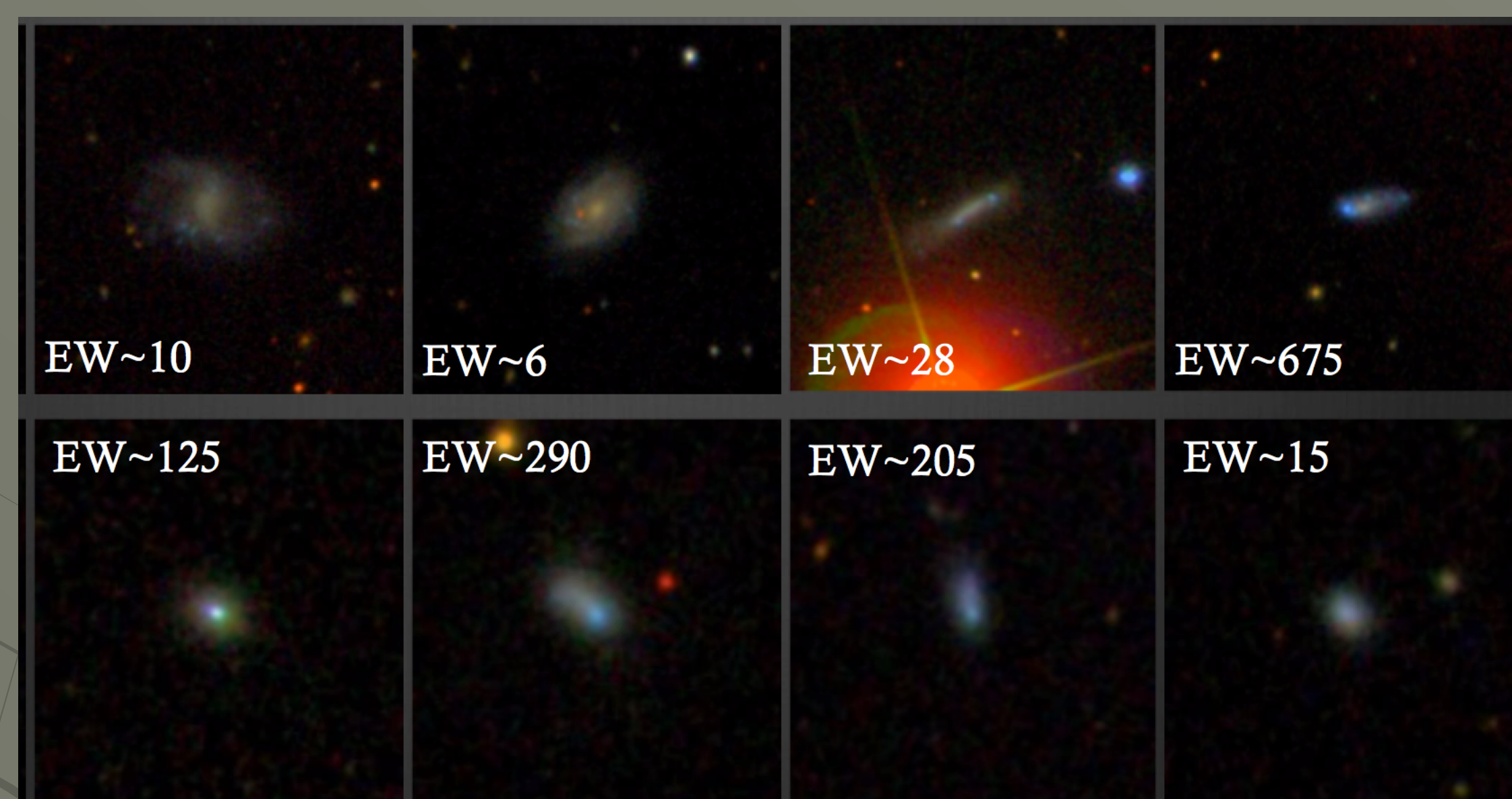
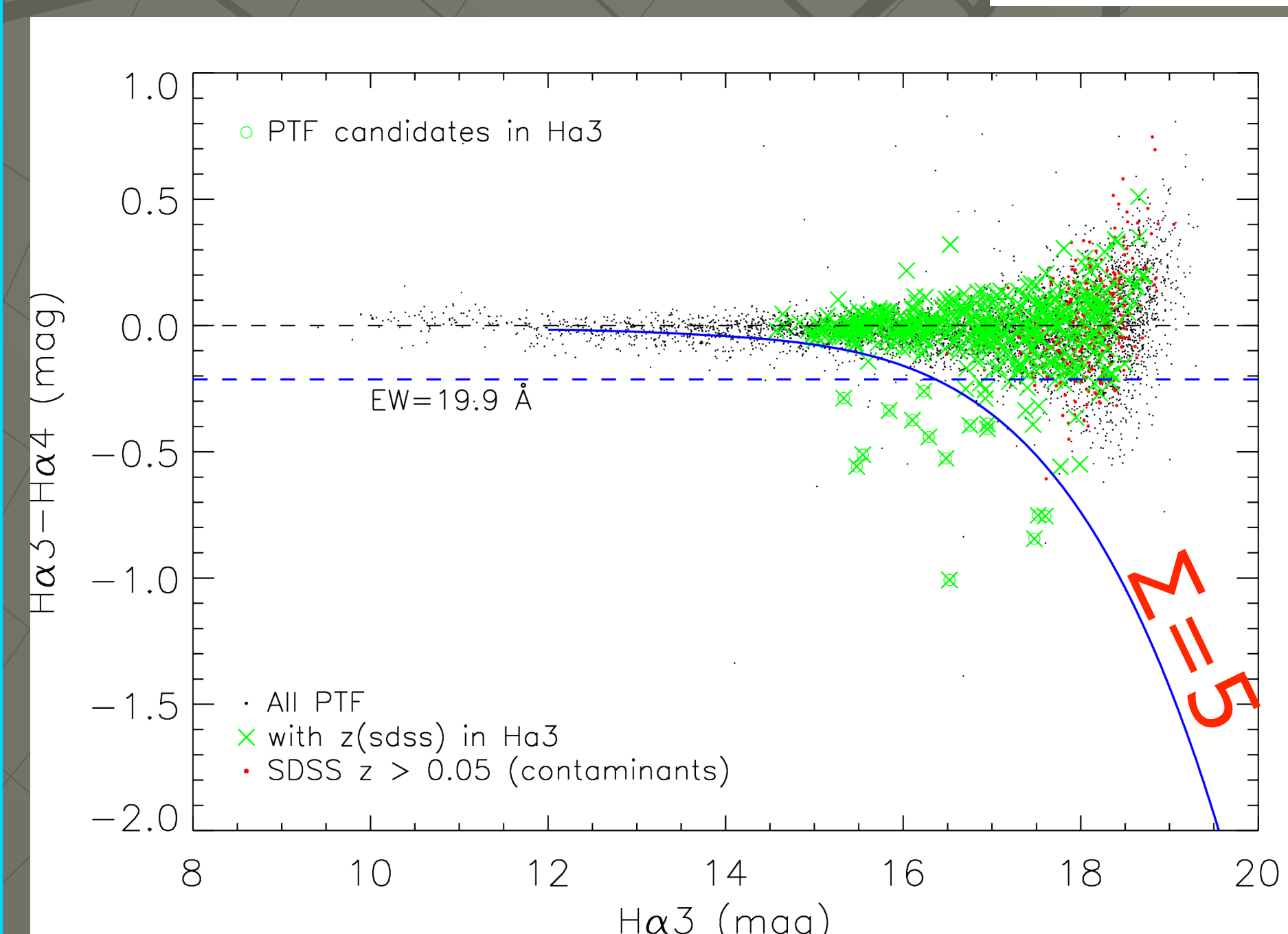


Figure Examples of CLU galaxy candidates that have been spectroscopically confirmed.

Results & Selection Methods

$$(\text{H}\alpha_{\text{on}} - \text{H}\alpha_{\text{off}}) > \Sigma\delta, \text{ where } \delta = \begin{cases} \Sigma * \text{std}(\text{bright stars}) \rightarrow (\text{Horizontal line}) \\ \Sigma \sqrt{\sigma_{\text{on}}^2 + \sigma_{\text{off}}^2} \rightarrow (\text{Curved line}) \end{cases}$$



Left: Ha3-Ha4 color versus Ha3 magnitude for a single PTF pointing (7.3 deg²). Sources identified as galaxy candidates are indicated with a circle. Magnitudes represent photometry within a 5 pixel aperture (2.5 times FWHM).

Color Excess (Σ) Statistics						
Σ (#)	N Total Candidates (#)	N Stars (#)	N High-z Galaxies (#)	Total Contaminants (#)	N Known Galaxies ($z < 0.048$) (#)	N in Correct H α Filter (#, % of known galaxies)
2.5	611	92 (15.06%)	273 (44.68%)	365 (59.74%)	278	223 (80.22%)
3.0	387	51 (13.18%)	125 (31.89%)	176 (45.48%)	235	199 (84.68%)
4.0	216	22 (10.19%)	39 (18.06%)	61 (28.24%)	167	151 (90.42%)
5.0	152	12 (7.89%)	12 (7.89%)	24 (15.79%)	137	126 (91.97%)
6.0	116	7 (6.03%)	7 (6.03%)	14 (12.07%)	107	101 (94.39%)
7.0	87	4 (4.60%)	2 (2.30%)	6 (6.90%)	85	80 (94.12%)

Above: We perform an experiment to test which Σ to use, and quantify this by the total contamination rate and the percent of known galaxies found. We find that a $\Sigma=5$ minimizes the contaminants while maximizing the success rate.

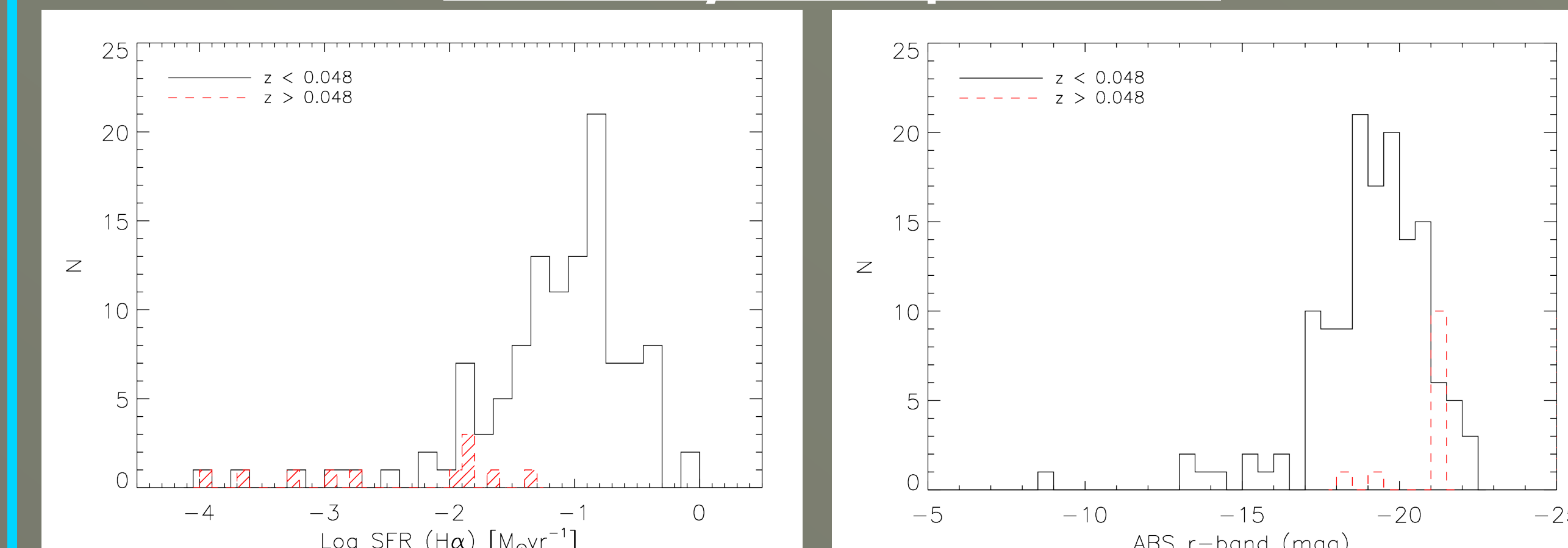
Results

We find a total of 155 candidates in 15 preliminary pointings (out of 3600), where all have SDSS or follow-up Palomar spectra. Our galaxy candidate selection method is sensitive to galaxies with an H α EW greater than 20 Å. Using a 5 sigma "On-Off" color excess cut, we find a **15.8% contamination rate** and a **92% success rate**.

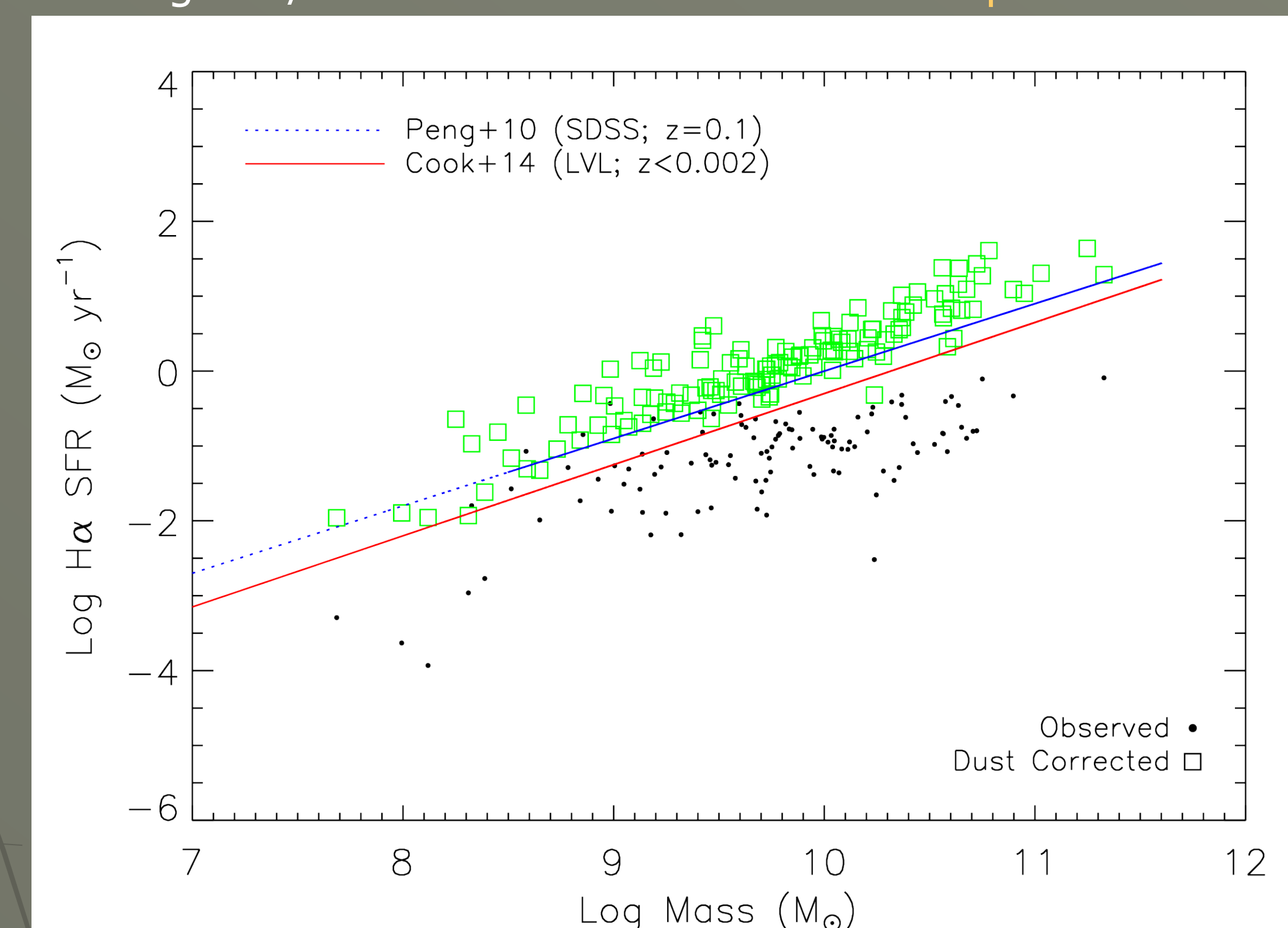
In addition, out of all 137 galaxies in our fields, 37 are newly discovered galaxies. However, this is an underestimate since the SDSS galaxy catalog is relatively complete down to our detection limit. We anticipate finding 20,000 new galaxies outside the SDSS footprint.

We also have found a few dozen **interesting "contaminant" sources: planetary nebulae and green peas**. These objects exemplify the many broad science applications of the data set, and demonstrates the wide impact this survey will have on many areas of astrophysical research.

Galaxy Properties



Bottom: The star formation rate (SFR) vs stellar mass galaxy main sequence. The SFR is a combination of H α + WISE 22um to account for dust extinction. The stellar mass is derived from WISE 3.4um using a M/L=0.5. **The data matches with previous trends.**



Interesting Candidates

