Towards the Complete Census of Extreme Emission Line Galaxies in the Local Universe: 9000 New Green Pea Candidates at $0.1<z<0.4$

Samonski, H; Salim, S

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Abstract

Green Pea galaxies (GPs) - named so due to their green appearance in composite gri SDSS images - are known to be Lyα emitting galaxies, at a low redshift of 0.112<z<0.360. However, high redshift Lyα emitters are thought to have fueled the epoch of reionization, thus, having a more complete census of GPs means better characterizations of their high redshift analogs. Through obtaining photometric and spectroscopic GP candidates through SQL queries in CasJobs, we present a new metric that can determine the classification of an object based on its best-fit. This process has reclassified about 12 times as many objects as Green Peas than previously thought.

1 Introduction

Green Pea galaxies (GPs), named so due to their green appearance in the Sloan Digital Sky Survey (SDSS) filters u, g, r, i, and z, were first analyzed in Cardamone et al. (2009), after being discovered by the Galaxy Zoo Project (Lintott et al. 2008). They're classified at a redshift of 0.112<z<0.360, where the [OIII] λ5007 Å line that gives their green color is in the r-band filter. Cardamone et al. (2009) reported 251 GPs, found using the CasJobs application from SDSS, by surveying Data Release 7 (DR7) photometry. Since being identified, various research has been done on GPs and their counterparts (Compact Galaxies, Extreme-emission line galaxies, XMPs, Blueberries (Yang et al. 2017), Purple Grapes, etc.) in efforts to understand the nature of these compact star forming objects, yet the most updated count we have of GPs comes from Jiang et al. (2011) who reports about 800 star-forming Green Peas, thus reinforcing that GPs are rare objects.

Current interest in the reionization era has caused much galactic research to center around Green Peas and especially their counterparts. During this period, the intergalactic medium (IGM) went from having neutral hydrogen to mostly reionized hydrogen, where the first stars and galaxies formed. This era is thought to have been fueled by objects such as star-forming galaxies (SFGs; e.g., Robertson et al. 2010), active galactic nuclei (AGNs; e.g., Haiman & Loeb 1998; Madau & Haardt 2015), and quasars (e.g., Madau et al. 2004). Similarly, Lyα emitters (LAEs), found at redshifts z >2 are thought to be a probe into the reionization era as they leak ionizing radiation out of their HI clouds (Yang et al. 2017). Green Pea Galaxies are thought to be low-redshift analogs of LAEs, since they have such similar galactic properties to high-z LAEs - small sizes, low stellar masses $10^{8-10} M_\odot$, low metallicities for their stellar masses, high specific star formation rates (sSFR), and large [OIII]λ5007/[OII]λ3727 ratios. Therefore, Green Peas act as laboratories for understanding the LyC leaking galaxies that may have helped reionize the IGM.

Due to GPs point-like photometry and unknown redshifts, the SDSS often misclassifies Peas as stars or QSOs. Because of this, GPs must be verified spectroscopically, with a strong [OIII]λ5007 Å line with an equivalent width up to ~1000 Å (Cardamone et al. 2009). Other efforts have been made to explore GPs not using SDSS data (Brunker et al. 2022, Liu et al. 2022), however these also need spectroscopic confirmation. In efforts to obtain a complete census of Green Pea galaxies through SDSS photometry, this research aims to understand the Cardamone et al. (2009) color selection criteria for GPs to determine accurate counts.

2 Sample Selection Methods

More text.

2.1 Initial

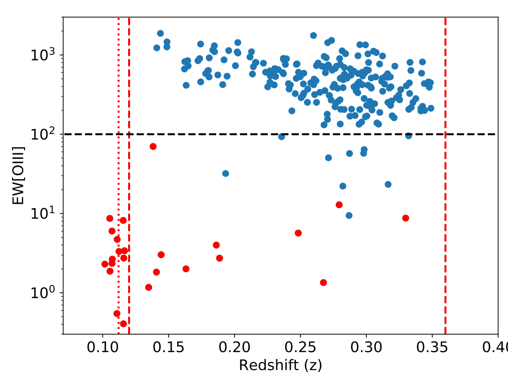

Figure 1: EWOIII vs z.

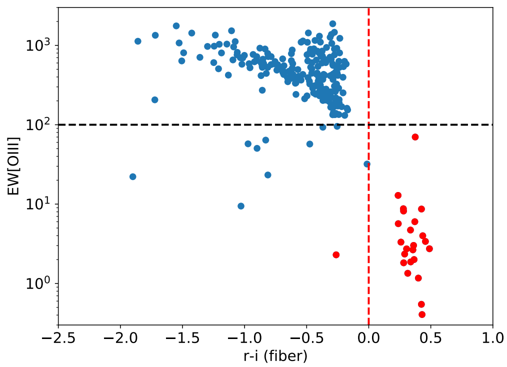

Figure 2: EWOIII vs r-i fiber.

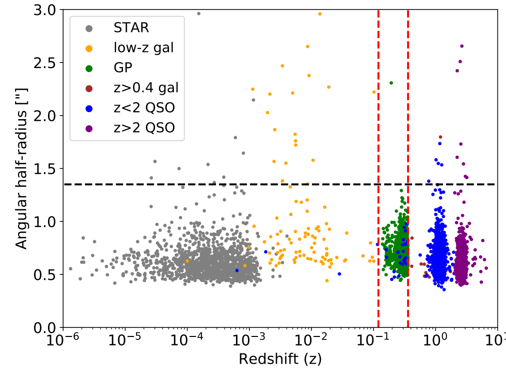

Figure 5: angular half radius vs z.

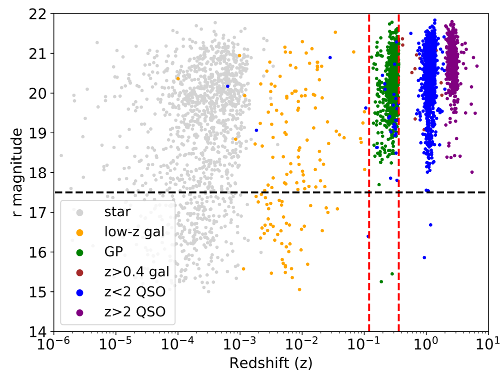

Figure 3: r mag vs z.

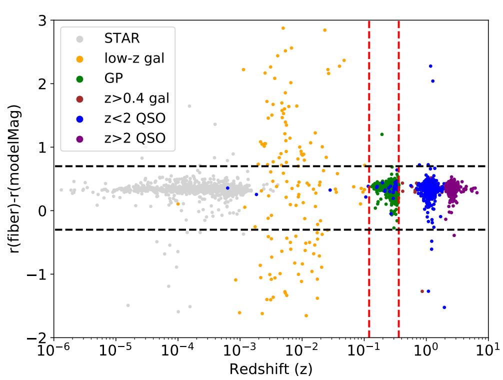

Figure 4: rfiber-rmodelmag vs z.

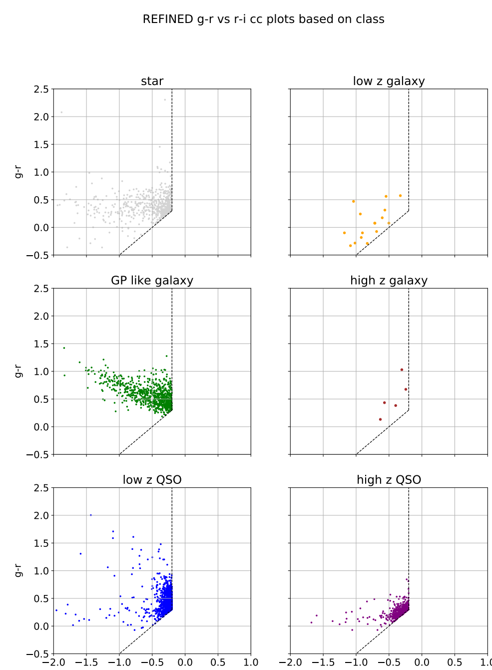

Figure 6: refined g-r vs r-i color-color plot.

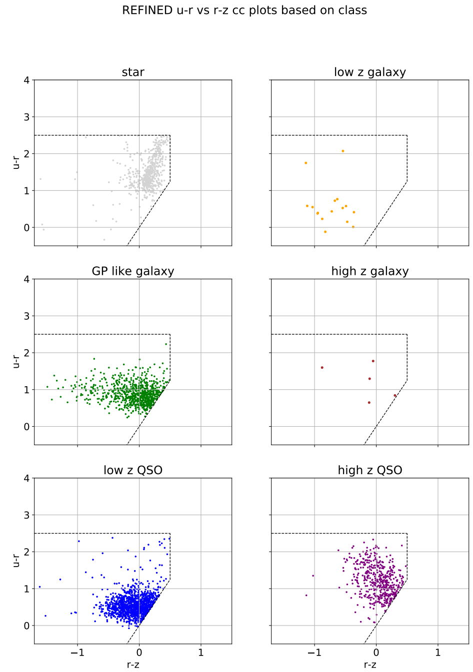

Figure 7: refined u-r vs r-z color-color plot.

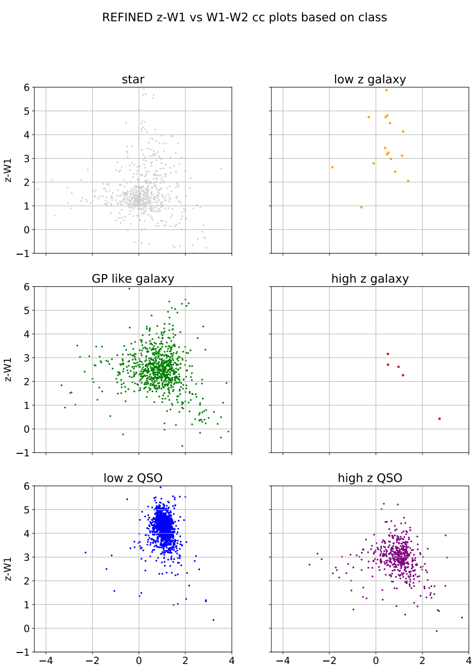

Figure 8: refined z-W1 vs W1-W2 color-color plot.

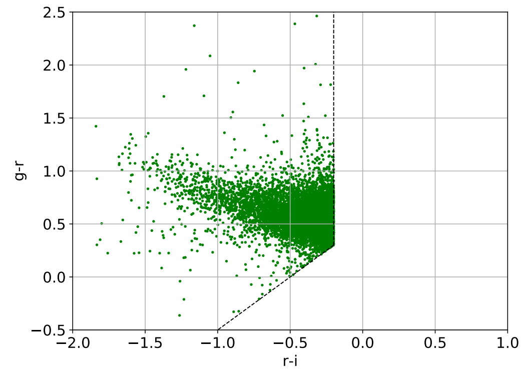

Figure 9: GP g-r vs r-i color-color plot.

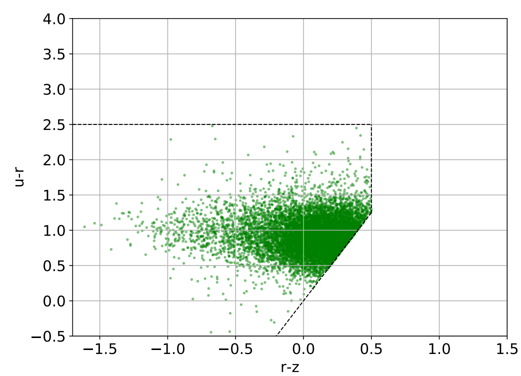

Figure 10: GP u-r vs r-z color-color plot.

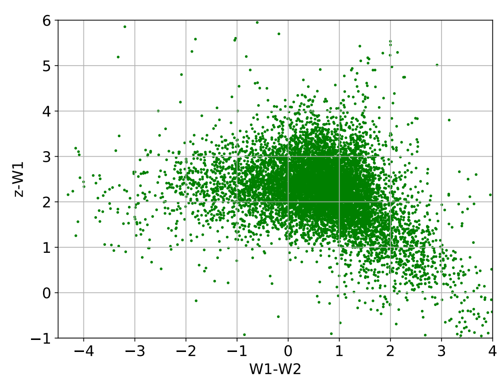

Figure 11: GP z-W1 vs W1-W2 color-color plot.

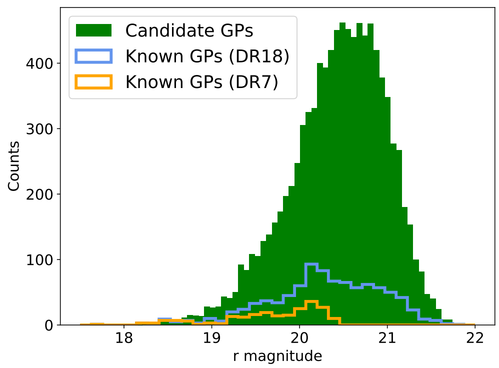

Figure 12: GP candidates r mag distribution.

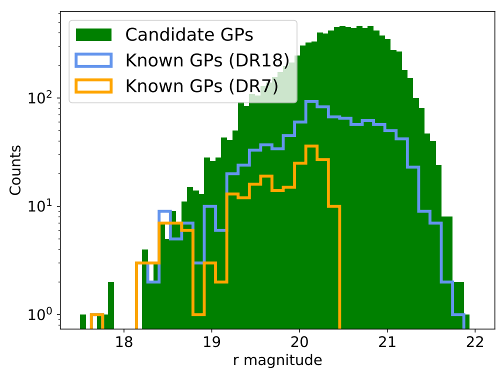

Figure 13: GP candidates LOG r mag distribution.

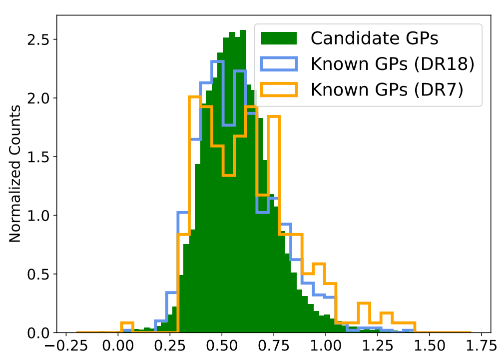

Figure 14: GP candidates g-r distribution.

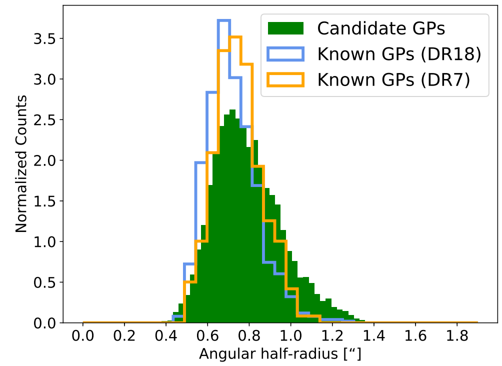

Figure 15: GP candidates angular half radius distribution.

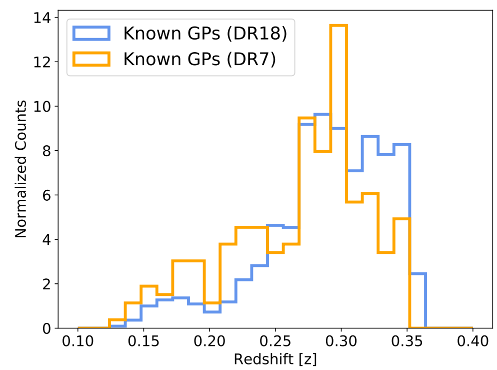

Figure 16: GP candidates redshift distribution.

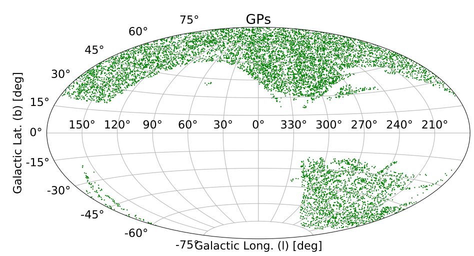

Figure 17: GP candidates galactic map.

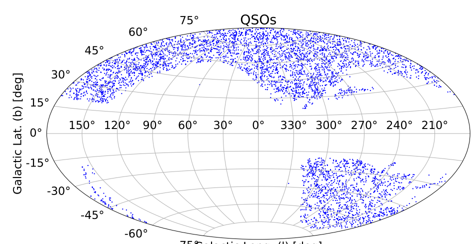

Figure 18: QSO candidates galactic map.

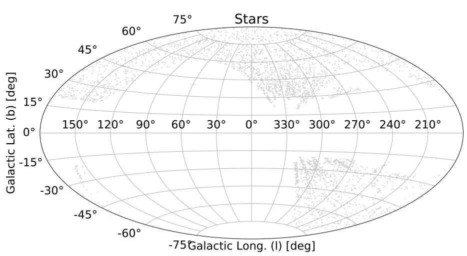

Figure 19: Star candidates galactic map.