Testing Photometry Issues in Luminous Red Galaxies

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1 Introduction

An objective of HSC Project is to understand the correlation between the star formation history and Dark Matter Halos of Luminous Red Galaxies (LRGs) through studying the slope of the luminosity density profiles.

In order to certify the validity of our results, it is essential that we test the photometric contamination caused by fainter galaxies that are not properly resolved, or *deblended*. Such galaxies can saturate the apparent magnitude of the galaxy, most prominently at the outer stellar halo of the galaxy.

Flags
flags.pixel.interpolated.center
flags.pixel.edge
flags.pixel.saturated.center
flags.pixel.cr.center
flags.pixel.bad
flags.pixel.suspect.center
flags.pixel.clipped any

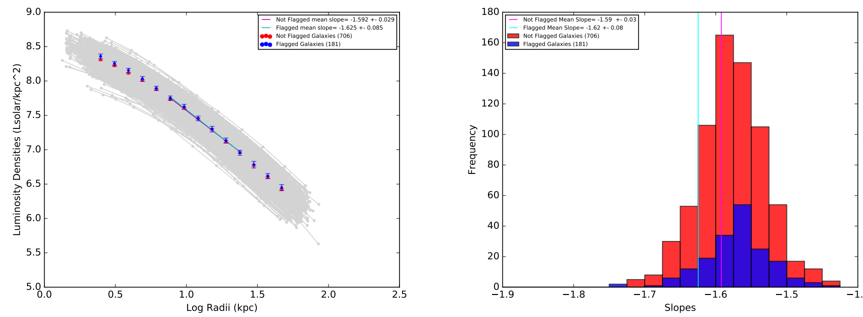
Table 1: Flag parameters in LOWZ

The LOWZ catalogue flags specific galaxies we suspect have been contaminated. We determined that the LRGs flagged by at least one of the flags in Table 1 influence the stacked luminosity profiles, and therefore it is necessary to disregard these galaxies.

2 Distinguishing Bright Center Objects

To determine whether bright object centers saturate our luminosity profiles, the LRGs are separated into two populations, one where flags.pixel.bright.object is **True** and one where flags.pixel.bright.object is **False**. In Figure 1, we construct a stacked luminosity profile for each flagged (blue points) and non-flagged populations (red points). In the background, I plot the luminosity profiles of the individual galaxies (gray curves).

Varying parts of the stacked profile use distinct galaxies at different redshifts. In order to homogenize our results, so they are all fit to the same physical boundary, we set a uniform outer limit. For our experiment, this outer boundary was



(a) Luminosity Density Profiles

(b) Distribution of alpha_star slopes

Figure 1: Stacked Luminosity Profile for LRG's flagged as Bright Center Objects (blue points), and those not flagged as Bright Center Objects (red points).

exactly 4r1/2 and was applied to both individual galaxies and stacked profiles. As seen in 1b, by removing the largest apertures from the profile, the mean slope of the flagged and not flagged galaxies are not consistent (within the scatter) with their distributions. This indicates we have removed any parts of the slope at risk of contamination from un-blended sources at the galaxies' envelopes.

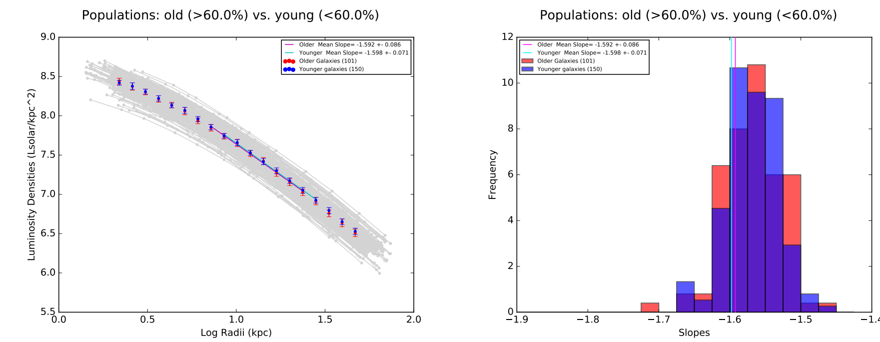
Interestingly, we see that galaxies flagged as bright objects are in agreement with those not flagged. While there appears to be no real difference, we next need to check how these flags alter specific tests we want to accomplish.

3 SFH and Bright Center Objects

One test this project is performing is the relationship between the luminosity profile slopes and star formation history (SFH). We use the VESPA code, which fits the spectra of all LRGs in the Sloan Digital Sky Survey's (SDSS) final data release. After matching this catalogue with the LOWZ galaxies, we next separate the LRGs into two different populations, based on whether or not 60% of the mass of the galaxy is formed in the oldest age bin (between 9.06 and 14 billion years ago). It is important to note that these are all early type galaxies, but we are still distinguishing them by SFH.

In Figure 2a the stacked slopes of older and younger populations of LRGs appear to be roughly the same. Figure 2breveals that their slope distributions, as well, are very similar. The stacked slopes coincide with the gaussian distribution within one σ. However, in order to completely understand our results, we must see how bright center objects affect the luminosity profiles of both the older and younger galaxies.

In Figure 3, I separately show the older and younger populations of galaxies, further splitting into flagged (blue points) and not flagged(red points). In the righthand column, the stacked slopes of is in agreement with the distribution of individual slopes. This is validated in Table 2, which compares the alpha_star



(a) Luminosity Density Profiles (b) Distribution of alpha_star slopes

Figure 2: In 2a, the luminosity profiles of older galaxies (red points) and younger galaxies (blue points). 2b reveals the distribution of alpha_star slopes for both populations, as well as the stacked slopes (vertical lines).

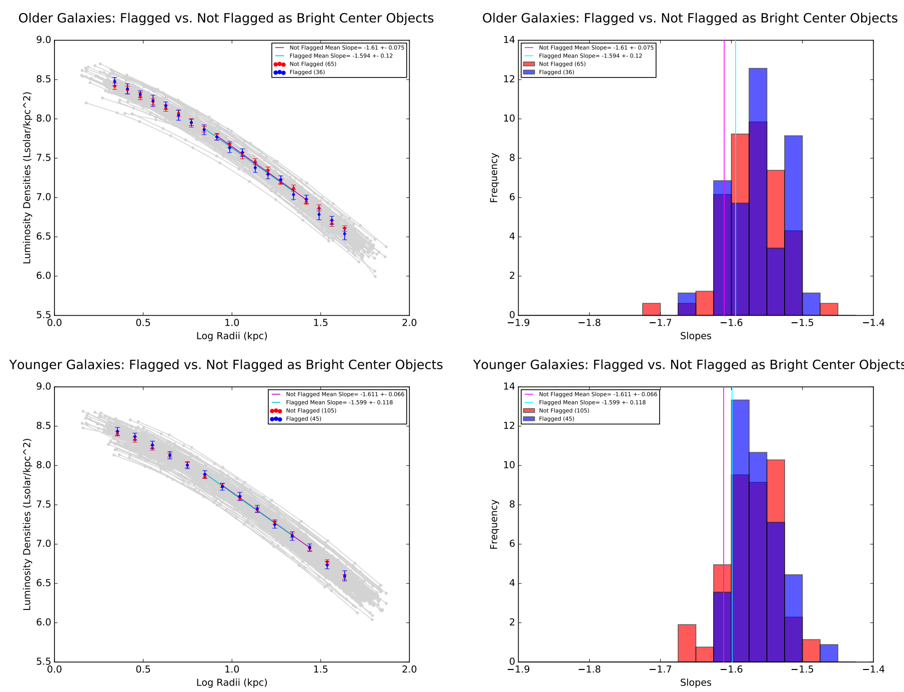


Figure 3: The lefthand column shows the luminosity profiles of older (upper) and younger (lower) galaxies. Flagged Bright Object Centers are blue points and Not Flagged are red points. The righthand column shows the alpha_star distribution amongst galaxies for flagged (blue bars) and not flagged (red bars). The stacked slopes are represented by the magenta and cyan vertical lines.

slopes of the stacked galaxies with the median of the slope distribution for each subsample. Here, we see that, within error, the stacked slopes of the subsamples for older and younger galaxies agree with the stacked slopes of the larger older and younger populations.

In accordance with Figure 1b, there is no significant difference between the flagged and not flagged stacked luminosity profiles for both the older and younger galaxies as seen in the right hand side of Figure 3.

Distribution of Alpha_Star Slopes		
	Stacked Slope	Median Slope
Old Galaxies	-1.593 ± 0.085	-1.565
Young Galaxies	-1.595 ± 0.072	-1.569
All Not Flagged	-1.59 ± 0.03	-1.57
All Flagged	-1.63 ± 0.08	-1.569

Table 2: These stacked and median slopes were calculated from specific population's individual galaxy slope distribution