Sizes of Passively Evolving Galaxies at $z \sim 2$ in CLASH

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Abstract. We select ten passively evolving and massive galaxies at redshift $z \sim 2$ from the Cluster Lensing And Supernova survey with Hubble (CLASH). We derive the stellar properties of these galaxies using the multiwavelength HST WFC3 and ACS data, together with Spitzer IRAC observations. We also analyze the optical rest-frame morphology of these high redshift objects by using the GALFIT package (Peng et al. 2002). The observed near-IR images, obtained with the HST/WFC3 camera with high spatial resolution and amplified by the foreground clusters, provide us with a good chance to study the structures of such systems. Six out of ten galaxies have on average a four times smaller effective radius, in agreement with previous works at redshift $z \sim 2$.

Keywords. galaxies: evolution, galaxies: formation, galaxies: high-redshift

1. Introduction and Result

The sizes of passively evolving and massive galaxies at redshift $z \sim 2$ have been found to be $\sim 4$ smaller than low redshift early-type galaxies of similar stellar mass. The lack of compact massive galaxies at low redshift implies that considerable size evolution must happen between $z = 2$ and $z = 0$. There are two main size evolution mechanisms: (1) dry minor merger (Naab et al. 2009); (2) “puff-up” due to gas mass loss (Fan et al. 2008, 2010). Recent studies found that the observed size evolution needed by compact massive galaxies at redshift $z \geq 2$ can not be explained well by the present models.

Here we selected ten passively evolving and massive galaxies from the Cluster Lensing And Supernova survey with Hubble (CLASH, Postman et al. 2012). The photometric redshift and stellar properties have been derived based on the HST ACS and WFC3 observations with 16 UV-to-NIR filters in total. Spitzer IRAC data, if available, have been also used. With the GALFIT package, we analyze the surface brightness profiles using a Sersic model. We find that galaxy sizes span a wide range: from $\sim 2$ times larger to $\sim 6$ times smaller than the local analogs of similar stellar mass. The large size scatter at redshift $z \sim 2$ will give some indications for the size evolution models.

References