Stellar surface density profile evolution of quiescent galaxies from z~2.2-0.4

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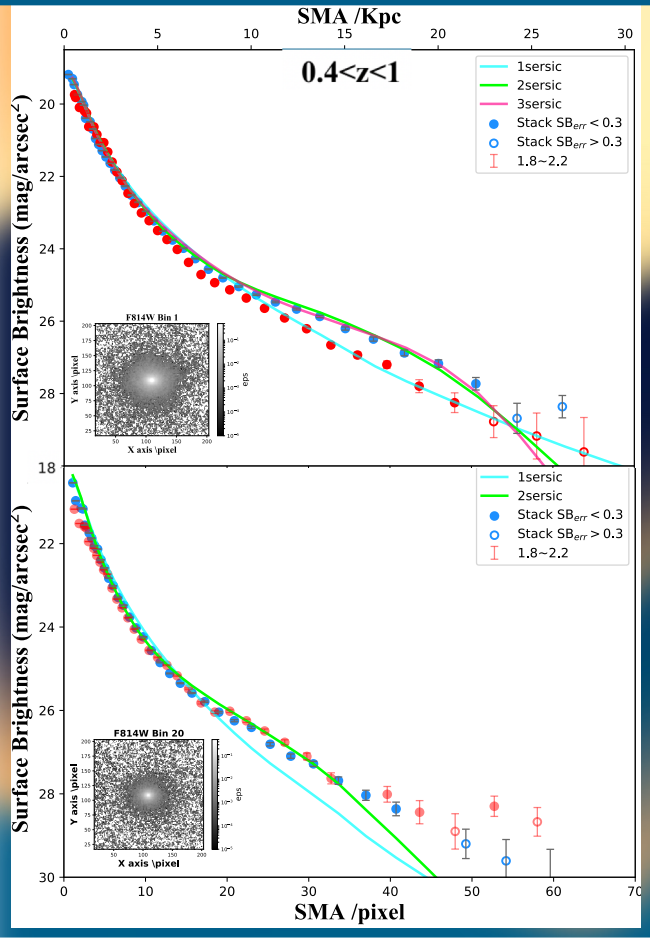
Summary

It has been well-established that galaxies grow in mass and size through star formation and mergers, but how this growth happens is not clear. In an effort to understand how mergers/accretions contribute to the size growth of galaxies over time, we derived unprecedented deep average surface brightness profiles (SBPs) of quiescent galaxies (QGs) of different central densities from redshift 2.2 to 0.4, by applying a stacking technique to images provided by a series of previous deep HST surveys. We carry out single and multiple sérsic fitting to stacked images with GALFIT which provides quantitative constraints. **Comparing SBPs and 1-sérsic models, we observe significant excess in the outskirt (out to 25 kpc) of low-z QGs, more extended than high-z counterparts (out to 17 kpc). Galaxies with higher central brightness experienced more significant growth in their outskirts over cosmic time than those with lower central brightness.**

Results



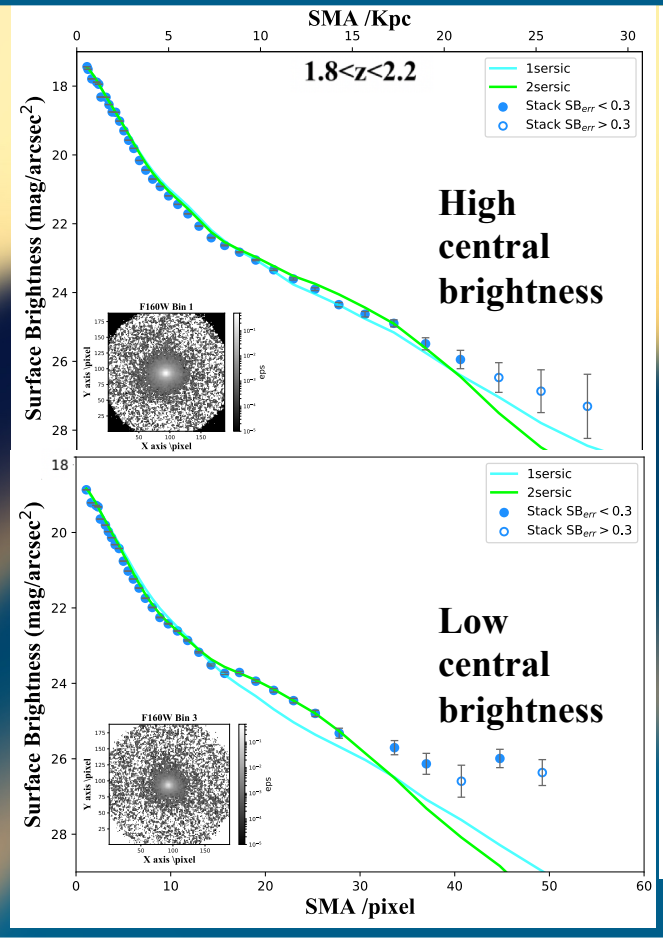


Figure 1: SBPs of stacked images of the brightest bin in 0.4<z<1.0 (left upper panel) and 1.8<z<2.2 (right upper panel) are shown as blue solid points (uncertainty<0.3mag) and blue hollow points (uncertainty>0.3mag). The SBPs of single sérsic best-fitting from GALFIT are presented as cyan lines while two(three) sérsic fit as green(red) lines. The bottom x-axis is semi-major axis (SMA) in pixels as an indicator for galactocentric distance, while the upper x-axis is in kpc. The surface brightness has been corrected for cosmic dimming effect down to z=0.1. The lower two panels show the SBP of stacked images of the dimmest bin in 1.8<z<2.2 (right) and counterpart in 0.4<z<1.0 (left) with comparative central density. For better comparison, SBPs of high-z counterparts are shown as red points in the left column, after evolution correction down to 0.4. The lower left subpanel shows the corresponding stacked images. Pixel size is rescaled to the middle redshift of each bin (i.e, 0.7 and 2.0, respectively).

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Sample and Method

Sample: QGs at redshift of 0.4 to 2.2, are selected from Hubble Space Telescope (HST) data utilizing UVJ diagram and Muzzin et al. (2013) classification. Interacting and contaminated galaxies are excluded. 2202 QGs are included in our final sample.

Method: Galaxies are grouped into four redshift intervals (0.4~1.0, 1.0~1.4, 1.4~1.8, 1.8~2.2). We divide galaxies in each redshift interval into subsamples of different central (<1kpc) brightness and derive an average surface brightness profile by stacking galaxy images for each subsample.
. Subsample size $\mathcal{L}$ varies in different redshift ranges to ensure the surface brightness brighter than 26 mag/arcsec^2 has an uncertainty lower than 0.3mag. $\mathcal{L}$ is 30, 40, 70, 80 for four redshift intervals respectively)