INTRODUCTION
Quiescent galaxies are generally red in the current age of the universe (nearby objects). We associate this color with the assumption that they don’t have young stars and thus no large scale star formation. These galaxies also tend to be very spherical and massive. One example can be seen bellow compared to a spiral star forming galaxy.

As we look farther away, the images of the galaxies are not so clear. Take a look at these four red galaxies for example, the light from each departed, from left to right: 7.46, 9.51, 11.26 and 11.69 $\times 10^9$ years ago. Light from the top galaxy was emitted 3.14 $\times 10^9$ years ago.

If they have no star formation, then how did they get so massive, concentrated and large? This question has puzzled astronomers for more than 50 years. All aspects of their evolution has been an obstacle for any theory of galaxy evolution. Here we will look at their size evolution. Astronomers use the Sérsic profile to represent a galaxy’s radial light profile:

$$\Sigma(r) = \Sigma_e \exp \left[ -b(n) \left( \frac{r}{r_e} \right)^{1/n} - 1 \right]$$

$r_e$ is defined as the radius containing $1/e$ of the total light. $n$ shows the concentration and is known as the Sérsic index. With a similar total light and other observed quantities (eccentricity and etc), these two parameters define the shape of a galaxy light profile.

IN THE LITERATURE
Some authors (e.g. vanDokkum+2010) claim there is a significant size evolution with $r_e \propto (1 + z)^{-1.2}$ while others (e.g. Saracco+2011) don’t observe such size evolution. Proponents of merging (e.g. vD+2010) associate it with merging and others (e.g. Carollo+2013) to the growth of their possible progenitors.

DIFFERENT PHILOSOPHY
Induction is commonly used by the, generally positivist, astronomers. But here we have used a new logical approach: Reduction to absurdity. Instead of placing positive faith in fitting results, we will assume the results of the two contesting scenarios on $r_e$ and see how that affects another property of the galaxies: the Sérsic index.

IMAGES & PSFs
In this study we used archival images from the GOODS-N region. For each redshift we used the nearest broadband filter to the restframe V band in that redshift. The ACS Treasury Survey (ATS) $i$ band and $z$ band images were used for $0.16 \leq z < 0.55$ and $0.55 \leq z < 0.88$ respectively. The MODS survey (Deep and Wide) $J$, $H$ and $K$ band images were used for $0.88 \leq z < 1.5$, $1.5 \leq z < 2.43$ and $2.43 \leq z < 3.5$.

The Point Spread Function (PSF) was fitted for stars separately for the Deep and Wide images of MODS and the whole region for ATS. The final PSF can be seen as the thick black lines of the images bellow.

Finding the Sérsic index ($n$)
Having assumed $r_e$ and knowing the total magnitude of the galaxy. We can simply find $n$ by creating mock profiles with various $n$s but similar total magnitude and similar $r_e$. We measure the flux on all elliptical annuli up to the sky level. Thus a one dimensional profile can be found for each galaxy. The flux value for each radius is divided by the flux of other radii and the various flux ratios for each combination of radii are used compared to those of the models to find the best $n$.

RESULTS
Median Sérsic index of Galaxies placed in bins of equal comoving volume. The purple line shows evolution in $n$ if we assume size evolution and the green line the evolution in $n$ if no size evolution has occurred.

Discussion: Assuming size evolution, results in a significant evolution in general morphological parameters to simultaneously occur and not just in the size.

REFERENCES