TRUNCATIONS AT HIGH REDSHIFT

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ABSTRACT:
Galaxy truncations are low surface brightness features (> 25 mag arcsec^{-2}) present in the outer parts of galaxy disks that are likely linked with the star formation histories. Therefore, they could represent better proxies for galaxy sizes rather than other more arbitrary ones such effective radii. Encouraged by the success in reducing the scatter in size fundamental relations by a similar study (Trujillo+20), we move beyond the nearby Universe to perform truncation measurements up to z = 1 by means of deep HST photometry. By so doing, we show that the sizes for disk-dominated galaxies decrease by a factor 2-3 at earlier cosmic times, while the mass density at the truncation increases by an order of magnitude.

CONTEXT:

- Galaxy size is an ill-defined quantity due to the fact that galaxies do not have proper borders

- The usual proxy for galaxy size is the effective radius, which is defined as the semi-major axis of the ellipse encompassing half of the light coming from the galaxy. Although a robust way of measuring this property, it suffers from a number of problems, especially the fact that it has to do with the light concentration and not only with its extent

- Recently, a work by Trujillo et al. (2020) suggested the use of the stellar mass density contour at 1 $M_{\odot} pc^{-2}$ as it is linked with density threshold for star formation in galaxy disks.

- We go one step beyond by utilizing disk truncations, which is a feature present in galaxy disks characterized by a sharp decline in their lights. However, it is located at faint surface brightness levels (> 25 mag $arcsec^{-2}$) and consequently only possible to investigate in deep surveys.

- Another study, by Chamba et al. (2020), is trying to accomplish this measurements in the nearby Universe. In the present study we show that it is possible to investigate it in the high-z Universe by making use of HST information, namely the CANDELS survey, that offers the perfect combination between depth and area

DESCRIPTION:

- We used the deepest imaging in the CANDELS fields (F606W, F814W filters covered with the HST ACS camera; F125W, F160 filters covered with the HST WFC3 camera)

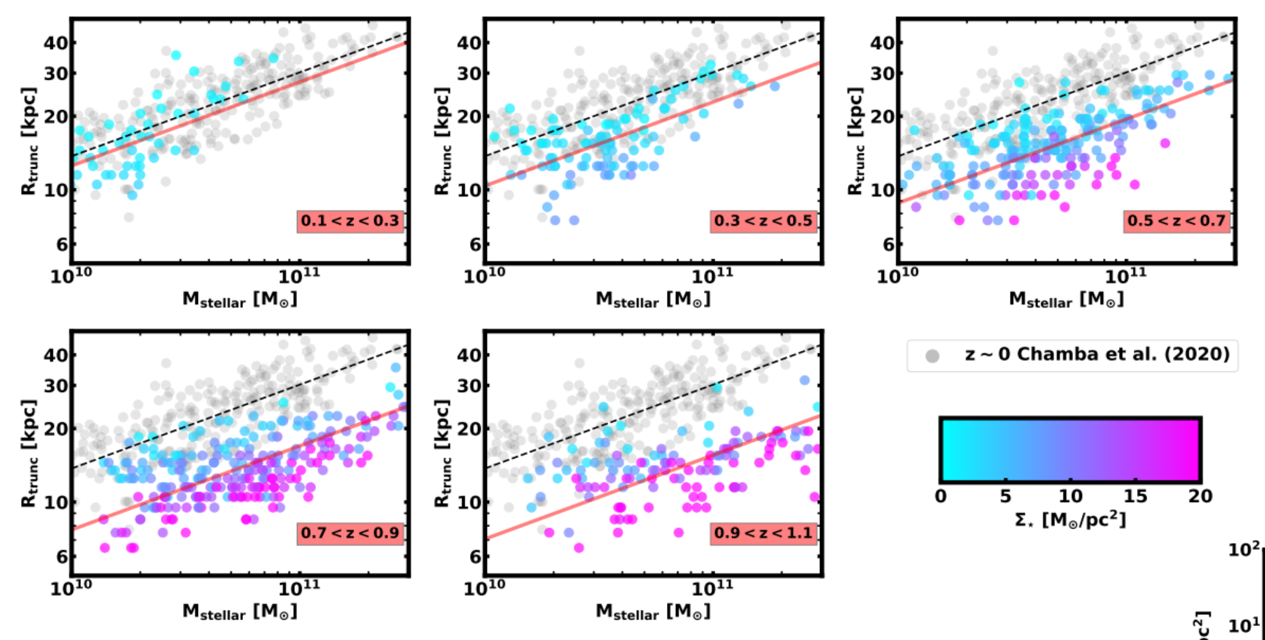
- We cut postage stamps for galaxy disks (selected from the parent catalog of Huertas-Company+15) with $M_{stellar} > 10^{10}\ M_{\odot}$ and $z_{spec} < 1$. In addition, we added the condition axis ratio > 0.3 in order not to be affected by inclination issues (Trujillo+20)

- We masked automatically and manually neighbouring galaxies. We also corrected by galactic extinction and cosmological dimming. Then, we obtained observed surface brightness profiles, restframe SDSS profiles and mass profiles. Integrating these latter ones, we also obtained stellar masses that are the ones we make use of throughout our paper.

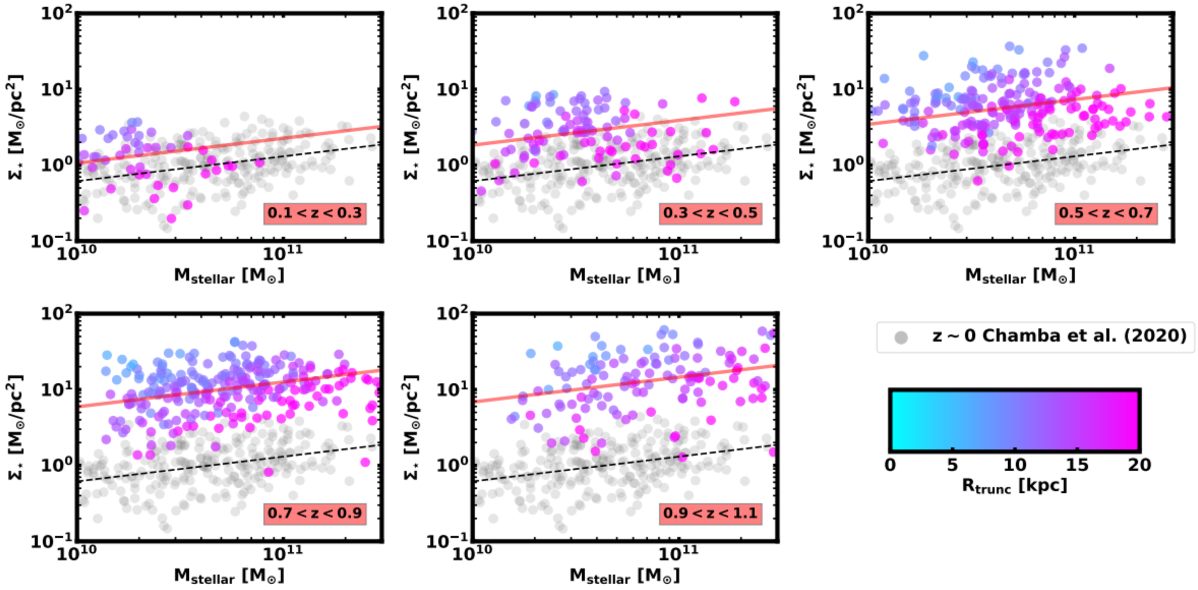
- Truncation positions (R_{edge}) are identified as sharp decreases in the galaxy surface brightness, restframe and mass profiles. Color profiles also help us for this task, because their characteristic U shape, being the truncation usually found at its bottom.

- We took as z~0 reference sample the one in Chamba et al. (2020) where the authors have done similarly to us, with the exception of utilizing visual morphologies instead of ours derived with neural networks

RESULTS

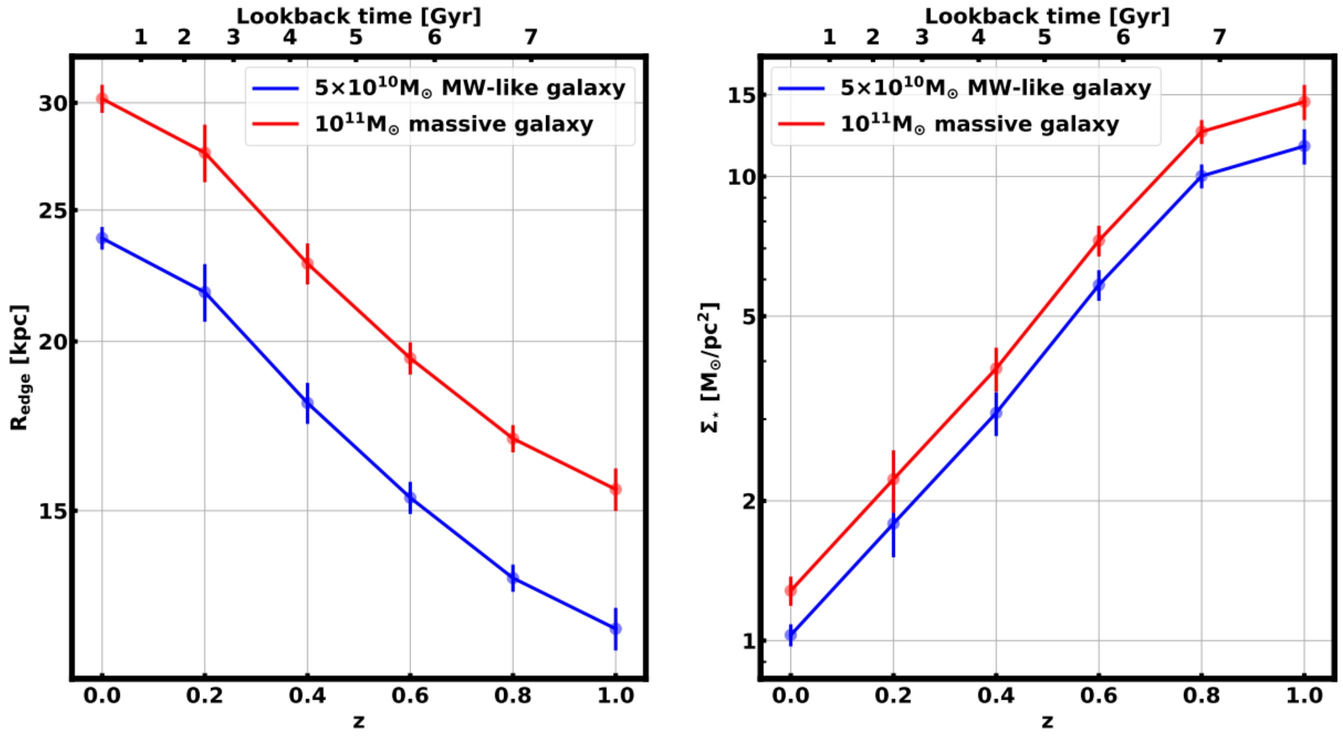


Truncation radius evolution



Evolution of the mass density at the truncation radius

- Galaxy sizes decreases with redshift by a factor x2-3
- Mass densities at the truncation increase by an order of magnitude
- This is consistent with the continuous increase in size of galaxies with cosmic time as seen by many other studies (e.g. Trujillo+07, Buitrago+08, Van der Wel+14 and references therein) although revealing the fact that the high-z disks are substantially different as those in the nearby Universe



IMPACT AND PROSPECTS

- Work in progress: we must quantify better our results and compare them with those obtained by using the effective radius as a size proxy. In addition, we must comprehend the origin of truncations, which is a field poorly explored thus far

- We demonstrate that the low surface brightness regime of high-z galaxies can potentially improve the state-of-the-art on galaxy sizes by obtaining a physically motivated proxy that reduces significantly the scatter in the mass-size relation

- This latter aspect, joined with the fact of the truncation being a feature present in galactic disks and not anything ad-hoc, opens a window to link baryonic and dark matter sizes