Dark Matter Dictates the Stellar Envelopes of Super Massive Galaxies

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and the HSC collaboration
Dark Matter Dictates Accretion onto Massive Galaxies
HSC survey
Wide + Deep + Lensing

- Rare objects
- Dark Matter Halos
- Faint outskirts
A Large Sample of Super Massive Galaxies

3000 galaxies with $M_* > 10^{11.6} \, M_\odot$  \hspace{1cm} 0.2 < redshift < 0.5
Profiles detected to 100 kpc for individual galaxies

no stacking!

28 mag/arcsec$^2$

Huang et al. 2018a
Stellar Profiles of Super Massive Galaxies

1. Massive Galaxies are not self similar

2. Large scatter in the outskirts (can be measured in HSC!)

3. Diversity of massive galaxy outskirts

Intrinsic scatter
Is the scatter amongst profiles (diversity of stellar envelopes) connected to dark matter halo mass?

Assembly of outer galaxy $\Leftrightarrow$ assembly of dark matter halo?
Galaxy galaxy weak lensing

Measures the coherent distortion pattern in the shapes of background galaxies

Directly measures the dark matter halo mass of galaxies ensembles
$M_{10 \text{kpc}}$ and $M_{100 \text{kpc}}$ Masses

![Graph showing the relationship between log(μ*/[M_☉ kpc^−2]) and R^{1/4} (kpc).](image)
$M_{10\text{kpc}}$ and $M_{100\text{kpc}}$ Masses
M_{10kpc} and M_{100kpc} Masses
Diversity of Stellar Envelopes

$M_{10}$

$M_{100}$ (or $M_{\text{max}}$)
Diversity of Stellar Envelopes

\[ M_{10} \]

\[ M_{100} \] (or \( M_{\text{max}} \))

\[ \log \left( \mu_*/(M_\odot \, \text{kpc}^{-2}) \right) \]

\[ R^{1/4} \, (\text{kpc}) \]

Average Profiles of Different \( M_* \) Bins
\( M_{10} \iff M_{100} \iff M_{\text{halo}} \)
How is halo mass ($M_{\text{halo}}$) extracted from the lensing signal?

**Full forward model**

**Semi-empirical galaxy model**

“the Universe Machine”

(Behroozi et al 2018)
Larger Envelopes = Larger Dark Matter Halo

(Halo mass dependence of the mass-size relation)
Huang et al. 2018c in prep
Conclusions

- HSC detects lights of super massive galaxies to 100 kpc
- Super massive galaxies are not self similar - diversity of stellar envelopes
- Weak lensing $\Rightarrow$ strong correlation between amplitudes/slopes of light profiles and dark matter halo mass

References:
Huang et al. 2018a arXiv:1707.01904
Huang et al. 2018b arXiv:1803.02824
Huang et al. 2018c in prep

- Detailed comparison between HSC and hydro simulations - Felipe Ardila’s talk on Thursday