WHAT DOES MORPHOLOGY TELL US?
Employing galaxy morphology to decode galaxy evolution

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The study of galaxy evolution is a fundamental part of understanding our own galaxy, as well as the universe as a whole. Simulations provide us with insight into the formation and evolution of galaxies as we know it – but is this comparable to real observations? Through our work, we aim to bridge the two current gaps in this field of research: (i) the comparison of simulations to real observations, and (ii) the use of mock observations to better understand real observations.

In this project, we compare the mass- and light-weighted morphologies of galaxies as a means to decode galaxy evolution and assess the accuracy of our current simulations. From the SIMBA cosmological simulations (Davé et al. 2019), we measure galaxy morphologies through maps of their physical properties and through mock observations. For real galaxy observations, the Hubble eXtreme Deep Field (XDF) (Illingworth et al. 2013), which contains some of the Hubble Space Telescope's deepest resolved imaging to date, is employed. We developed a pipeline that analyzes both simulations and observations (mock and real) and compares their morphologies. To test this pipeline, we applied it to a SIMBA simulated galaxy. For both simulation and mock observation of this galaxy, we measured the half-light radii – the aperture in which half the light resides – at a series of 9 different wavelengths, and we used its simulated stellar mass map to measure the half-mass radius – the aperture in which there is half the mass. Comparing these measurements shows that the mock galaxy mostly agrees with the simulated; these results can be seen in Figure 1.

The next steps of our project include extending these analyses to include star formation rate measurements and applying this pipeline to more simulations and mock observations, but also to the 9000+ galaxies in the XDF. If we find that the simulations, mock and real observations agree, we can thus use simulations to understand the physical processes driving galaxy evolution and better interpret observations. If they however do not agree, this study can be used to improve the future generations of simulations.

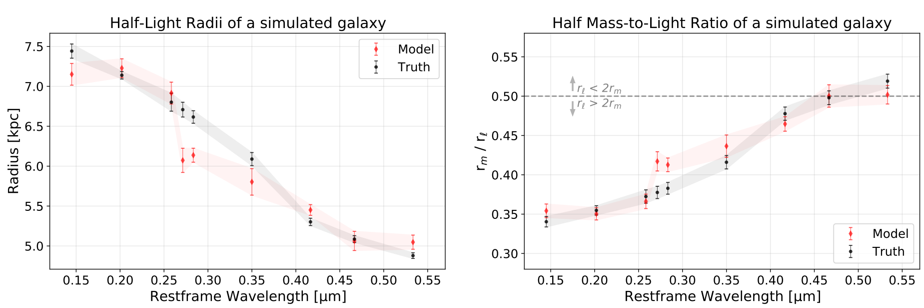

Fig. 1.—: Left: The half-light radii measurements of a galaxy through simulations (*Truth*) and mock observations (Sérsic *Model*) from the SIMBA suite of cosmological simulations at a selection of 9 wavelengths. Right: The half-mass-to-half-light radii relation for a simulated galaxy. The ratio of the mass-to-light radii is found using the measurements in the left panel.

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