Observing Galaxy Assembly in Simulations

Mock observations and galaxy morphology statistics in cosmological hydro simulations

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WFIRST + Big Hydrodynamical Simulations =

stories of galaxy assembly

star formation

dust attenuation

stellar & supernova feedback

supermassive black hole accretion and feedback



merger

Why simulations?? (theoretical)





Why simulations?? (observational)

CANDELS Multi-Cycle Treasury Program



Grogin et al. 2011, Koekemoer et al. 2011

- Goal:
 - exploit all information in observations
 - accurately classify rare but important stages
 - interpret surveys by direct analogy with theory

'Big' Cosmological Hydro Simulations >~ (100 Mpc)³

- Achieving WFIRST resolution at z > 1
 Eagle, Illustris, MassiveBlack-II, Horizon-AGN, ...
- Follow decades of N-body + semi-analytic modeling successes
- Platforms to study origins of galaxy structure

Illustris Synthetic Images Torrey, GFS et al. (2015) ; GFS et al. (2015b) illustris-project.org/data



Genel et al. (+GFS, 2014)

Illustris Synthetic Images Torrey, GFS et al. (2015) ; GFS et al. (2015b) <u>illustris-project.org/data</u>



Morphology OK versus Mass, SFR



Snyder et al. (2015b)

Morphology OK versus Mass, SFR



Snyder et al. (2015b)

a reflection of feedback-regulated mass assembly





Snyder et al. (2015b)

Galaxy fueling has subtle, diverse effects on images



Snyder, Lotz, et al. (2015a), Peth et al. (in prep.)

galaxy mass accretion histories by Nir Mandelker, Daniel Ceverino

M. Peth et al. (in prep)

 Mass assembly in galaxy center precedes (observed) bulge growth by ~400 Myr



See also: Zolotov et al. (2015), Tachella et al. (2016)

HST AR#13887



Mock HST Ultra Deep Field from Illustris (inspired by Millennium Run Observatory: Overzier et al. 2013)



"WFIRST"







WFIRST + Big Hydrodynamical Simulations = stories of galaxy assembly

- Create synthetic data, analyze in same way as Archives
- 2. Measure simulated galaxies' intrinsic evolution
- 3. Share broadly

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aside: are shapes and their correlations feedback model-dependent?



See also Tenneti et al. (2015); intrinsic alignments in hydro sims



	cosmology	feedback o	dust & metals
Empirical	structure	galaxy	predict
	formation	formation	data
N-body +	structure	galaxy	predict
Semi-analytic	formation	formation	data
Hydrodynamic	structure	galaxy	predict
	formation	formation	data
Hydro +	structure	galaxy	predict
Radiative Transfer	formation	formation	data

numerical

analytic

structure correlates best with quenching

