Physics of Galaxy Color Migration: Environment Driven

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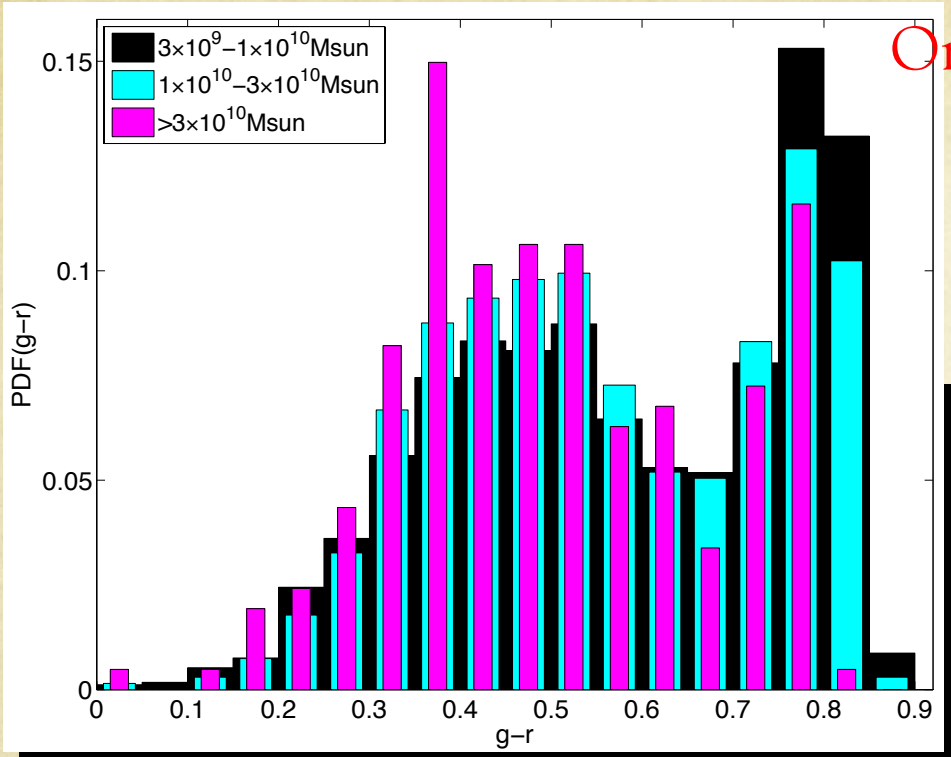
LAOZI (aka Lao Tzu) Simulations

(Large-scale AMR Omniscient Zoom In cosmological hydro sims)

- Enzo adaptive-mesh-refinement (AMR) hydro code
- Zoom-in box size 30x34x30 Mpc^3
  a contiguous volume embedded in 120Mpc/h periodic box
- Spatial resolution 29-114 pc/h at all times
- 2000-3000 galaxies with stellar mass greater than 10^{10} Msun at each redshift,
  entire history for each galaxy tracked from z>6 to present
- Sophisticated physical treatments of all microphysics and supernova feedback processes
- Simulations reproduce a non-trivial set of obs (not shown)

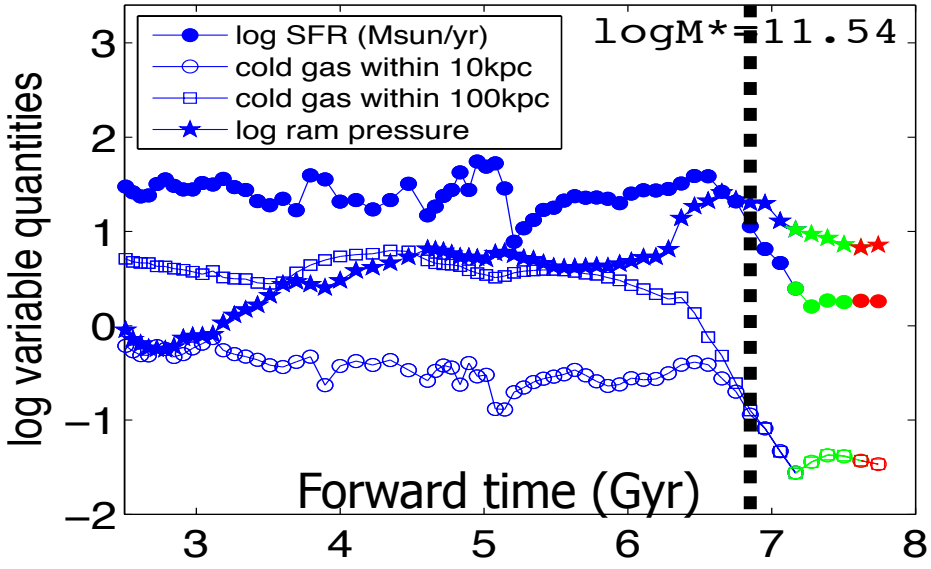
Cen (2013, ApJ, 781, 38) "On the Origin of the Hubble Sequence: I. Insights on Galaxy Color Migration From Cosmological Sims"

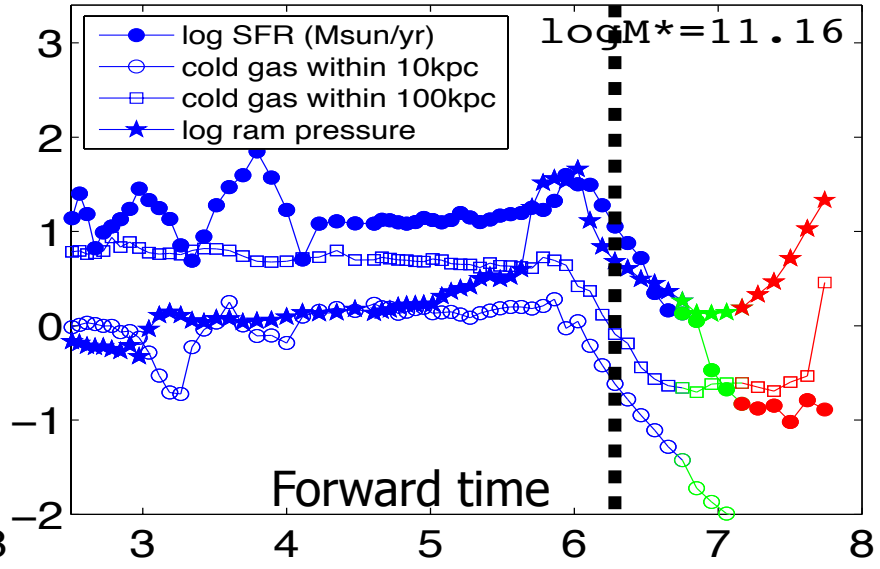
One relevant observable: color bimodality reproduced

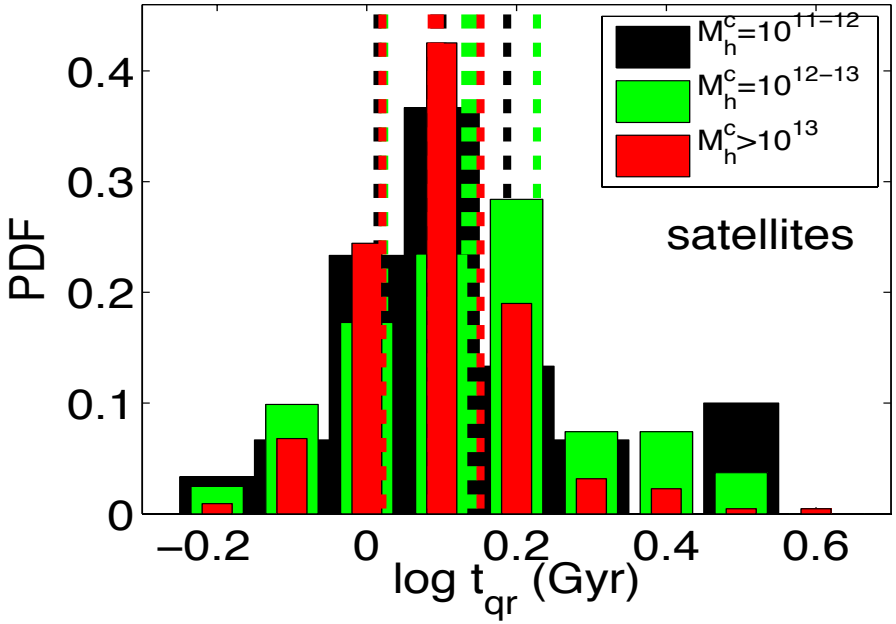


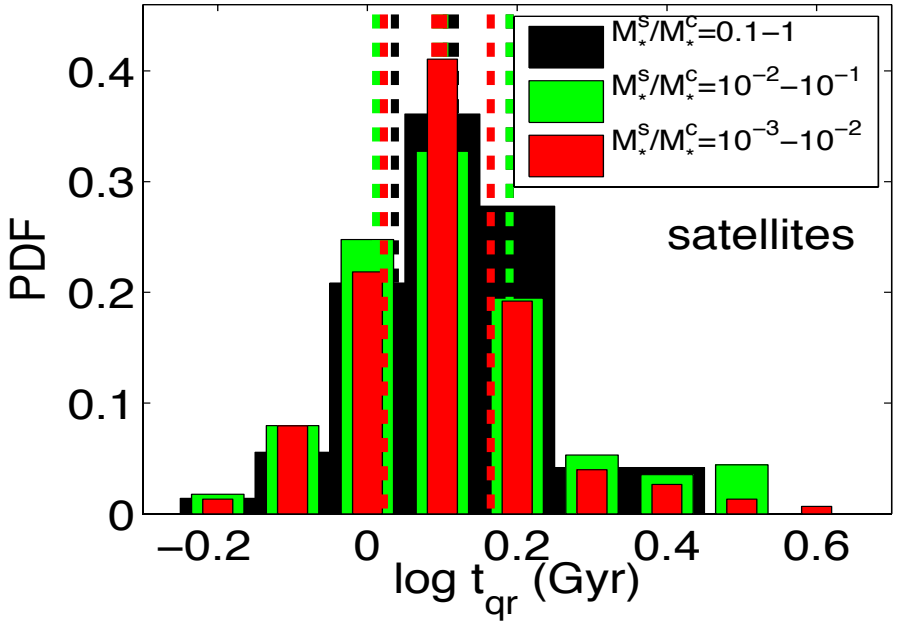
an example galaxy (interaction) at z=3: gas density

The vast majority are quenched by a combination of ram-pressure stripping and (then) cold gas starvation

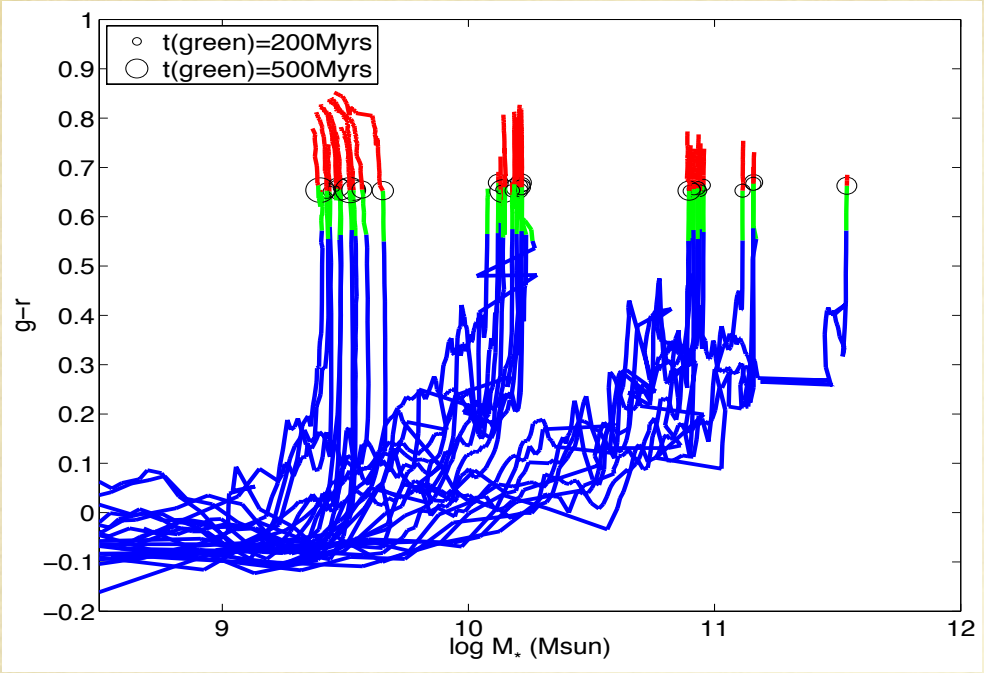


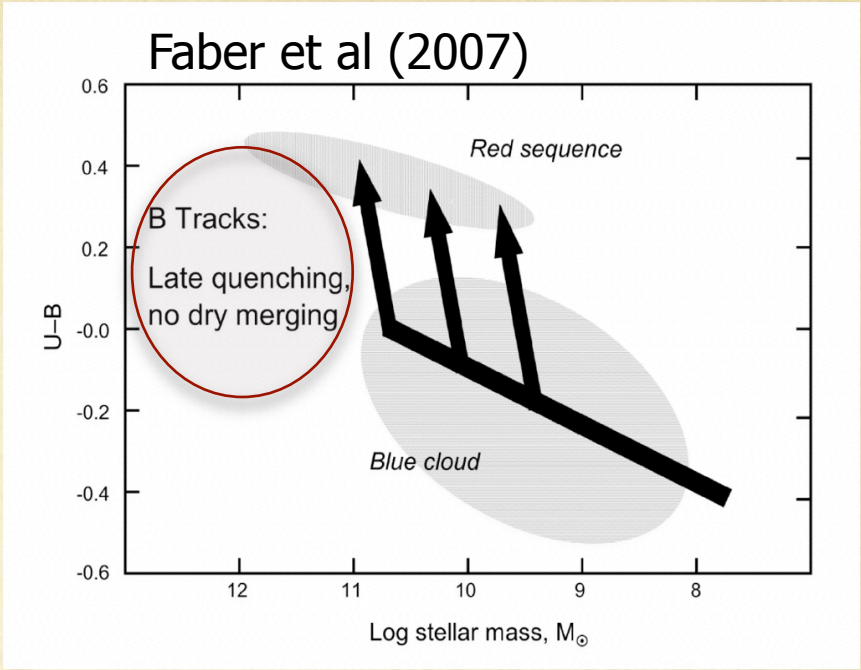


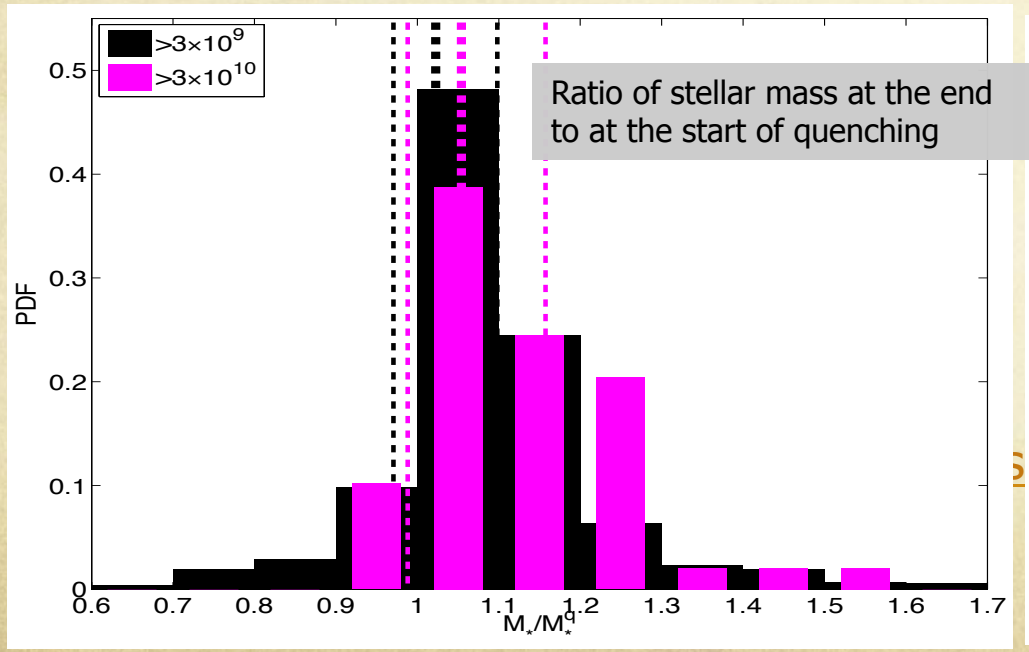




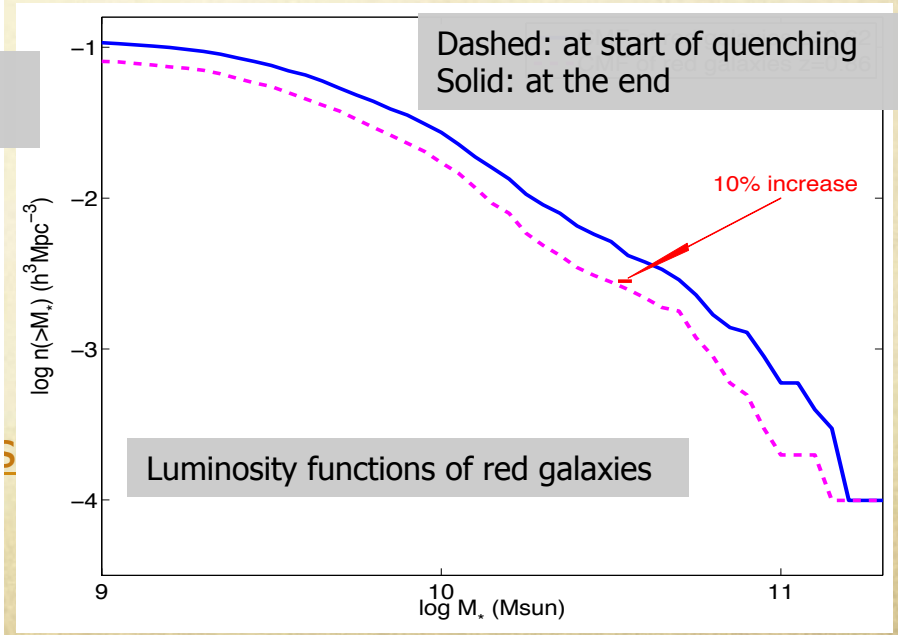
Galaxy color migration tracks: dry mergers not prevalent







Ratio of stellar mass at the end to at the start of quenching



Luminosity functions of red galaxies

A simple accurate feedback solution: end of ad hoc ways

Kimm & Cen (2014, ApJ, 788, 18), poster#12

1. Solve Sedov-Taylor with cooling beforehand
2. Express solution as a function of M_{swept}/M_{ejecta}
3. Lay down the analytic solution on the simulation grid that is angle-dependent
4. Capture feedback regardless which phase (free expansion, Sedov-Taylor, cooling or snowplow) the solution is in at the simulation solution scale
5. Have implemented in RAMSES and ENZO