Interaction Induced Size Evolution in Galaxies

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Introduction

In this work we utilize two suites of 75 different simulations of major galaxy mergers based on the Gadget model (Springel & Hernquist 2003) and the novel "Feedback in Realistic Environments" FIRE model (Hopkins, et al. 2014). These mergers are composed of spiral galaxies of mass ratio 2.5:1 and are set at various impact parameters, eccentricities, and relative spin-orbit orientations. We focus on the effect of interactions on the evolution of the size of the gaseous, stellar, and star-forming components of the galaxies.

Motivation

When considering field galaxies, we see that the population of spiral galaxies outnumbers that of the spheroidal early type galaxies (ETGs). In regions crowded with many galaxies, though ETGs -- particularly fast rotators -- dominate the population (Figure1). We speculate that the increase in number of fast rotator ETGs in these environments can be attributed to interactions between galaxies.

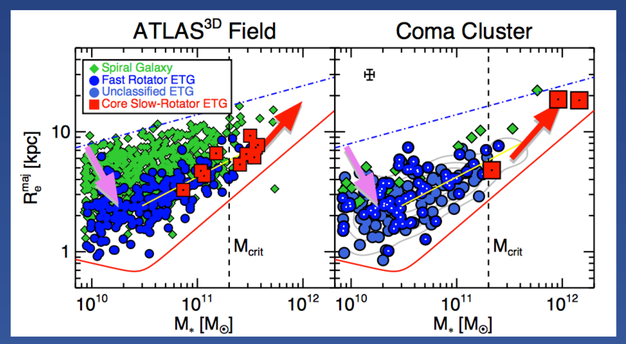


Figure 1: Effective radius (Reff) against mass of field galaxies [left] and cluster galaxies [right]. As a function of environment, populations shift from being spiral dominated to ETG dominated without significant mass increase (Cappellari, et al. 2013).

Figure 2: The Coma Galaxy Cluster is a cluster is known to contain thousands of galaxies most of which are slow rotator ETGs.

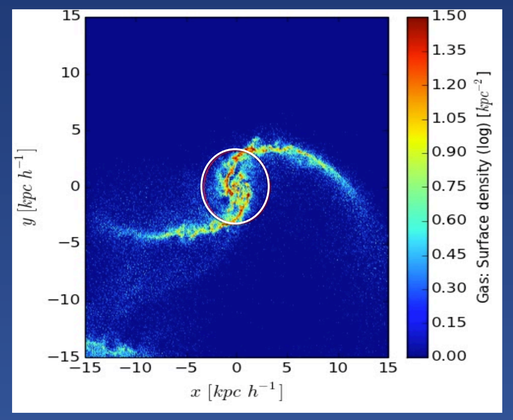
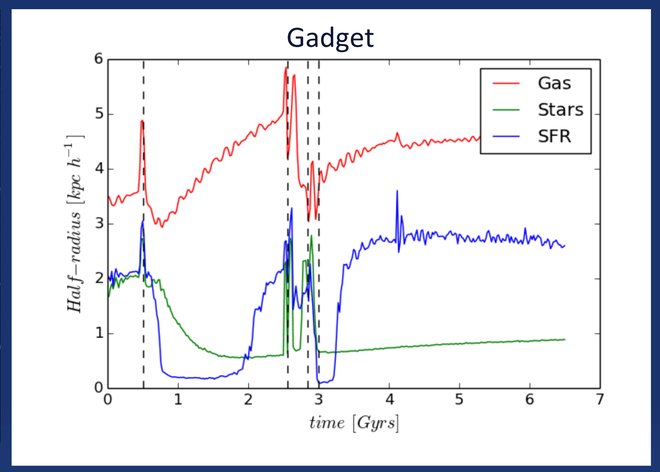


Figure 3: A two-dimensional histogram of the surface density of the gas centered on one galaxy. The red circle indicates the half-mass-radius of the gaseous component.



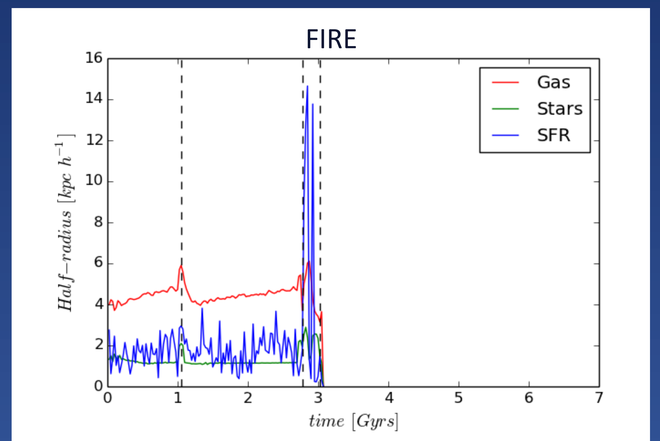


Figure 4 & 5: Both figures plot the half-radii against time for the gaseous component (Red), stellar component (Green), and star-forming component (Blue). The vertical dashed lines correspond to the times at which closest passage occur.

	Gadget	FIRE
Model	SPH	GIZMO
Star Formation	Volumetric Kennicutt-Schmidt recipe	Cool, self-gravitating gas
Feedback	Thermal Feedback	Adds heat & momentum

Figure 6: The differences between the Gadget and FIRE simulations.

Results

- All components shrink (gaseous component later heats and expands)
- Shrinkage more pronounced in the Gadget simulation

Future Work

- Determine importance of each orbital parameter
- Calculate concentration: ratio of 80% to 20% radii
- Separate molecular gas from ionized gas
- Compare results to observations (SDSS)

References

- Springel V., Hernquist L. 2003, MNRAS, 339, 289
- Hopkins, et al. 2014, MNRAS, 445, 581
- Cappellari, Michele 2013, ApJL, 778, 6

Scan here for clips of the simulation!

Acknowledgements

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