

Galaxy Formation: Mergers and Accretion

Benjamin L'HUILLIER

Françoise COMBES, Benoît SEMELIN
LERMA, Observatoire de Paris

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Outline

- 1 Galaxy Growth
- 2 Multizoom Simulations
- 3 Galaxy Detection and Tracking
 - How to detect galaxies?
- 4 Mergers vs Accretion Fractions

Galaxy Growth

Galaxy Formation

- Two modes of galaxy growth:
 - Mergers of galaxies,
 - Accretion of gas from the intergalactic medium.
- Goal: Quantify the baryonic mass assembled through mergers and gas accretion
 - Detection of structures at each timestep
 - Time tracking: merger tree building

Multizoom Simulations

Multizoom simulations (Semelin & Combes 2005)

- TreeSPH code with DM, stars and gas particles
- Initially: cubic cosmological simulation
- Resimulation of spherical regions of interest at higher resolution
- In resimulated regions, particles enter the box: number of particles is *not constant*

Simulation parameters

- $R_{\text{box}} = 8.60 \text{ Mpc}$
- $t_{\text{end}} = 9.1 \text{ Gyr}$
- $N_{\text{part}} \sim 14 \text{ M}$
- $m_{\text{DM}} = 1.4 \times 10^8 M_{\odot}$
- $m_{\text{b}} = 3 \times 10^7 M_{\odot}$
- $\varepsilon_{\text{soft}} = 6.75 \text{ kpc}$

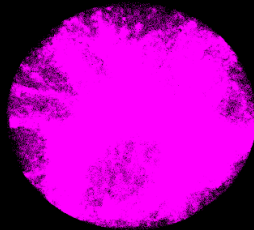
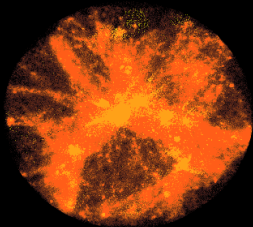
Galaxy Detection

Structure Finder

- Hierarchical finder to keep track of the structures during mergers: AdaptaHOP (Aubert et al. 2004, Tweed et al. 2009)
- Modifications to detect gas and stars in galaxies
- Parameter study: ρ_T , other parameters?

8.3 Gyr

8.3 Gyr



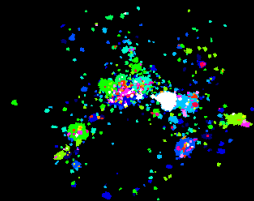
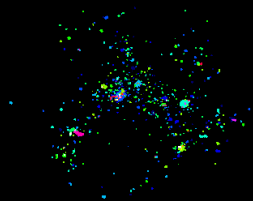
4.1 Mpc

4.1 Mpc



8.3 Gyr

8.3 Gyr



4.1 Mpc

4.1 Mpc



8.3 Gyr

8.3 Gyr

408.6 kpc

408.6 kpc



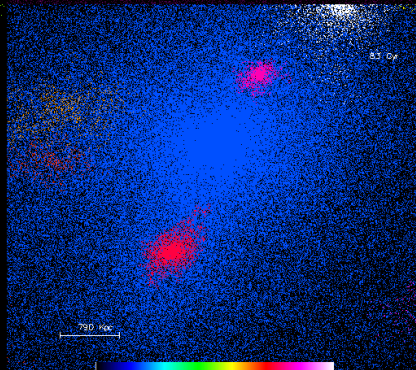
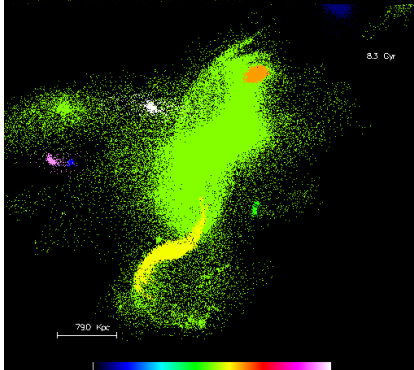
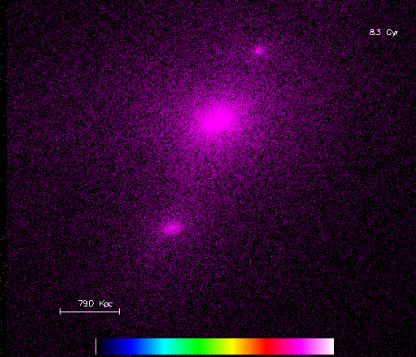
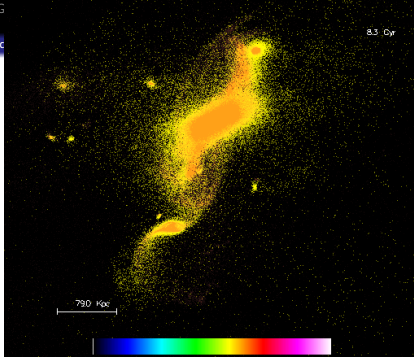
8.3 Gyr

8.3 Gyr

408.6 kpc

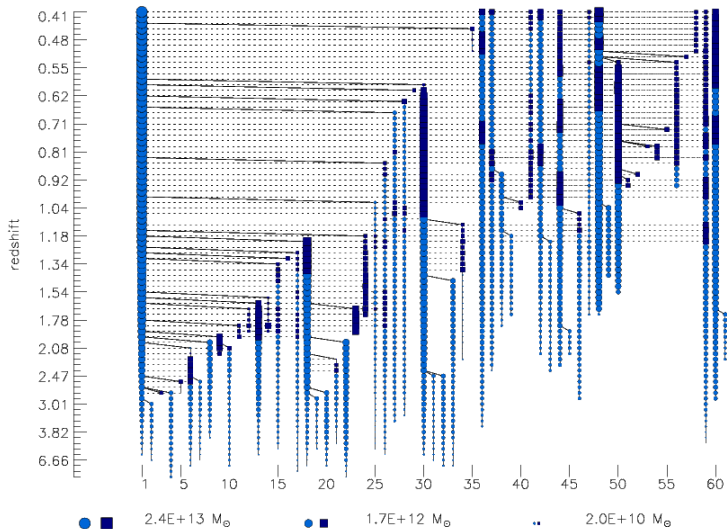
408.6 kpc





How to detect galaxies?

Merger tree of a galaxy (baryons)



Mergers vs Accretion Fractions

How to compute Accretion and Mergers?

- Computation of the merger tree of each main galaxy at last snapshot
- At every snapshot, each particle is assigned either to a structure or to the background.
- Where do particles come from?
 - particles coming from background: Accretion
 - particles coming from another (sub-)structure: Merger
- Particles can also leave the structure: evaporation or disruption

Accretion fraction (baryons)

Galaxy	1	2	3	4	5	6
Mass ($10^{11} M_{\odot}$)	107.5	244.81	140.81	1.73	143.40	8.98
Accretion fraction	1.04*	0.65	0.67	0.52	0.95	0.71

Mass history of a galaxy

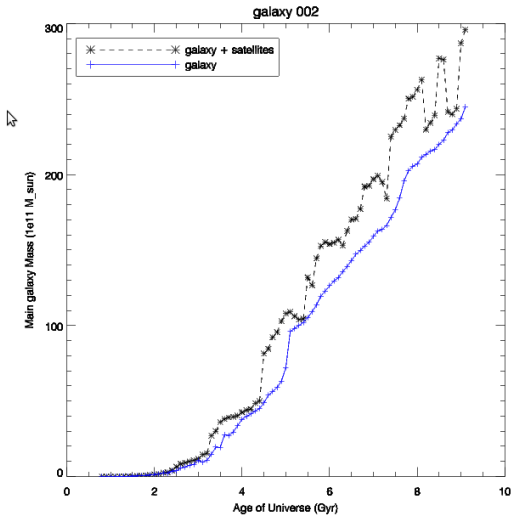


Figure: Mass evolution of the largest structure in a cluster

Mass history of a galaxy

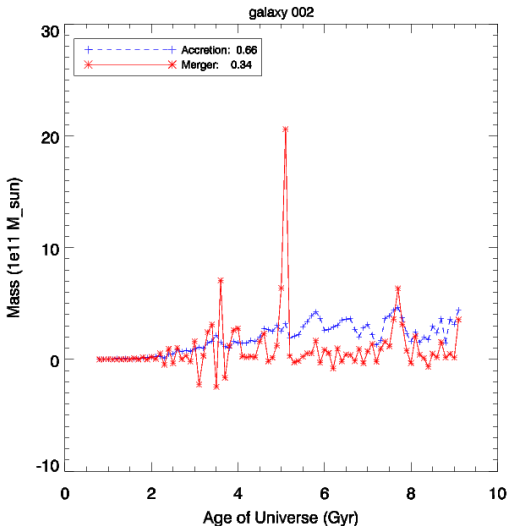


Figure: Mass gain: accretion and mergers

Conclusions and perspectives

Conclusion

- Using AdaptaHOP enables baryonic structures tracking
- Baryonic mass assembly seems to be dominated by accretion

Perspectives

- Further parameter study
- Statistical study of the mass accretion,
- Influence of the environment:
 - Accretion and merger fractions
 - Star formation history
 - Baryonic fraction and gas fraction