Galaxies reionising the universe: light from the first objects

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Introduction

Small galaxies ($M_{vir} \lesssim 10^9 M_\odot$) are responsible for most of the ionising budget for the Reionisation.

- How do these galaxies form their stars?
- How much of the UV radiation escapes the galaxies?

Very hard to constrain with current observations, but major science case for JWST.

$\Rightarrow$ Need for high resolution simulations of high-z, low mass galaxies with radiative hydrodynamics.

Methods: Ramses-RT

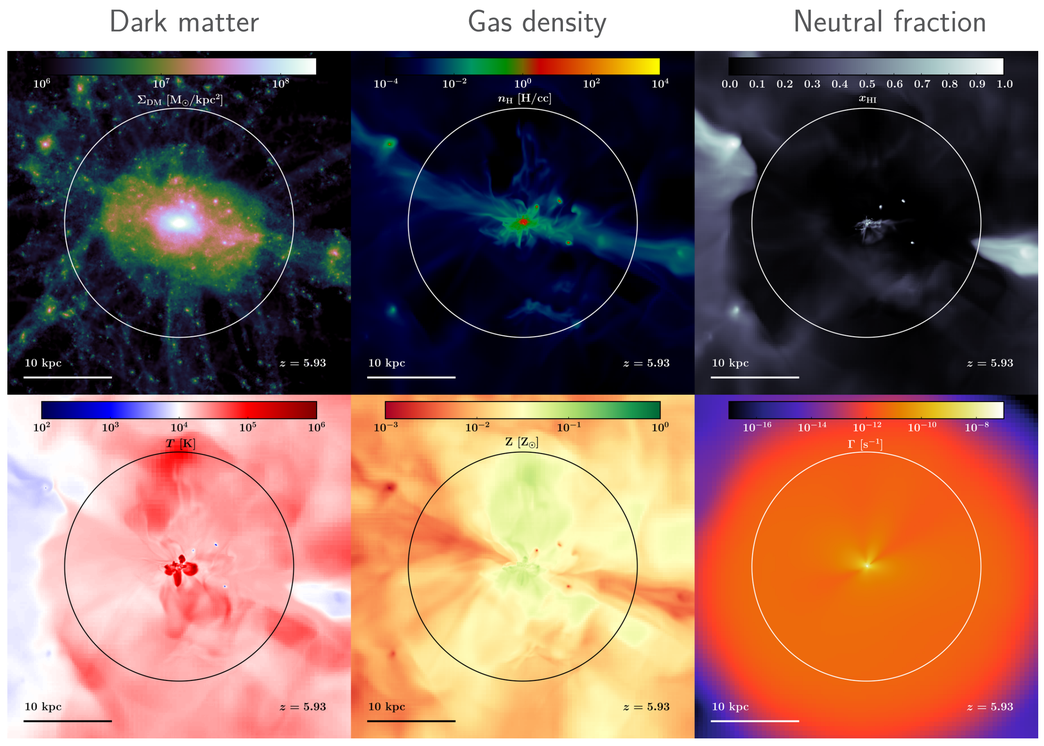
We use the RHD version of the Ramses AMR code (Rosdahl et al, 2013).

- High resolution
  - Dark matter: $m_{DM} \simeq 10^3\ M_\odot$
  - Gas: $\Delta x \simeq 10 - 20$ pc
  - Stars: $m_\star \simeq 120\ M_\odot$
- State of the art subgrid models
  - Gravoturbulent star formation (Devriendt, Slyz, Kimm, in prep.)
  - Resolved mechanical feedback (Kimm & Cen, 2014)
- Ionising radiation propagated in 3 bins (HI, HeI, HeII)
- H + He thermochemistry solved on the fly

We resimulate three haloes: $M_{vir} = 10^8 M_\odot,\ 10^9 M_\odot,\ 2.5 \times 10^9 M_\odot$ in a $10 h^{-1}$ Mpc box.

All simulations are stopped after 1 Gyr ($z \simeq 5.7$).

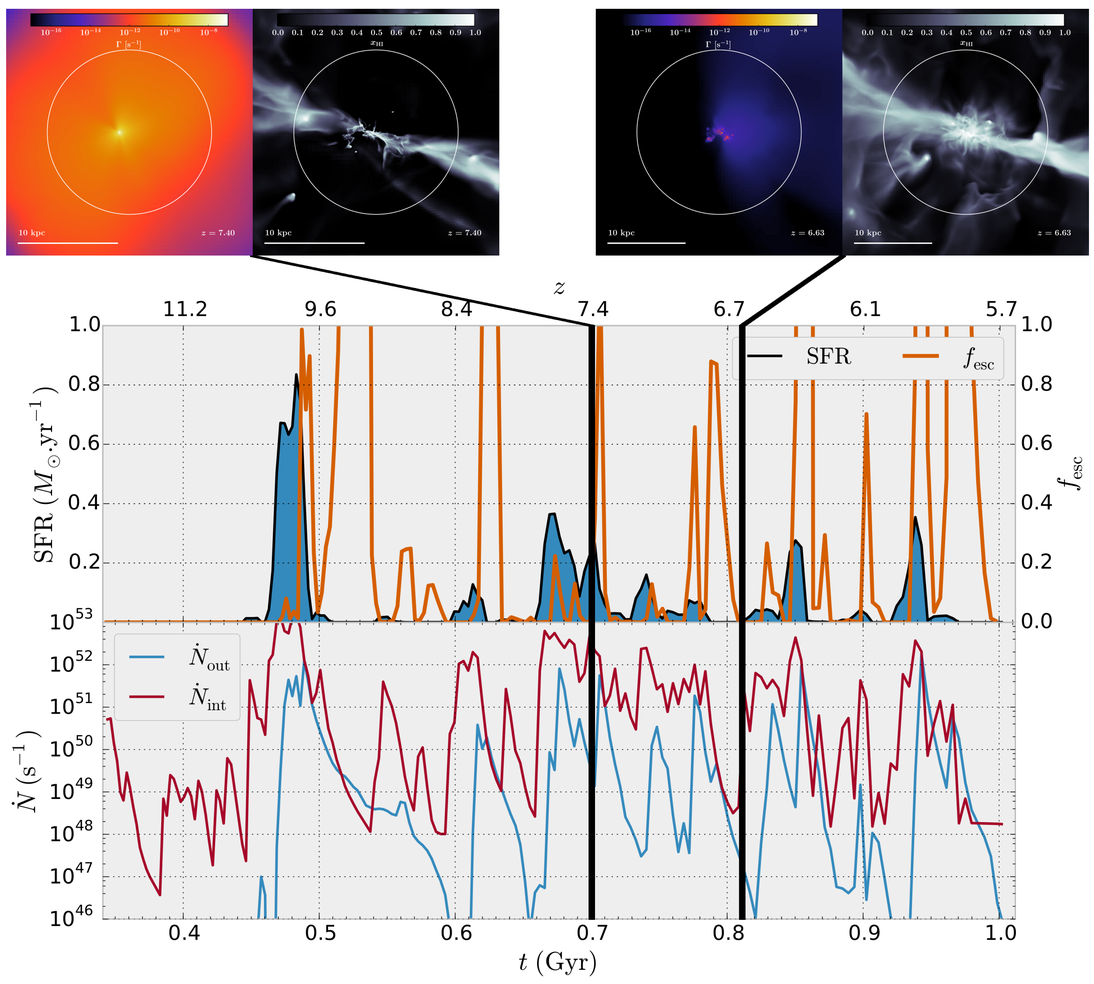
Simulations



- We focus on the most massive halo. At $z \simeq 5.7$, the total stellar mass is $M_\star \simeq 2 \times 10^7 M_\odot$.
- The galaxy undergoes a succession of episodes of star formation and SN feedback that launch powerful winds.
- The global behaviour is qualitatively similar for all our simulated haloes.

Bursty assembly of galaxies

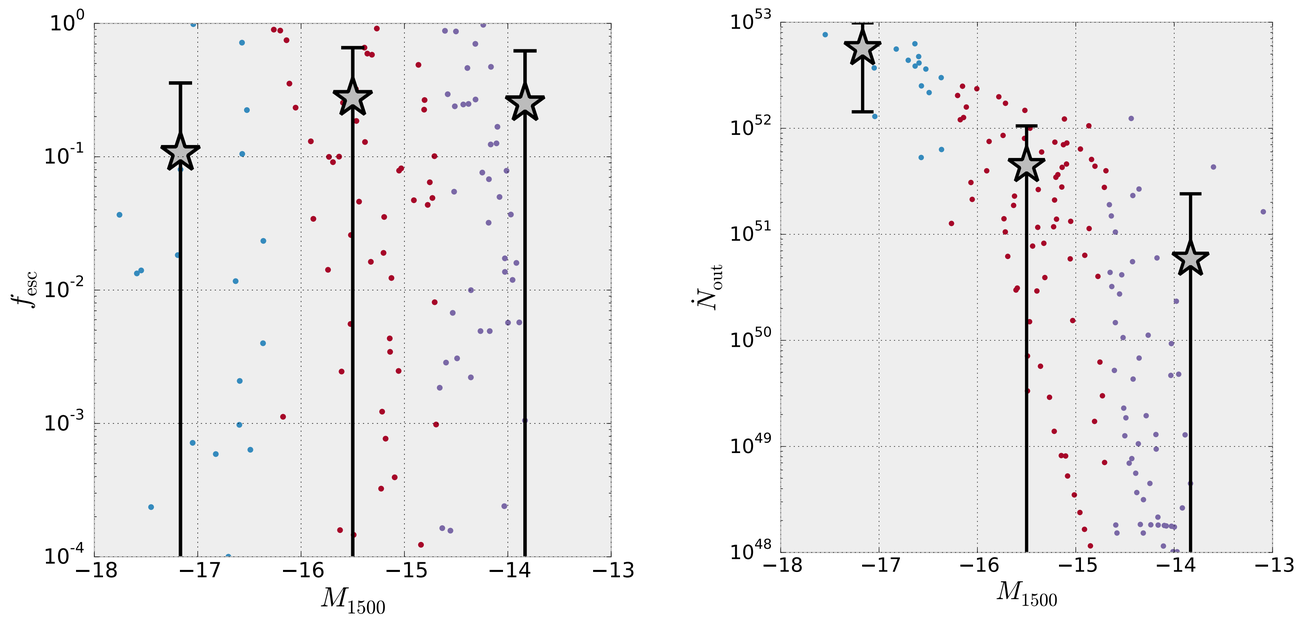
- In low mass galaxies, SN feedback removes gas from the ISM and heats the gas in the halo.
- The escape of ionising radiation happens after the stellar birth cloud has been cleared by SN.
- Galaxies alternate between "burst" phases ($f_{esc} \sim 100\%$) and "quiet" phases ($f_{esc} \sim 0\%$).
- The IGM is photoheated and photoionised during the "burst" phases, and cools and recombines during the "quiet" phases.



Observational properties

From the simulated SFH, we compute the UV magnitude of the galaxy.

- Bursty star formation results in large variations in time of the UV magnitude.
- There is no strong correlation between the UV magnitude and the escape fraction.
- Selections based on the UV luminosity will favor galaxies that are more Lyman leaking.



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