Influence of galactic mergers on the escape of LyC radiation during reionization

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SCUOLA
NORMALE
SUPERIORE

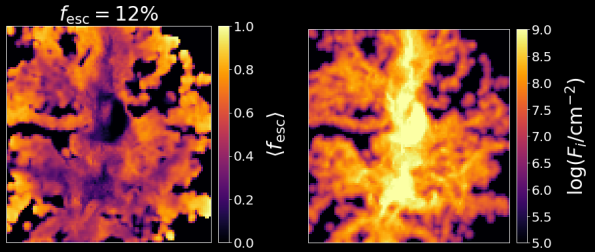
Why are mergers important in the early Universe?

- Increase in star-formation $\Rightarrow$ more LyC production (Lahén+ 2020)
- Offset of galactic gas $\Rightarrow$ formation of LyC escape channels (Le Reste+ 2024)
- Mergers in overdense regions could drive creation of ionized regions facilitating Lyα escape. (Witten+ 2024)

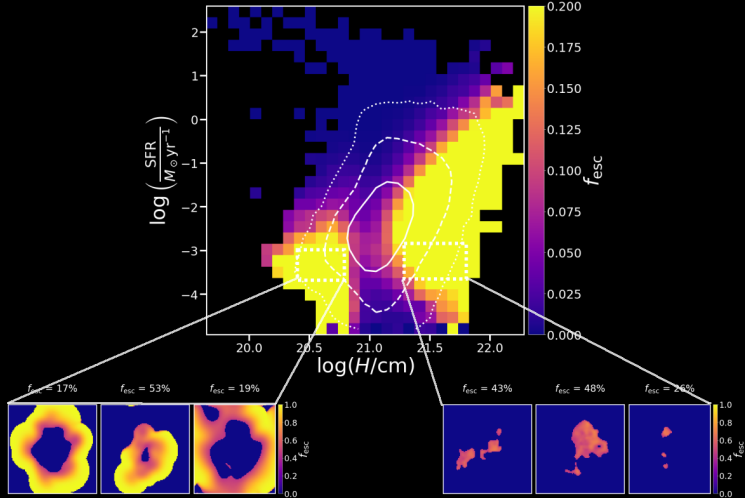
Goal: Investigate impact of mergers on LyC escape in TNG50 galaxies and their correlation with galactic properties.

Physical modelling of LyC escape

- Galaxy modelled as a thin plane
- LyC absorbed by gas+dust
- Ionizing flux proportional to the SFR
- $f_{\rm esc}$ evaluated on a grid
- $f_{\rm esc} = \langle f_{\rm esc,grid} \rangle_{F_{\rm ion}}$



Bimodal distribution of $f_{\rm esc}$



Extended SF, high Z

Localized SF, low Z

Merger impact on escape modes

- Gas displacement, increased column height and decreased gas density

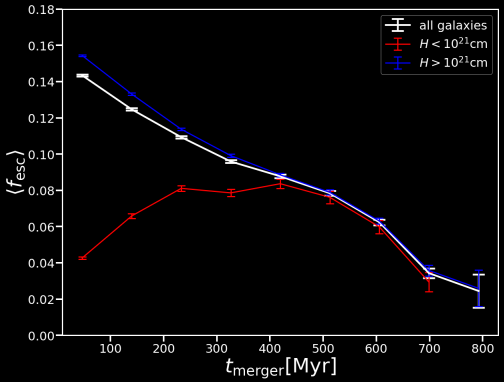
  $\Downarrow$

  $f_{\rm esc}$ increases in the localized mode

- Dispersion of star-forming gas and decrease of metallicity

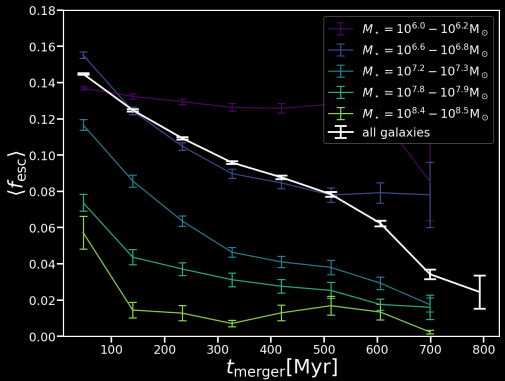
  $\Downarrow$

  $f_{\rm esc}$ decreases in the extended mode



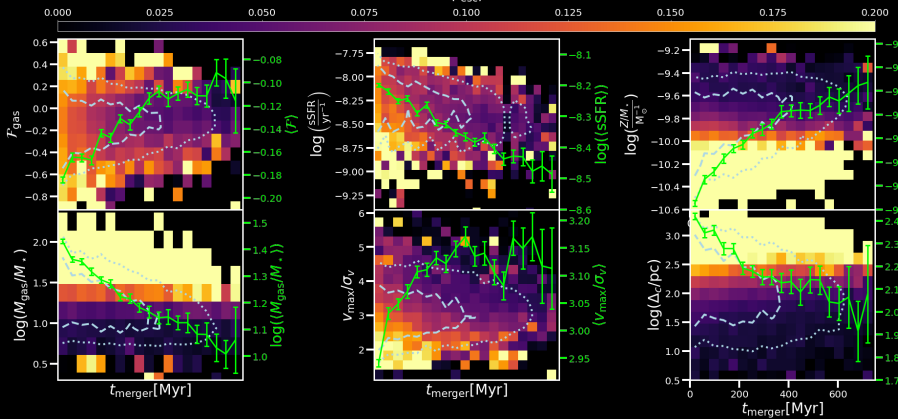
Mass dependence of merger impact

- In low mass galaxies equilibrium establishes quickly after a merger $\Rightarrow$ No strong correlations with t_{merger}
- In massive galaxies no high f_{esc} values are reached
- Strongest decline for galaxies with $M_\star \sim 10^{7.2}$ 12% $\rightarrow$ 2%



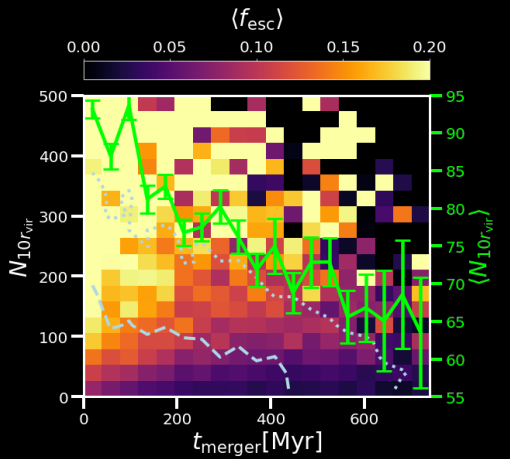
Reasons for increased f_{esc}

- Inflow of metal poor gas + decreased metallicity
- Decrease in gas density through increase in velocity dispersion
- Relative gas displacement



LyC escape in overdense regions

- Galaxies with recent mergers reside in overdense regions
- Galaxies in overdense regions generally have a higher $f_{\rm esc}$
- The reason is more efficient gas accretion and decreased metallicity in star-forming regions.



Conclusions

- Mergers significantly increase LyC escape from localized star-forming regions (14% $\Rightarrow$ 3% for $M_\star \sim 10^7 M_\odot$ galaxies.)
- $f_{\rm esc}$ is increased through
  - Gas displacement from star-forming regions
  - Decreased metal and dust content
  - Dispersion of gas and decrease of gas density
- LyC escape is generally more efficient in overdense regions