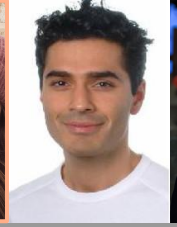
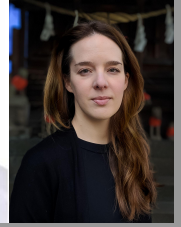
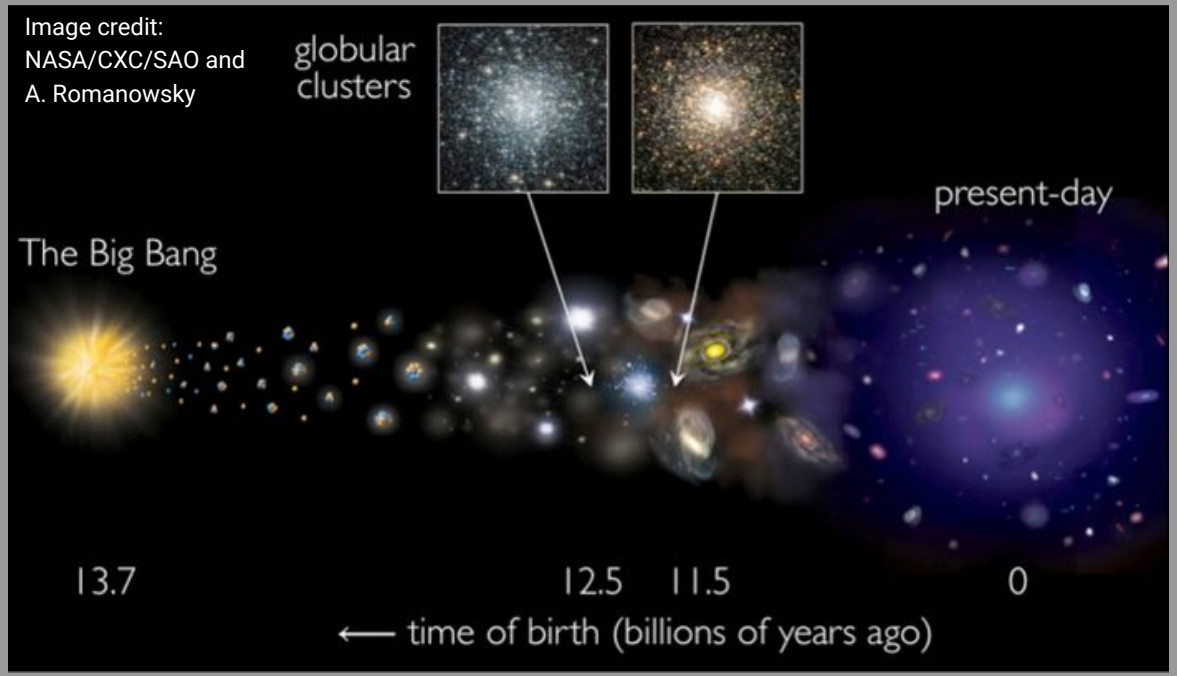




Infant Globular Clusters: Extremely Dense Star Forming Factories at High Redshift

Outline

We explore a suite of high-resolution cosmological simulations at redshift $z > 6$ to investigate the formation of old, low-mass stellar systems with a particular focus on globular clusters (GCs).



FiBY Simulations

The First Billion Years (FiBY) simulations are high-resolution cosmological SPH simulations.
They track metal pollution and include SN feedback and Pop II / III star formation.

We use a simulated volume $(4\ \mathrm{cMpc})^3$ with 684^3 particles per type. The mass resolution is $1250\ M_\odot$ and $6160\ M_\odot$ for SPH and dark matter particles, respectively.

Frederika Phipps | Supervisors: Sadegh Khochfar and Anna Lisa Varri | NAM 2021 | Phipps et al. (2020) | A&A. vol 641. Id. A132

Identifying Infant GC Candidates

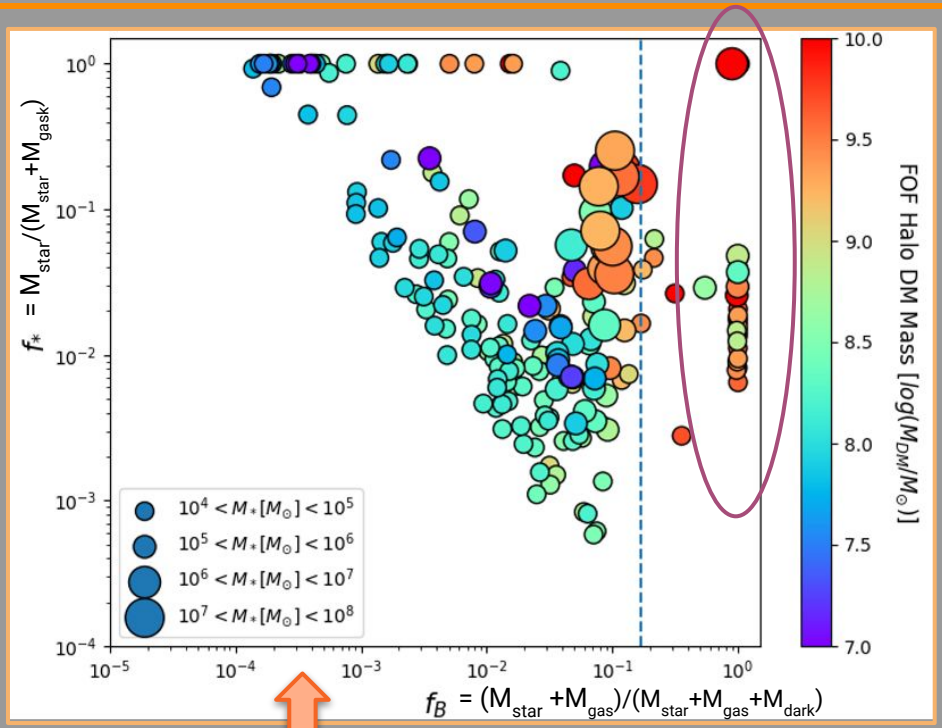
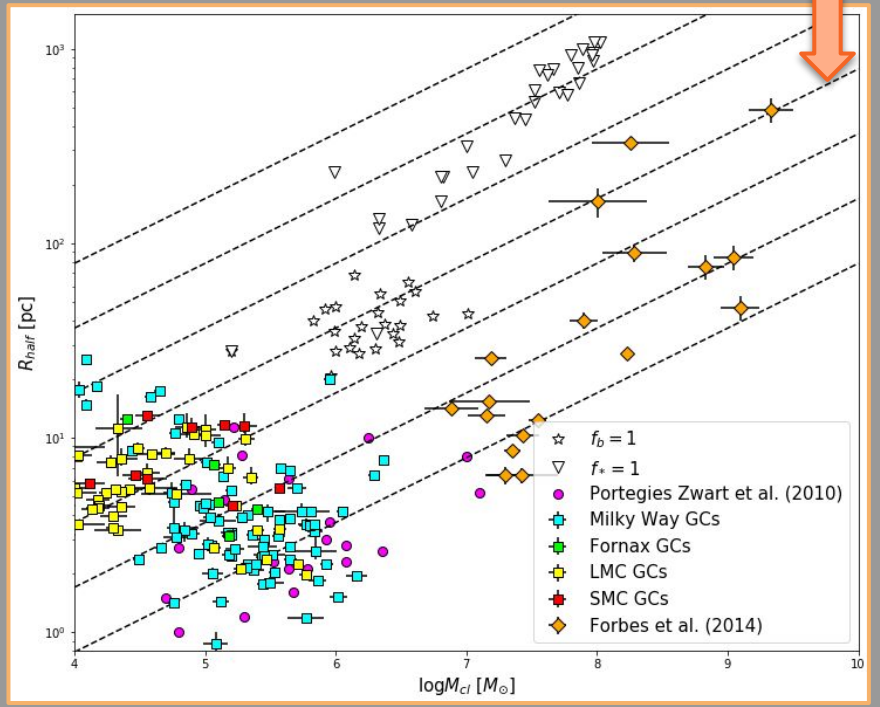


Figure 1:

The group in the purple circle are our infant GC candidates. They have stellar masses similar to local Universe GCs, large gas reservoirs and appear to live in an extended dark matter halo (associated with their host galaxy), although no dark matter is gravitationally bound to them locally.

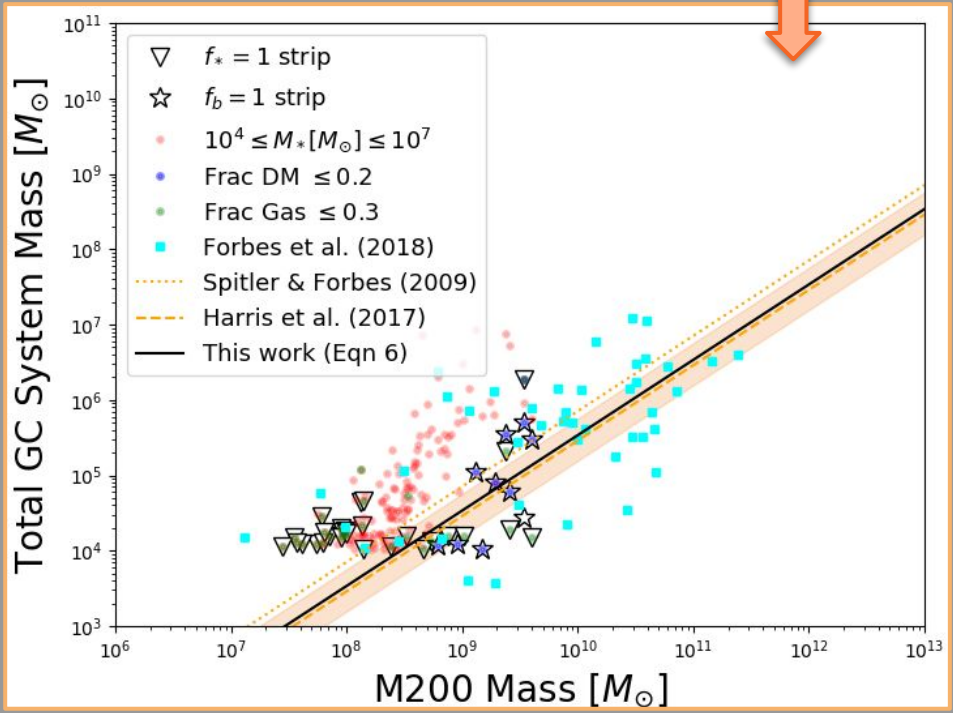
Figure 2:

The GC candidates have been plotted in the size-mass plane with local Universe data for a selection of star clusters and dwarf galaxies. **Our objects have slightly higher masses than local Universe GCs due to excess of gas.** This hints at the potential for future star formation.



High and Low Redshift Scaling Relations

Figure 3:
We analyse the **GC system mass - halo mass relation** for the infant GC candidates. Overlaid are two redshift-zero fits to local Universe data. The good agreement between the simulated and observed data implies that this relation could be set at formation.



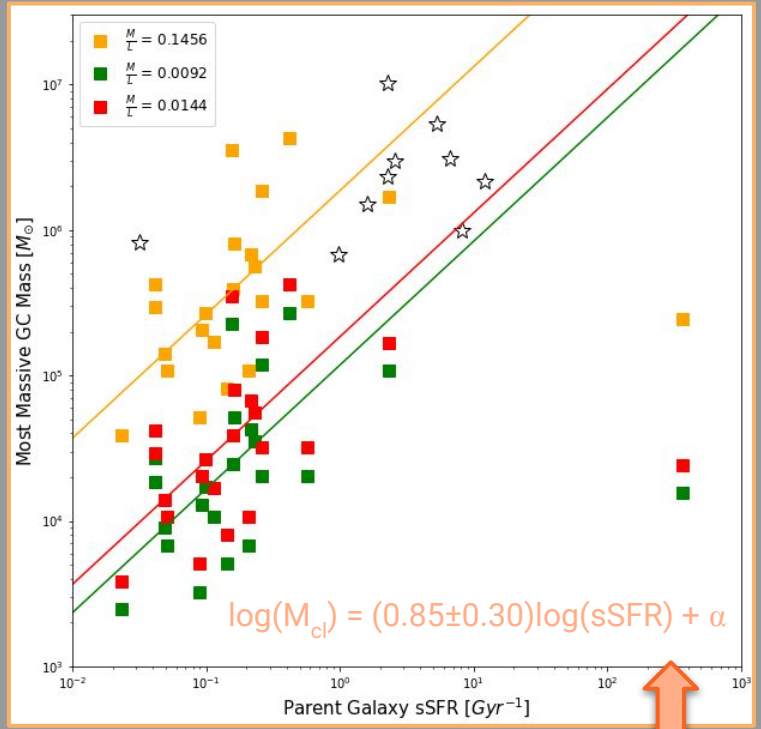
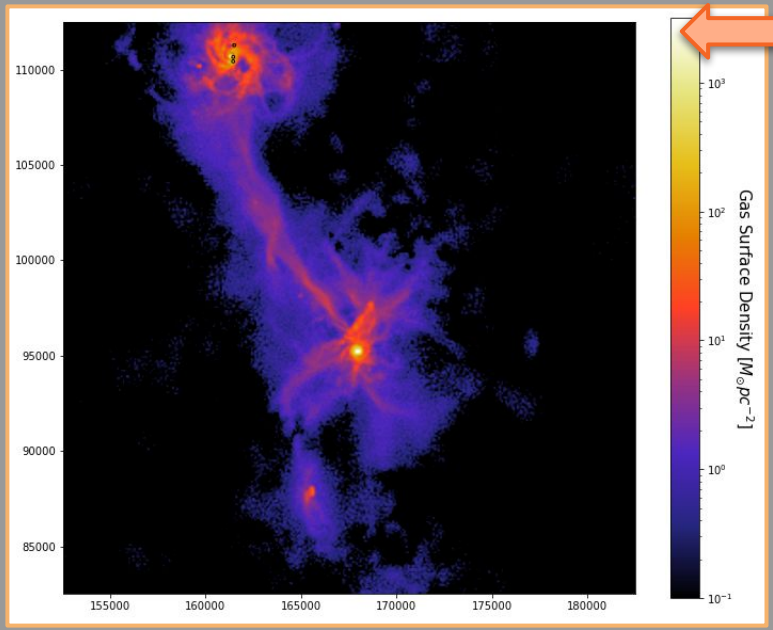
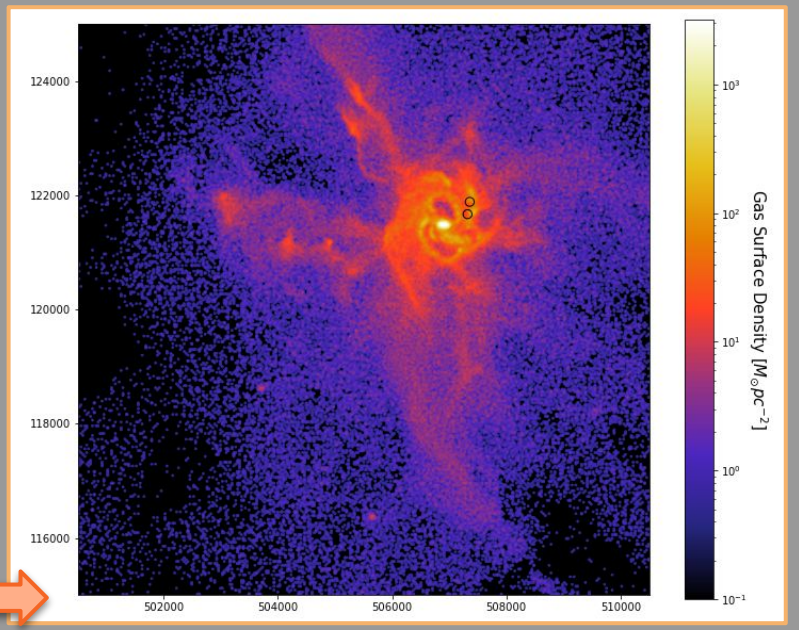


Figure 4:
We also propose a **new relation between the most massive GC and the specific star formation rate** (sSFR) of the host galaxy. A simple power law simultaneously matches the observed low redshift GCs and predicted infant GCs at z=6.

Galactic Environments



Figures 5 and 6: By examining the galactic environments of the candidates, we can establish **a connection between the large-scale environment and the small-scale cluster processes**. Black circles indicate the locations of the candidates. They are preferentially located in the spiral arms of the host, which are rich in high-density gas and ongoing clustered star formation events.



Conclusions

- ➔ We identified a group of objects in the FiBY simulations that are likely infant GC candidates
- ➔ Their properties are similar to those of local Universe GCs although the simulated GCs have more gas
- ➔ The redshift-zero GC system mass - halo mass relation fits well to the z=6 simulated data
- ➔ We present a novel relation between the sSFR of galaxies and their most massive GC that holds across redshift

Things to look forward to

We are currently investigating the formation channels of these objects. We will evaluate the impact of the host galaxy's ongoing star formation as well as exploring the detailed physical properties of the systems on small scales.

Acknowledgements

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