Haggar+20, MNRAS, 492, 6074
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# Backsplash galaxies in simulations of galaxy clusters

**Roan Haggar**, Meghan Gray, Frazer Pearce, Alexander Knebe, Weiguang Cui, et al.

roan.haggar@nottingham.ac.uk

## How do galaxy clusters grow?

**Galaxy clusters:** The largest gravitationally bound structures in the Universe, containing 100s – 1000s of galaxies. They grow by accreting galaxies, via gravity.

Galaxies fall into a cluster (i.e. enter $R_{200}$), but some pass straight through and leave again, 'rebounding' to the cluster outskirts. These are known as **backsplash galaxies**.

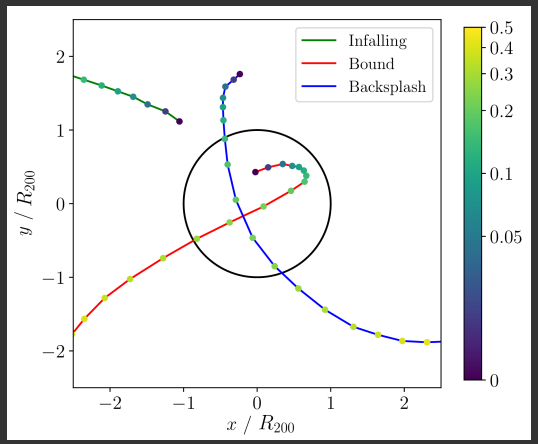
What **fraction** of galaxies in cluster outskirts are backsplash galaxies? How strongly do they contaminate samples of 'infalling' galaxies, found in cluster outskirts?

## How can we study backsplash galaxies?

**TheThreeHundred Project:** An unprecedented sample of 324 simulated galaxy clusters, taken from a 1 Gpc cosmological volume.

Using **dynamical histories** of galaxies from simulations, we can distinguish between backsplash galaxies and those on their first infall.

This is not easy observationally, as we cannot see the orbital histories of galaxies.




## References

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Gill S. P. D., Knebe A., Gibson B. K., 2005, MNRAS, 356, 1327
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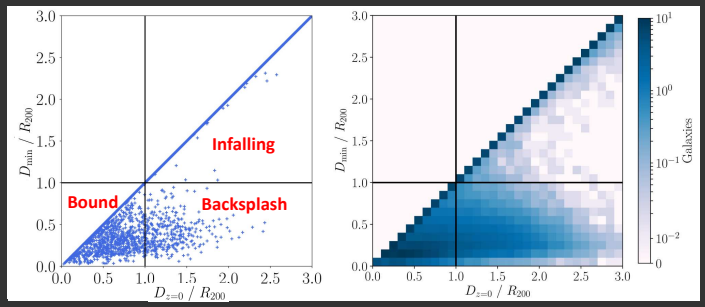
## How common are backsplash galaxies?

Plotting the distance of a galaxy from the centre of a cluster at present day, $D_{z=0}$, against its closest approach to the cluster, $D_{min}$, allows us to define a region of phase space in which galaxies are outside of the cluster radius, $R_{200}$, but have been inside the cluster at a previous time.

These are the **backsplash galaxies**.

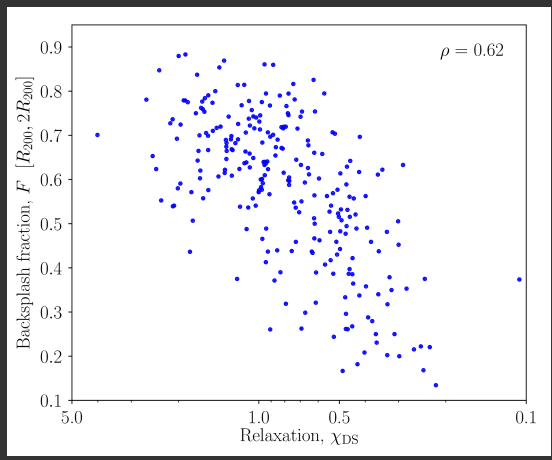



These two panels show the phase space of galaxies for one cluster, and averaged across all clusters. On average, **58%** of galaxies between $[R_{200}, 2R_{200}]$ from a cluster are backsplash galaxies.

This fraction also differs between clusters. **More relaxed** clusters (those not undergoing mergers, and accreting galaxies slowly) have a **higher backsplash** fraction. In the most relaxed cluster outskirts, 80% of galaxies can be backsplash.

Galaxies in the same regions will therefore have different histories.

Backsplash galaxies are likely to differ from infalling galaxies, as they have previously experienced processes such as **tidal effects** and **ram pressure stripping** that are enhanced in cluster environments.




Calculating the prevalence of backsplash galaxies therefore helps us disentangle the processes that shape the properties of cluster galaxies.