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# Tidal disruption of substructure in galaxy clusters

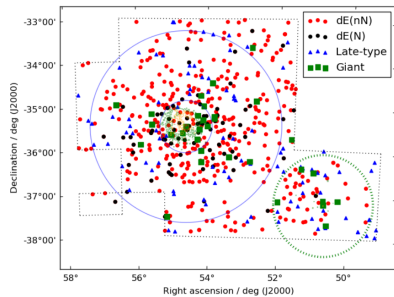
Nelvy Choque Challapa

Rory Smith, Graeme Candlish, Reynier Peletier, and Jihye Shin

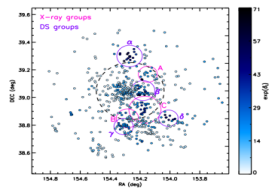
June 30, 2020

# Substructure in clusters

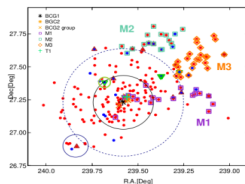
From observations:



Infalling group in Fornax (Venhola et al 2018)



Substructures in A9631 (Jaffe et al 2016)



Substructures in A2142 and its outskirts (Einasto et al 2017)

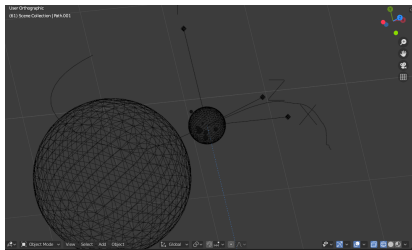
# Substructure in clusters

From simulations:

- A significant fraction of today's cluster members spent time in a previous host (e.g De Lucia et al. 2012, Han et al. 2018, Benavides et al. 2020).
- In Han et al. 2018,  $\sim 48\%$  of galaxies spent time in a previous host.
- Galaxies might be "pre-processed" in groups before they join the cluster.

Once inside the cluster group galaxies face a combined environmental influence.

# Simulations



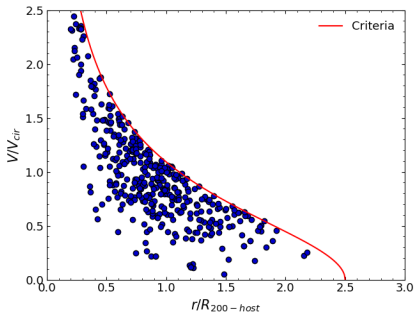
Can we reconstruct in present day observations the presence of galaxies that infalled in groups?

This work:

- N-body zoom-in simulation (GADGET-2) in a  $\Lambda$ CDM cosmology (Taylor et al. 2019).
- Mass resolution  $3.32 \times 10^6 M_{\odot} h^{-1}$ .
- Two clusters analyzed;  
 $M_1 = 9.16 \times 10^{13} M_{\odot} h^{-1}$ ,  
 $M_2 = 1.04 \times 10^{14} M_{\odot} h^{-1}$ .

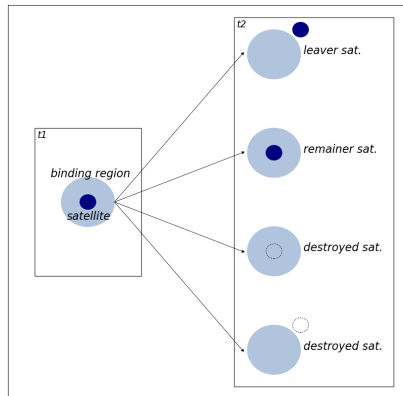
# Membership and outcome of satellites

Satellites at the moment when their hosts fall into the cluster (crossing  $1R_{200}$ )



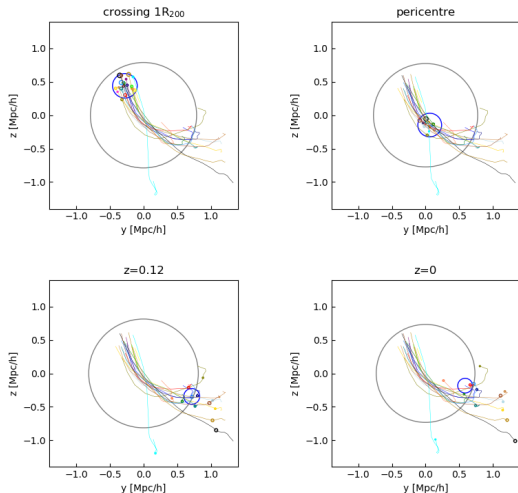
similar criterion as in Han et al 2018

Possible outcomes of satellites at  $z=0$



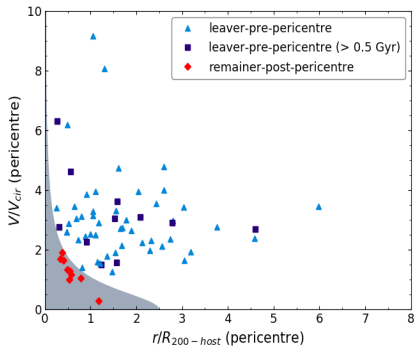
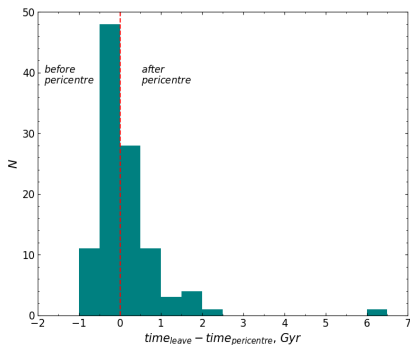
How, when and why satellites end up with that outcome...?

# When the disruption of substructure happens?



Dissociation of a host halo when it passes cluster pericentre.

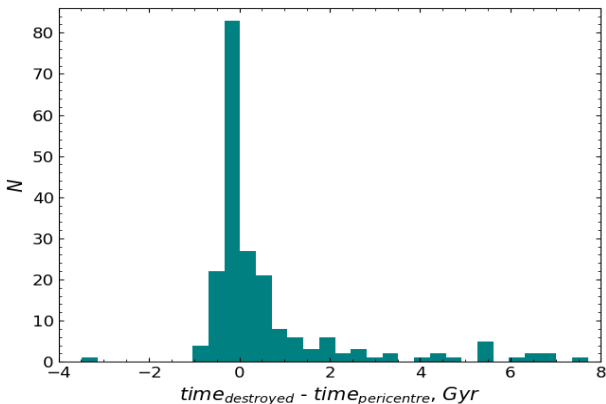
# When the disruption of substructure happens?



Most of satellites leave their host typically no later than half a Gyr after pericentre.

# Why do satellites become unbound from their hosts?

Tidal forces during the first pericentric passage in the cluster are very efficient at breaking up groups.

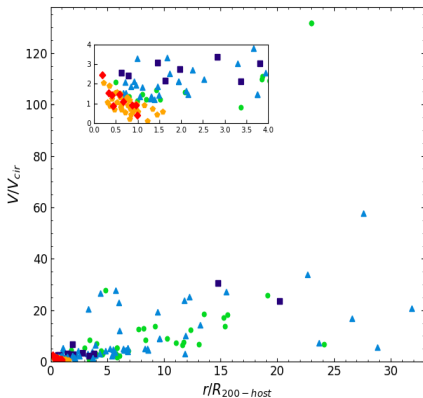


Cluster tides also dominates the tidal mass loss and destruction of satellites.

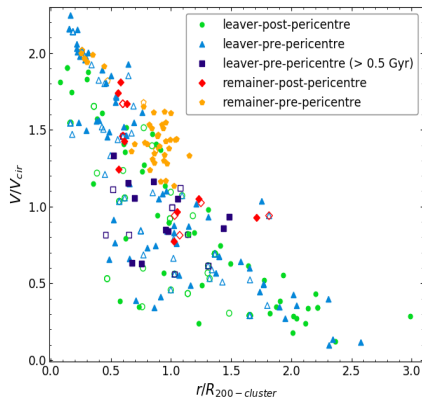


# Where do satellites end up ?

At the hostcentric frame ( $z=0$ )



At the clustercentric frame ( $z=0$ )



Leaver satellites are widely distributed and mixed with the cluster population.

# Conclusions

- Tidal forces during the first pericentric passage are very efficient at disrupting groups.
- Most of satellites will leave their host typically no later than half a Gyr the pericentric passage and mix quickly with the cluster population.
- Substructures seen in cluster today is very likely on their first infall.