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Tracking Halo Orbits and Their Mass Evolution around the Large-scale Filaments

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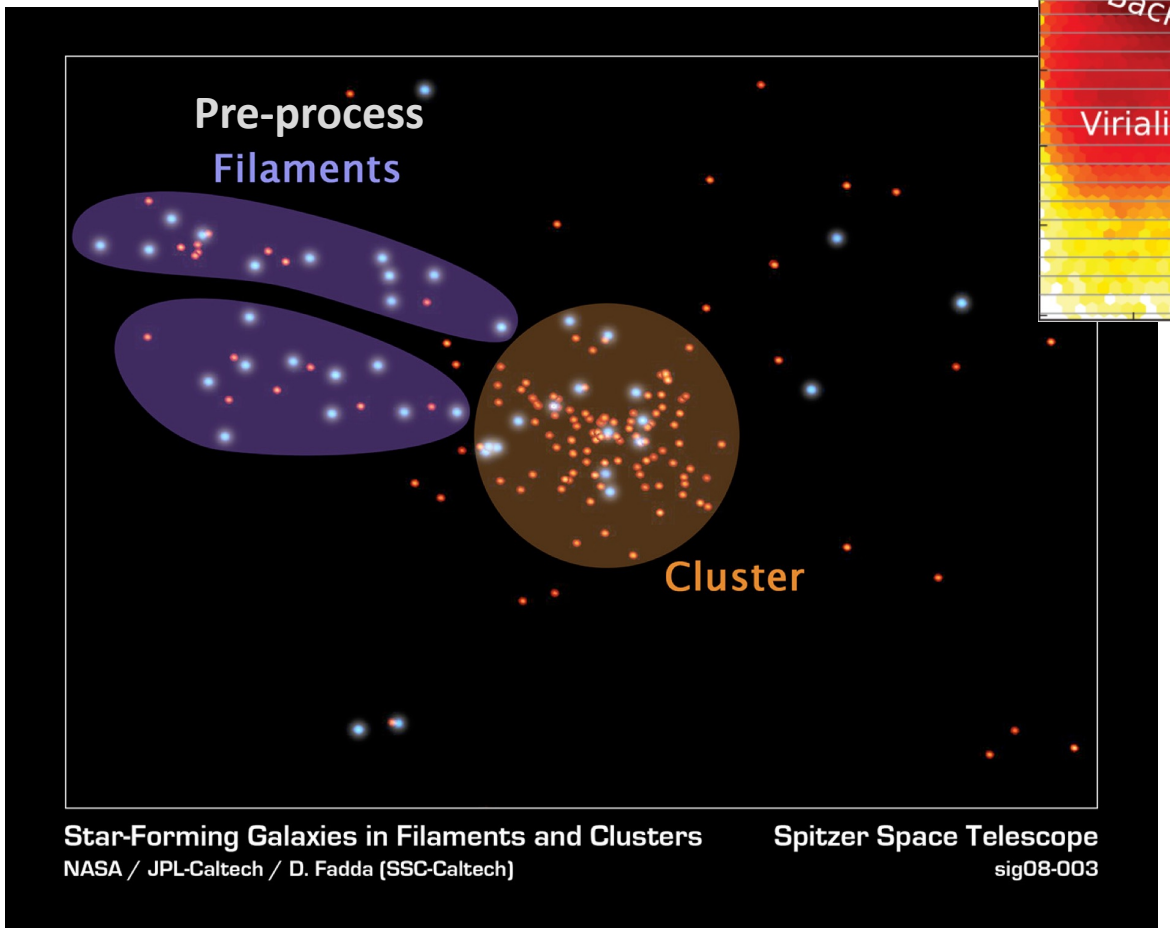
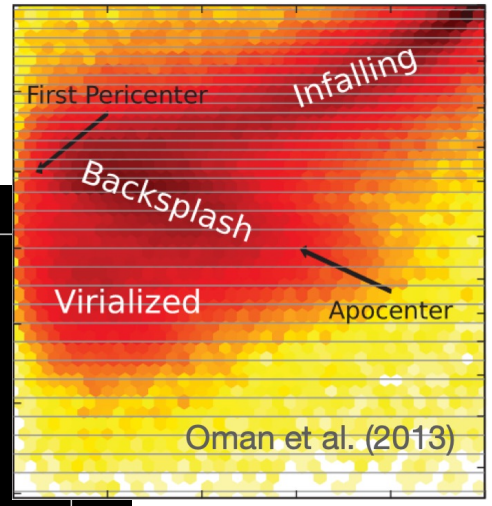
1. Motivation



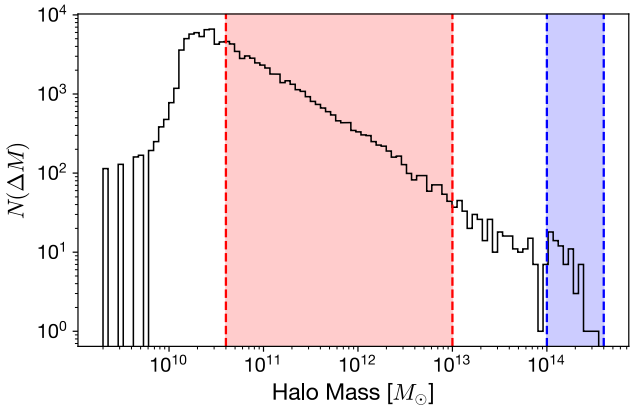


2. Data and Method

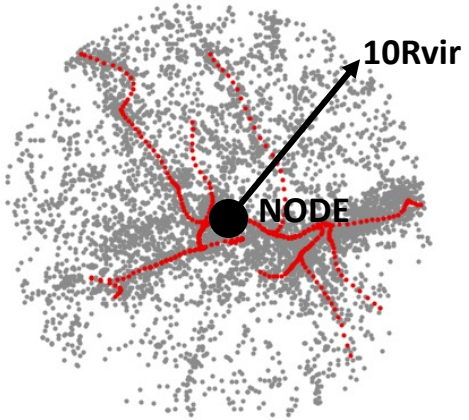
Code	Gadget-3 (Springel 2005)
Cosmological Parameters	$\Omega_\Lambda = 0.7$ $\Omega_M = 0.3$ $H_0 = 68.4\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$ $\sigma_8 = 0.816$ $n = 0.967$
Box Size	120 Mpc
Mass Resolution	$1.072\times10^9 M_\odot/h$
# of Initial Conditions	64

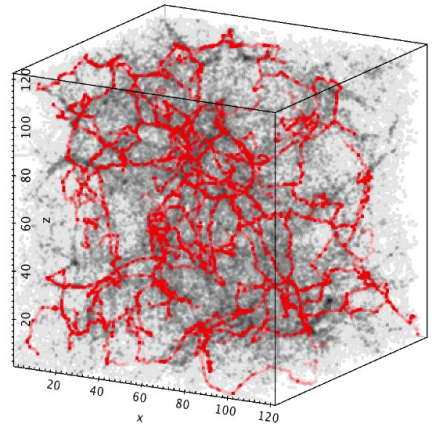
N-Cluster Run (run @ KASI)

AMIGA Halo Finder



DisPerSE





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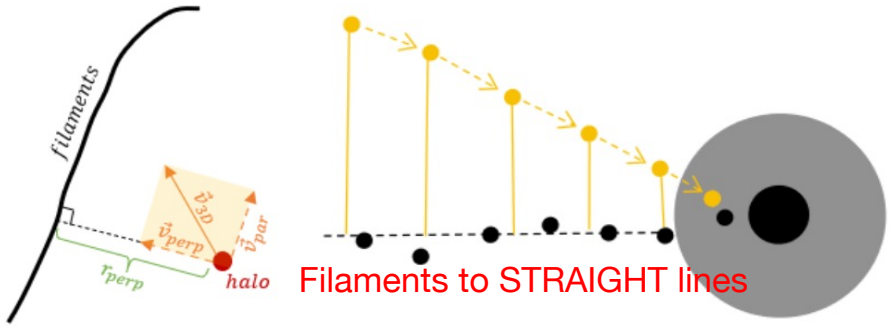
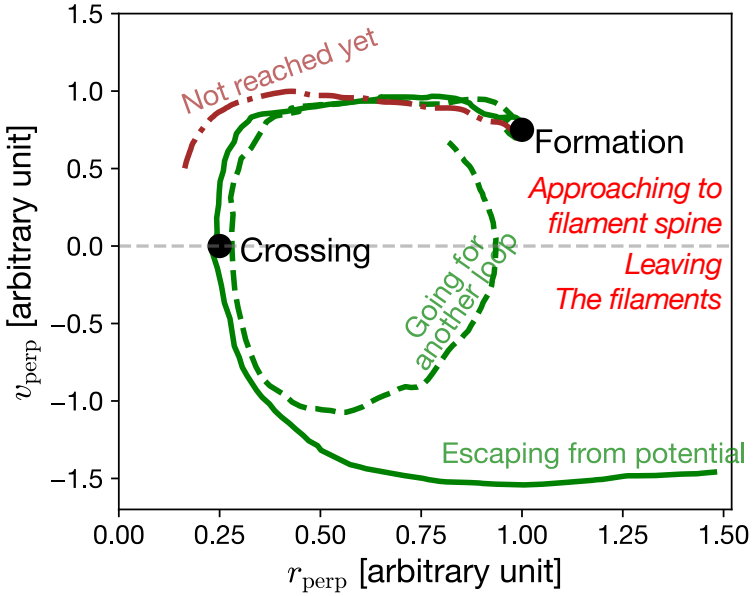
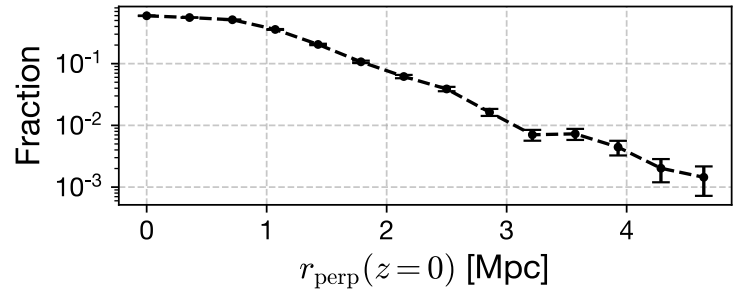
3.1. Trajectories in the Phase-space

Perpendicular Method







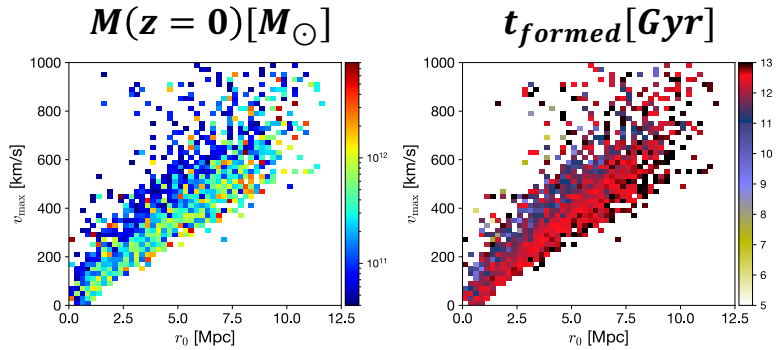
3.1. Trajectories in the Phase-space

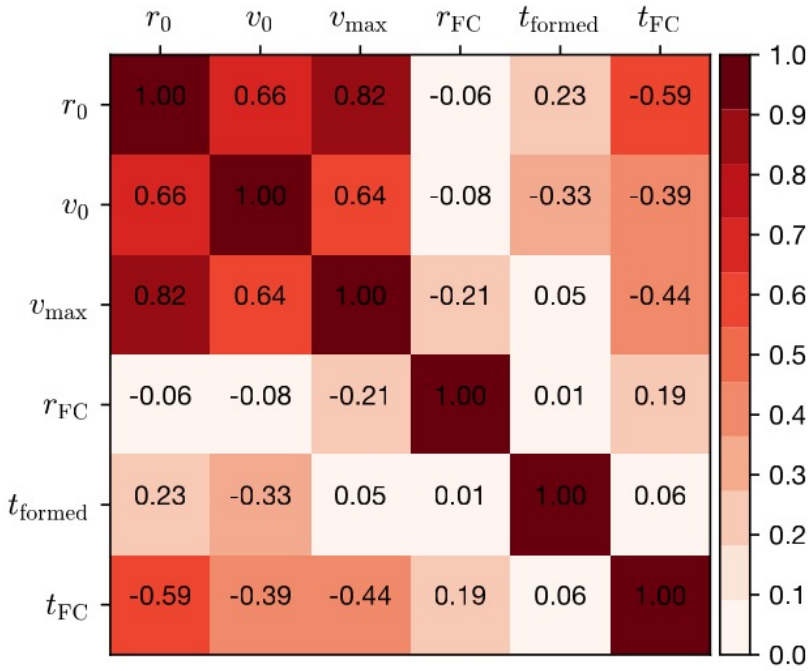
Parameters Defined

- Parameters representing a trajectory in the phase-space

Parameter	Description
r_0	Initial r_{perp}
v_0	Initial v_{perp}
v_{max}	Maximum v_{perp} before the first crossing
r_{FC}	r_{perp} at the first crossing
t_{formed}	Time since formation
t_{FC}	Time since the first crossing

- Pearson Correlation Coefficients $r_{ij} = \frac{\sigma_{ij}^2}{\sigma_i \sigma_j}$





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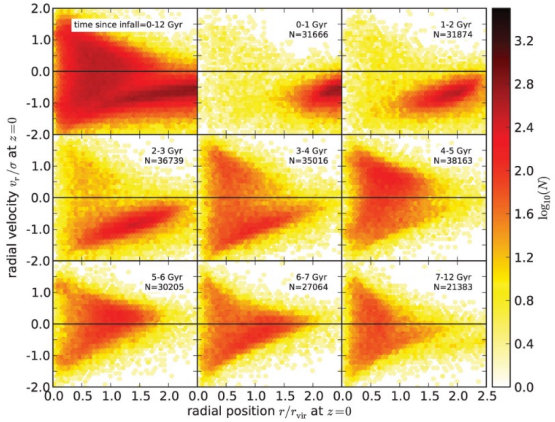
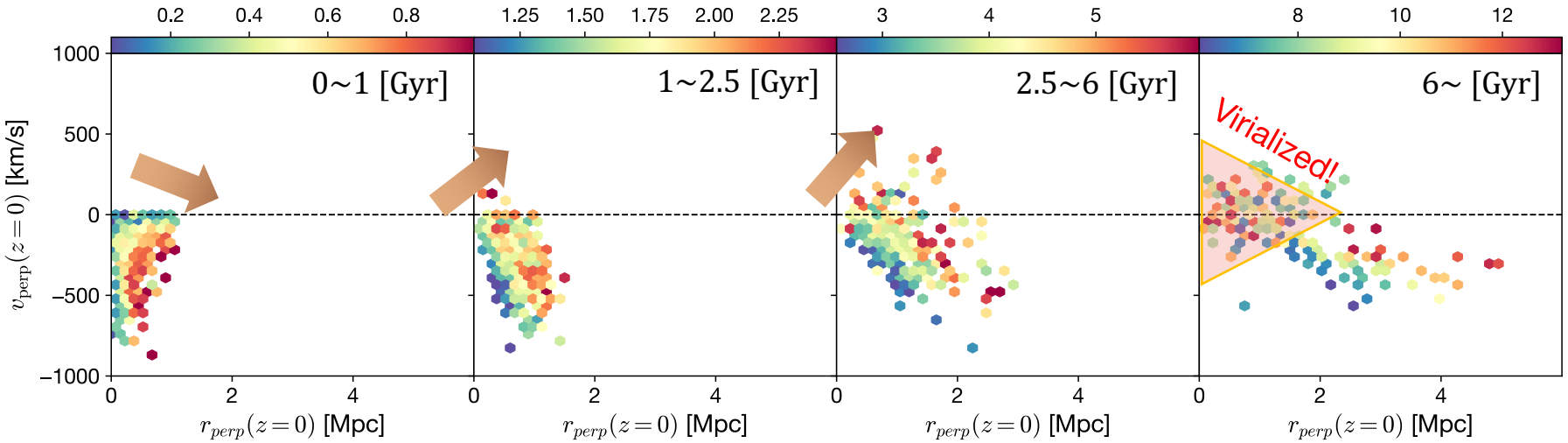
3. Results

3.2. Virialization of Halos



Phase-space Diagrams with t_{FC} Binning



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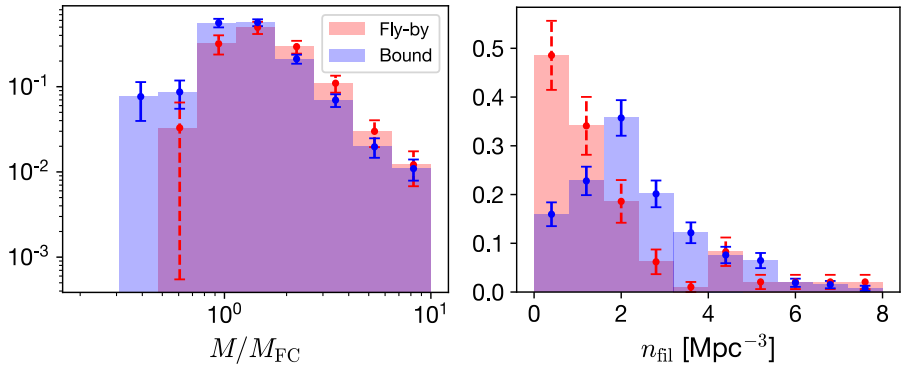
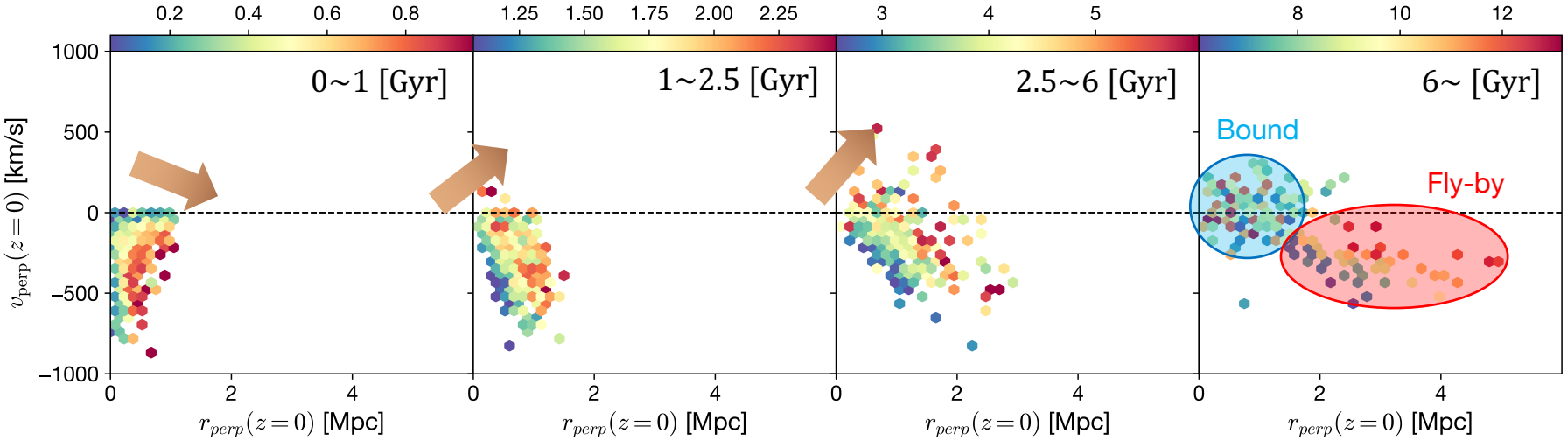
3.2. Virialization of Halos

Phase-space Diagrams with t_{FC} Binning





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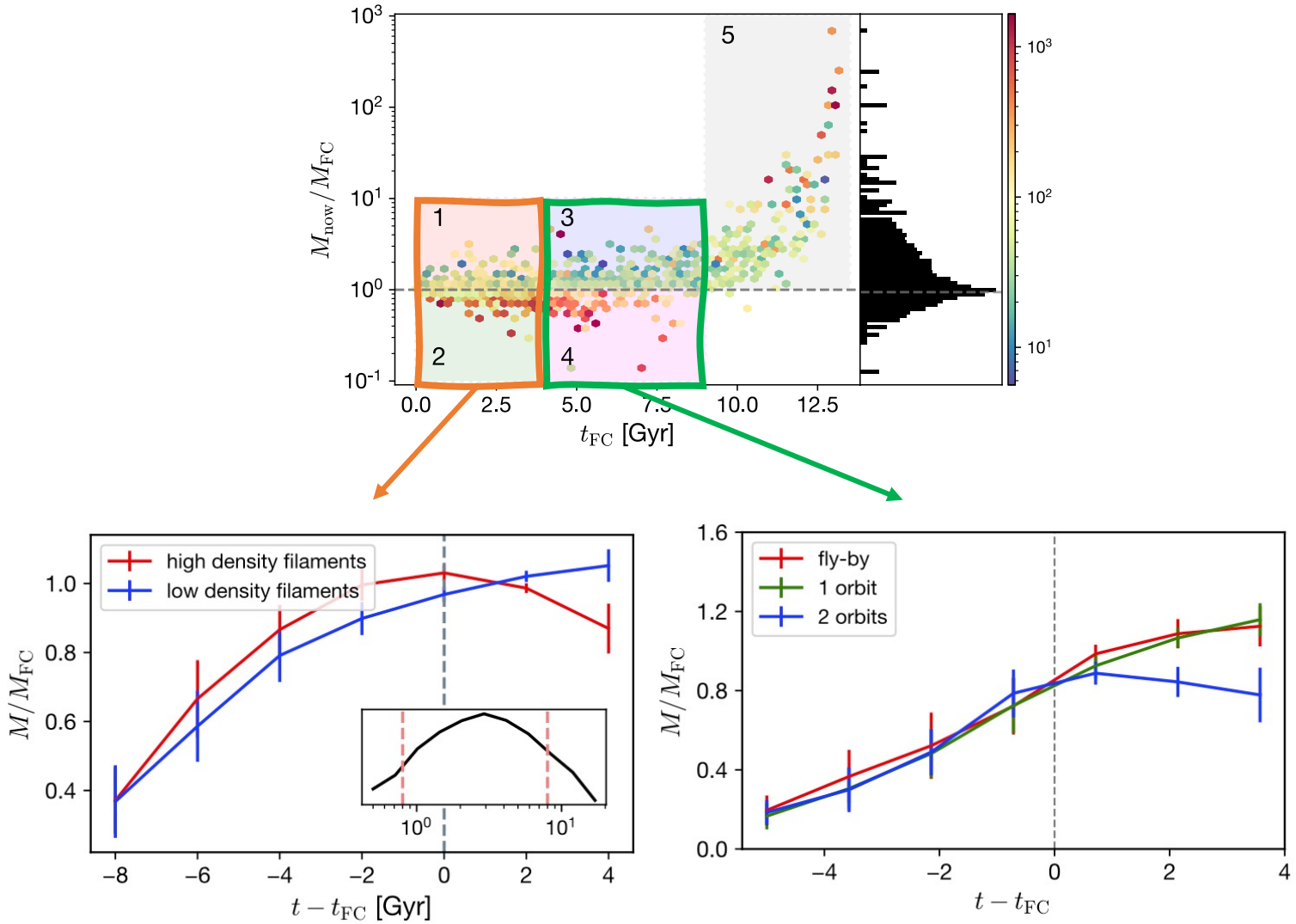
3.3. Mass Evolution of Halos

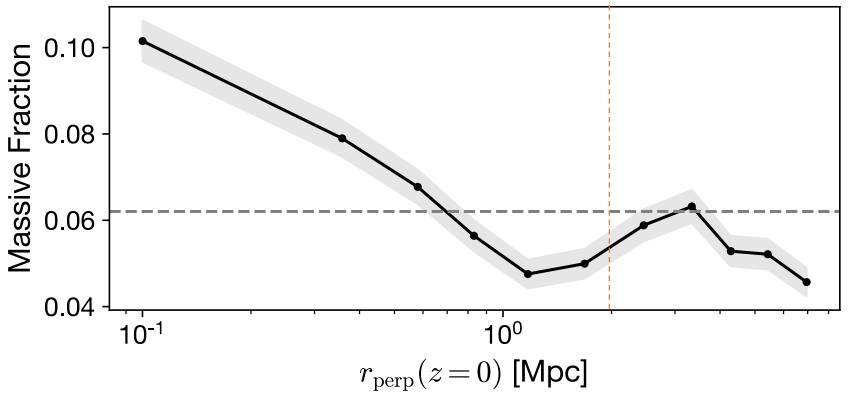


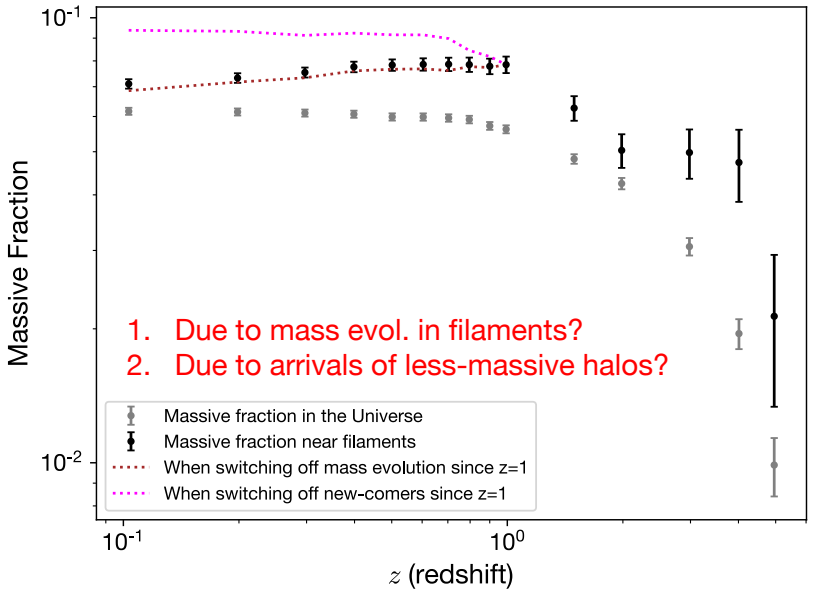
3.4. Mass Segregation

$M/M_{\odot} > 10^{12}$

Massive halos arrive earlier, less massive later

- The fraction of massive halos is lower when farther from the filaments
- Massive *crosser* halos lose their kinetic energy and sink in(consistent with observation)





SUMMARY

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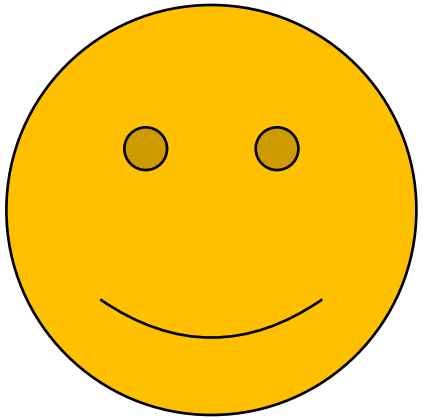
1. Halos show a similar trajectory in perpendicular phase-space.

2. Halos are virialized in filament environments after at least 6 Gyr since the first pericenter crossing.

3. Halos grow in mass as they approach filaments, and will lose mass if the environment is harsh enough.

4. Mass segregation of halos around the filaments is mostly caused by massive halos approaching faster than less massive ones, and dynamical friction plays a role for crossers.

Thank you



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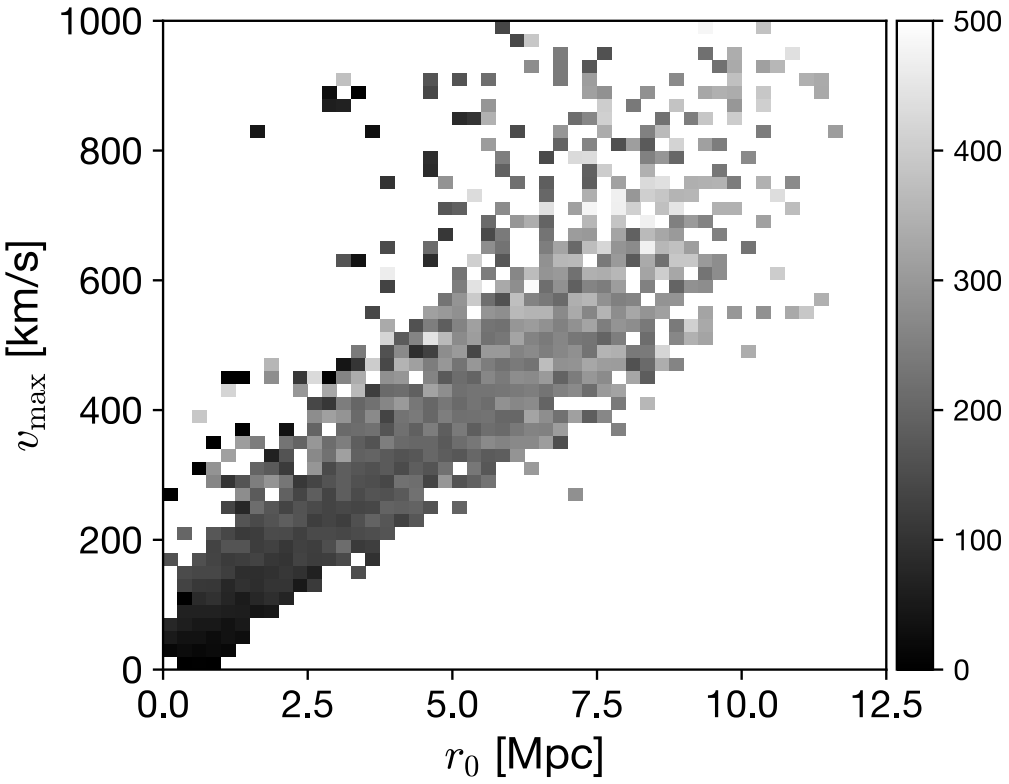

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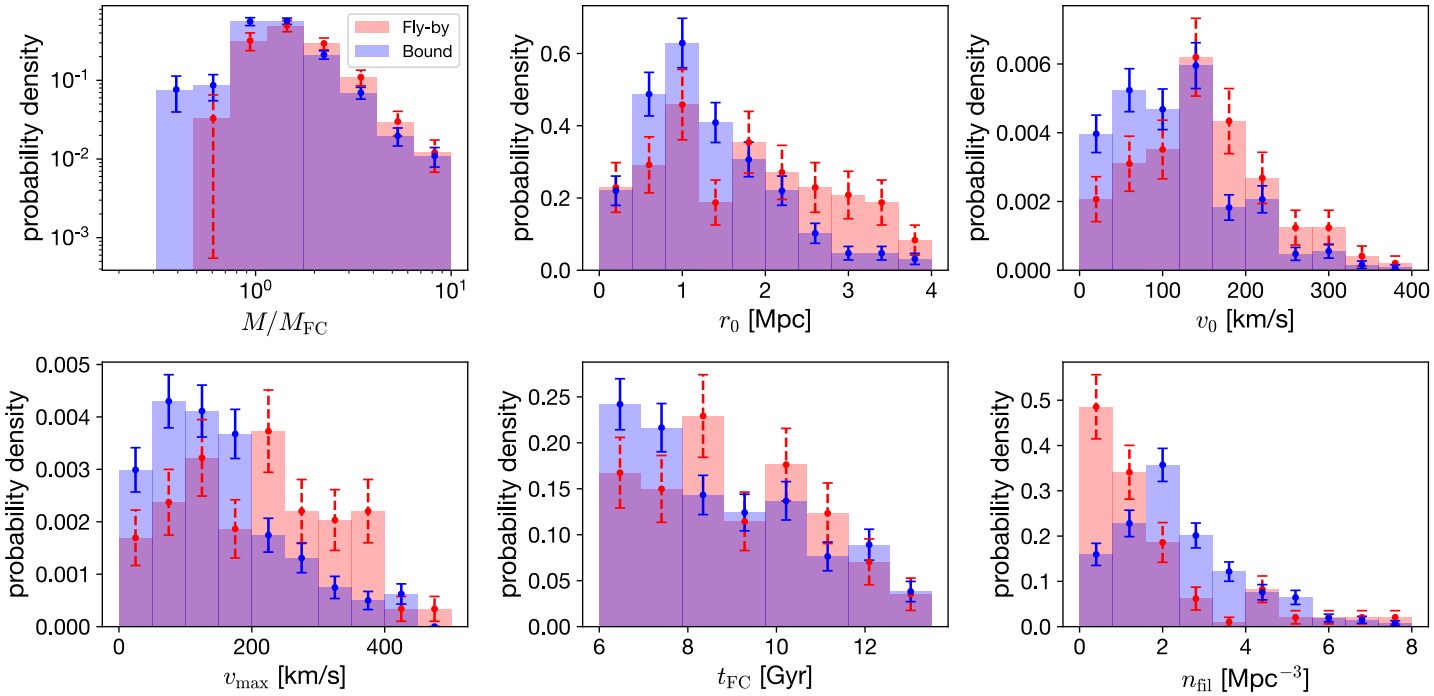
Comparison between *Bounds* and *Fly-bys*



- Fly-bys are tend to be ancient crossers, formed farther from the filaments(thus higher velocities) and in the lower density environments.
- Mass evolution of bound objects may depend on environments.

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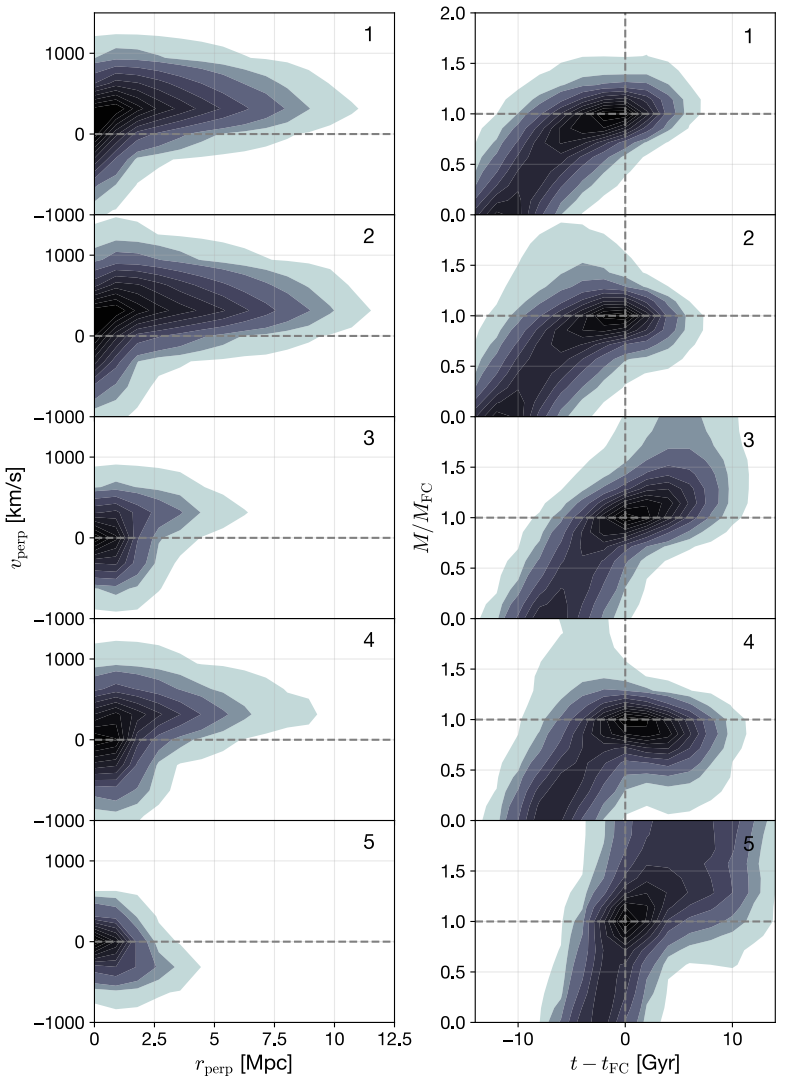

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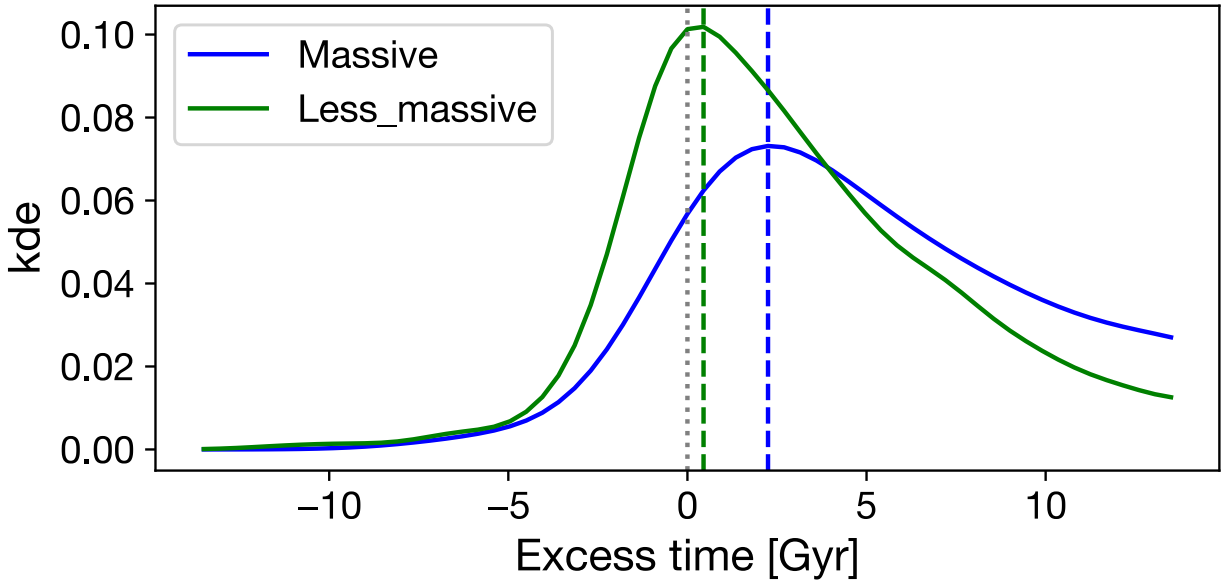

age – time to reach 2Mpc

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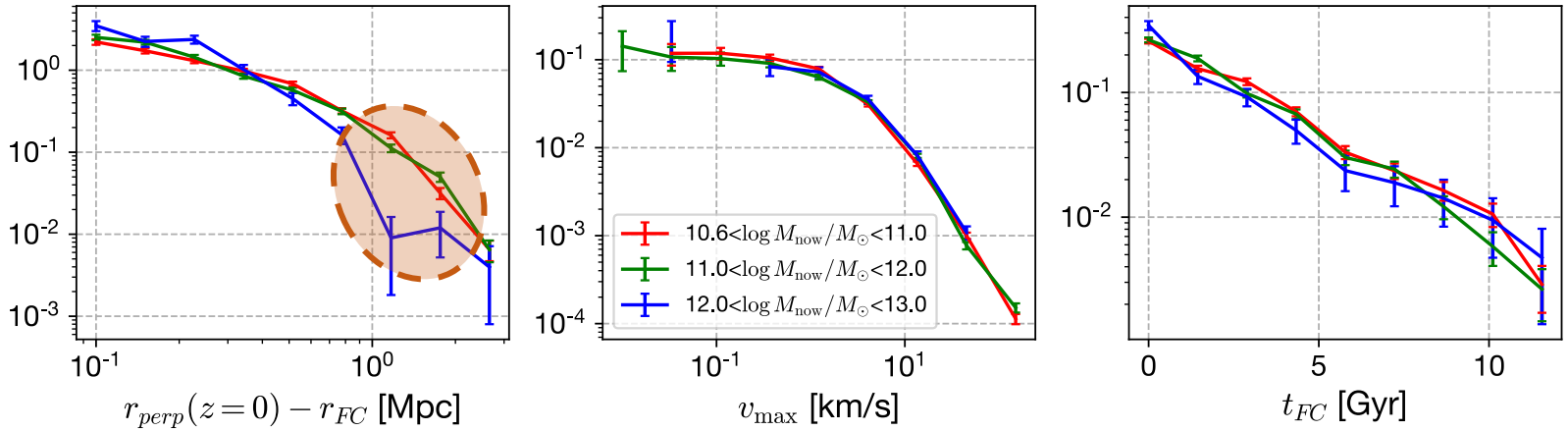
Dynamical Friction plays a role



- For crossers, because their mass segregation can be mixed up with their orbital motion
- Without the effect of velocity and time since infall, most massive halos are suppressed to stay closer to the filaments after the infall.