Presented by Hannah Jhee

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Phase-space Analysis of Halos around the Large-scale Filamentary Structures

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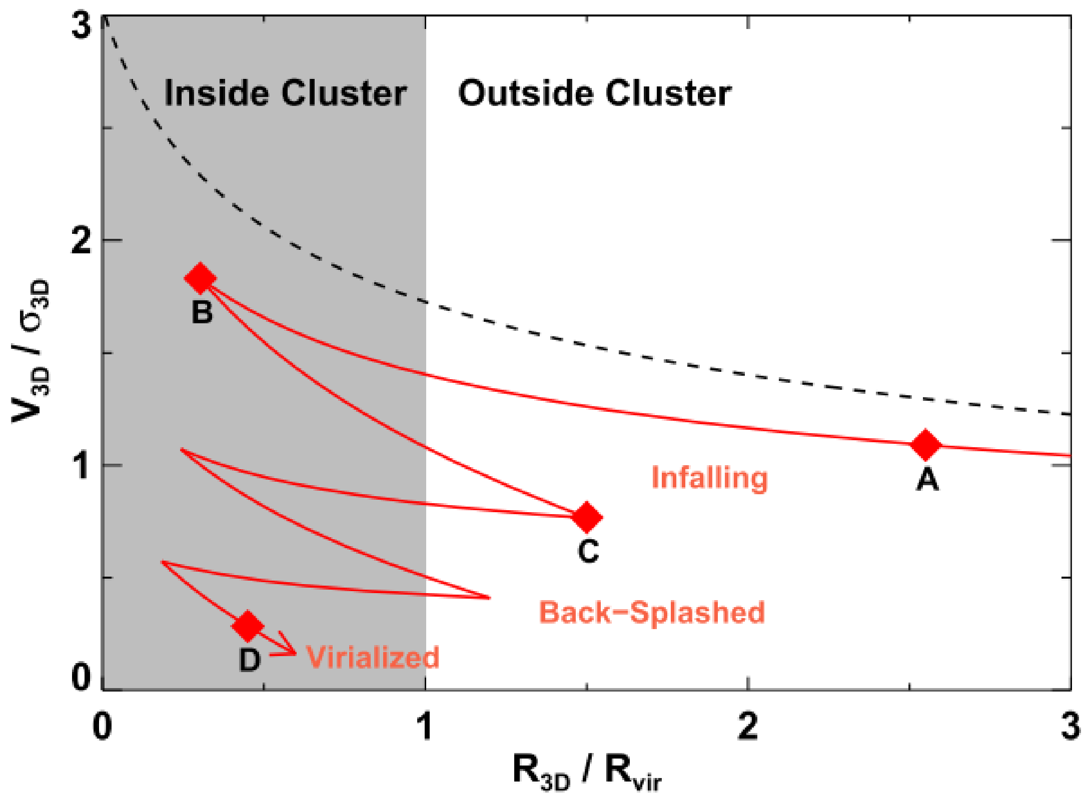
1. Motivation

- ✓ By Oman et al.(2013) and Rhee et al.(2017), halos falling into the clusters are shown to have typical trajectories on the normalized phase-space.
- ✓ So, phase space analysis can be a tool to understand the evolutionary steps of a galaxy.
- ✓ Can similar work be done for halos around the filaments too?

Rhee et al.(2017)



2. Data and Method

N-Cluster Run

- Cosmological N-body Simulation (Gadget-3)
- Cosmology :

Ω_Λ	0.7	h_0	0.684
Ω_m	0.3	σ_8	0.816
Ω_b	0.047	n_{spec}	0.967

- Box size : 120 Mpc
- Resolution : $1.072 \times 10^9 M_\odot/h$

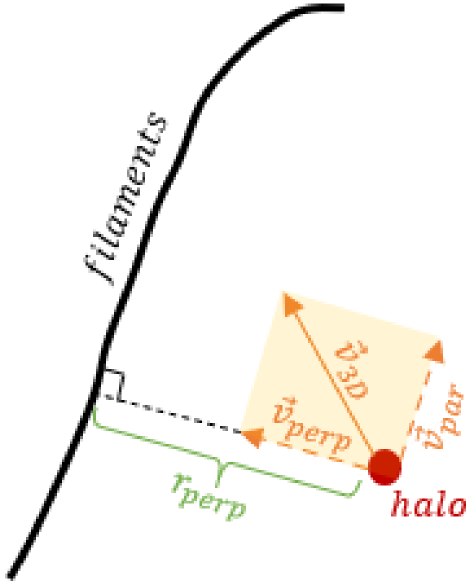
$$r_{perp} = |\hat{u} \cdot \vec{D}_{halo}|$$
$$v_{perp} = |\hat{u} \cdot \vec{v}_{3D}|$$
$$v_{par} = |\vec{v}_{3D} - \hat{u} v_{perp}|$$

Amiga Halo Finder(AHF)

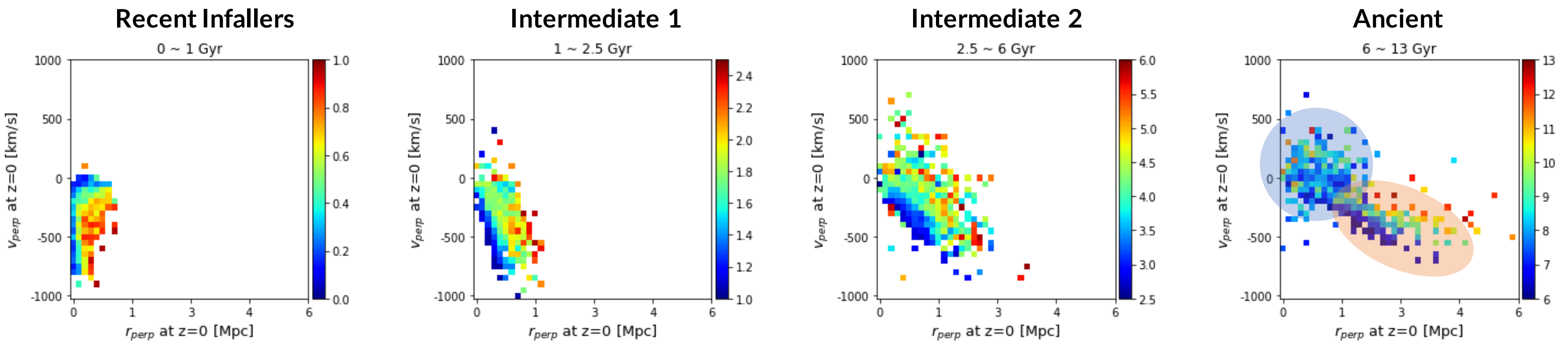
- Finds gravitationally bound systems in the cosmological simulations

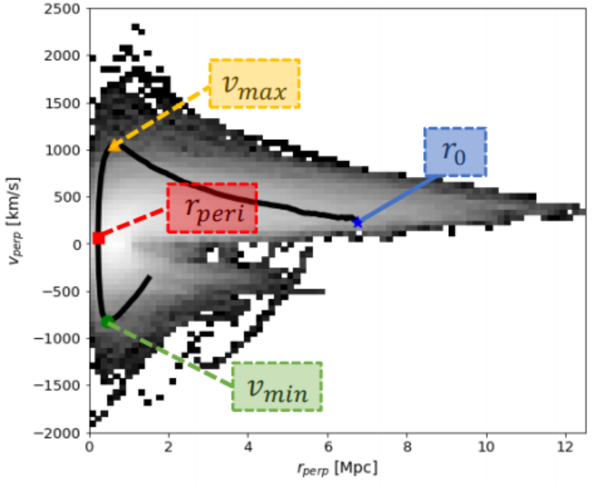
DisPErSE

- **D**iscrete **P**ersistent **S**tructures **E**xtractor
- Applied to $R < 20R_{vir}$ around each cluster in order to find the filament structures



3.1. Examples of Phase-space Diagrams

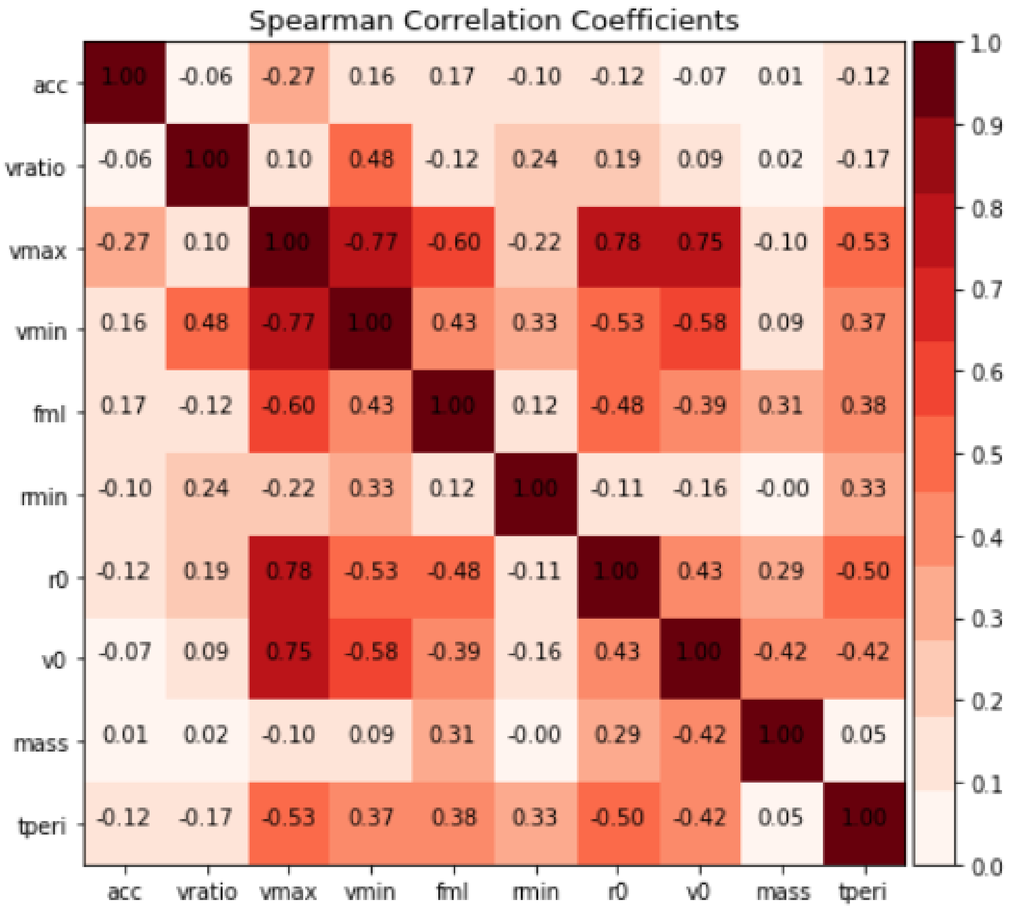




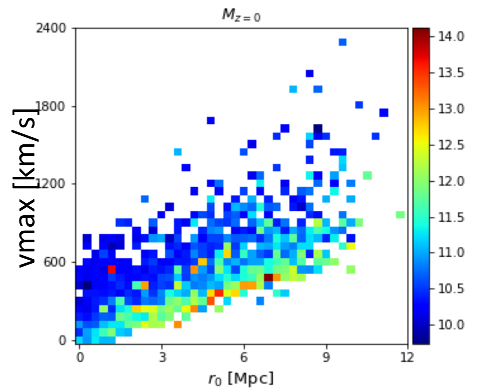
$$t_{peri} = t(z=0) - t(v_{perp}=0)$$

- ✓ Halos typically gain velocities linearly until they reach their peaks and then shows turn-around motion after falling into the filaments.
- ✓ The position on the phase-space at $z = 0$ is relevant to t_{peri}, and the gradient in the figure disappears as halos spend a long time inside the filaments. → Virialization
- ✓ Body(blue) & Tail(orange) objects in the last bin

3.2. Parameter Correlations



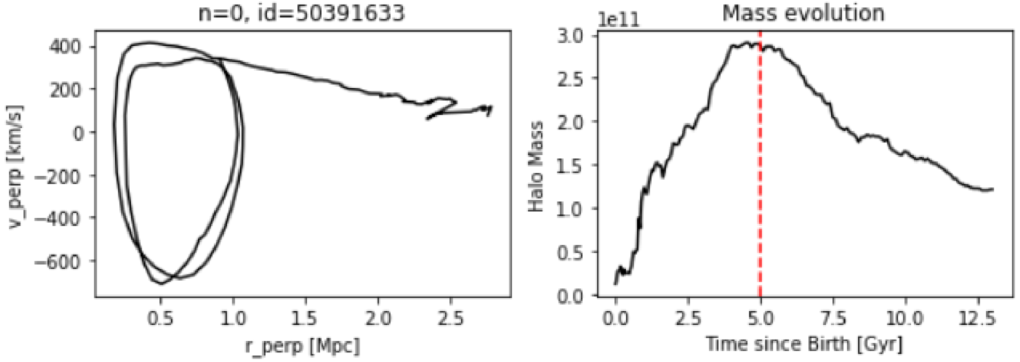
Parameter	Configuration
acc (a)	Acceleration right after hitting the 1st v_{max}
vratio (Γ_v)	$\Gamma_v = v_{min}/v_{max}$
vmax (v_{max})	1st maximum velocity
vmin (v_{min})	The absolute value of 1st minimum velocity
fml (f_{ML})	$f_{ML} = 1 - M_{now}/M_{peak}$
rmin (r_{min})	r_{perp} at 1st pericenter($v_{perp} = 0$)
r0 (r_0)	Initial r_{perp}
v0 (v_0)	Initial v_{perp}
mass (M_{halo})	Halo mass at $z = 0$
tperi (t_{peri})	Time since the 1st pericenter

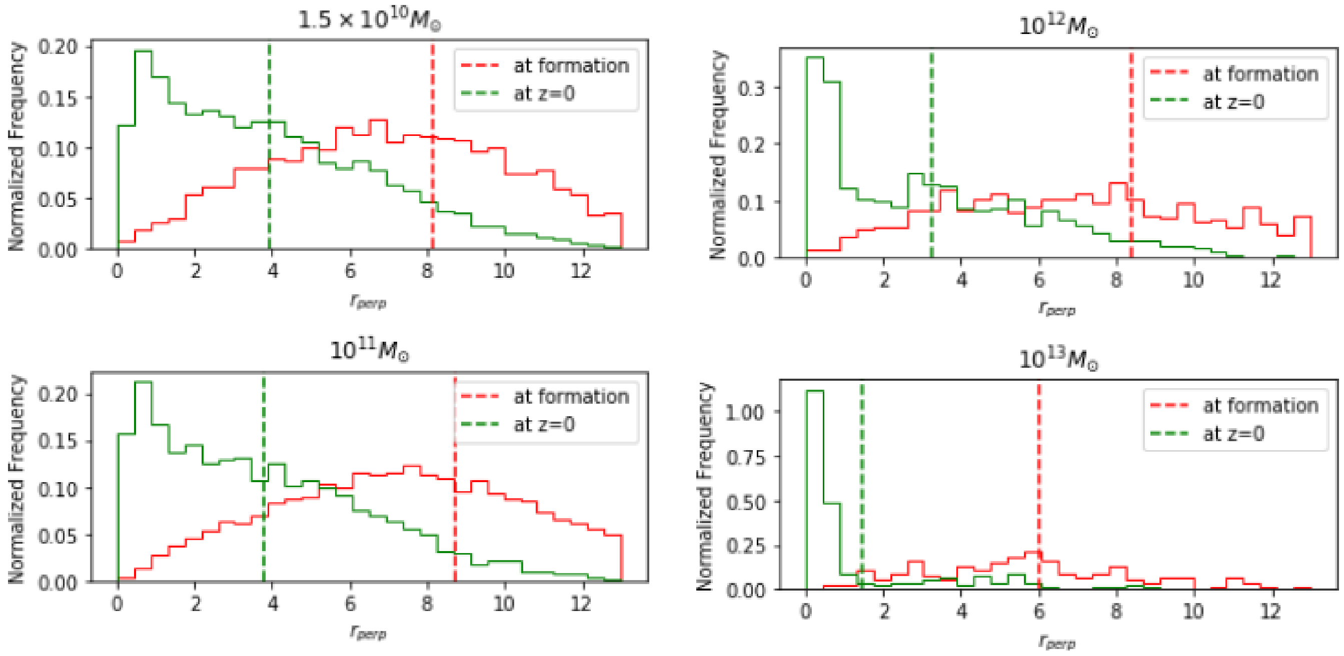


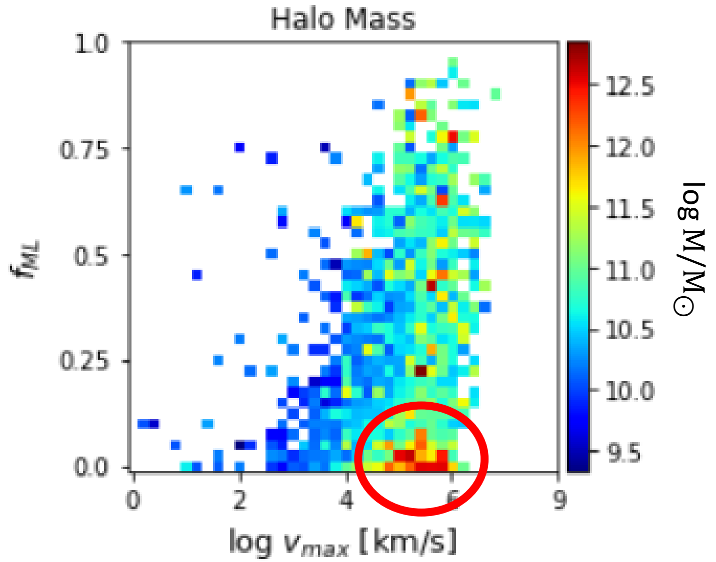
✓ Lower mass halos have higher velocity peaks under the same condition of the initial distances to the filaments.

3.3. Mass Evolution of Halos

- ✓ Are the trajectories relevant to the mass evolutions?
- ✓ Observational Fact (Chen et al. 2015).: Higher mass halos are closer to the filaments at $z = 0$







Thank you!