

HALO FINDING IN ENZO, ART, AND GADGET



Peter Behroozi, Stanford University
UC-HIPACC Summer School 2010

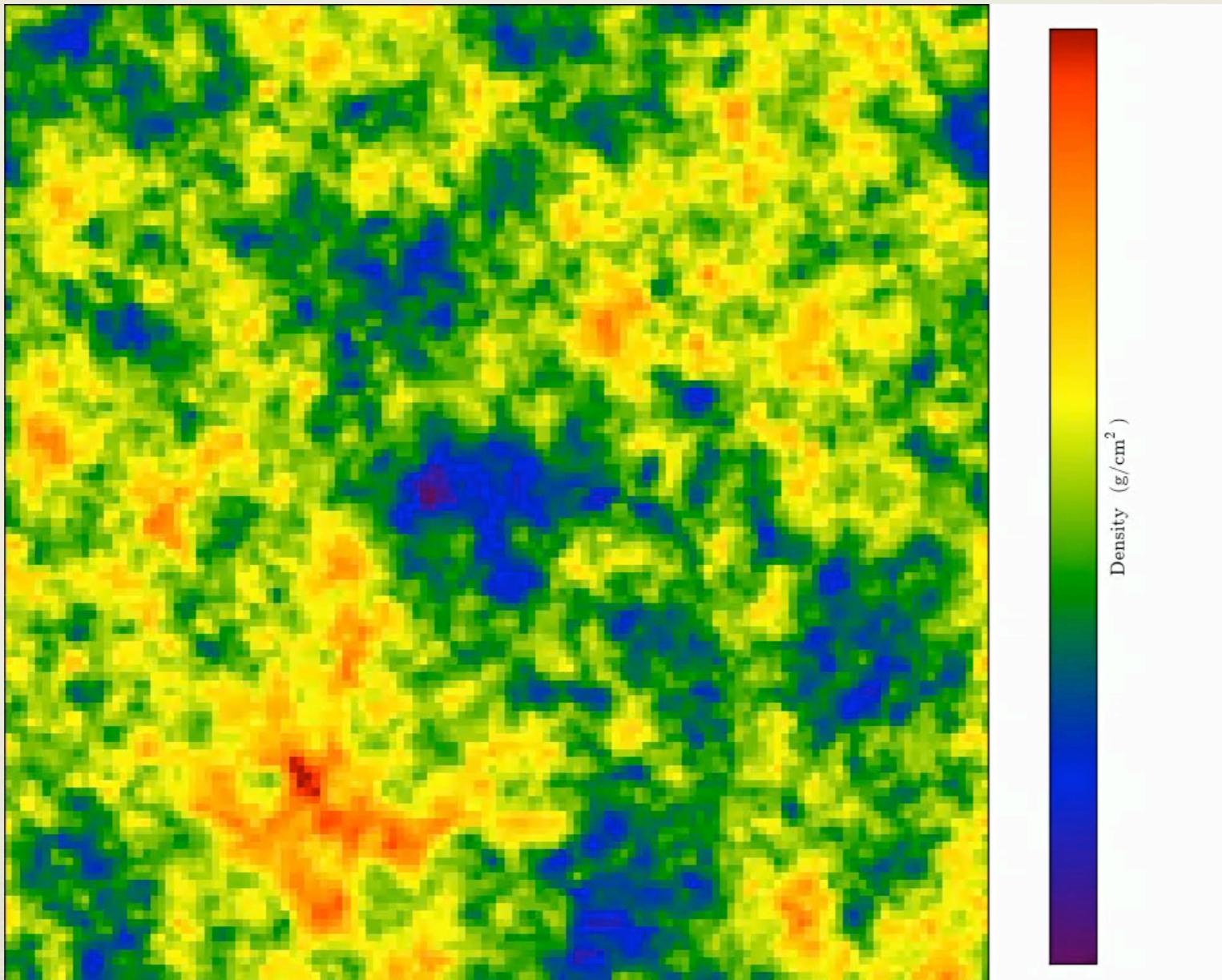
Actually, mostly just:
HALO FINDING IN ENZO



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The Simulation

128 cubed root mesh, 60 Mpc/h, WMAP5 cosmology



Circles represent halo maximum radii

Halo Finding Algorithms Bundled with ENZO

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HOP / Parallel HOP

(particles attached to same halo as the densest
particle in their N nearest neighbors)

Halo Finding Algorithms Bundled with ENZO



HOP / Parallel HOP

(particles attached to same halo as the densest particle in their N nearest neighbors)



FOF / SUBFIND

(particles attached to same halo as their nearest neighbors within a specified linking length)

Which one is better?



HOP / Parallel HOP

(particles attached to same halo as the densest particle in their N nearest neighbors)



FOF / SUBFIND

(particles attached to same halo as their nearest neighbors within a specified linking length)

Quantitative Tests

Quantitative Tests

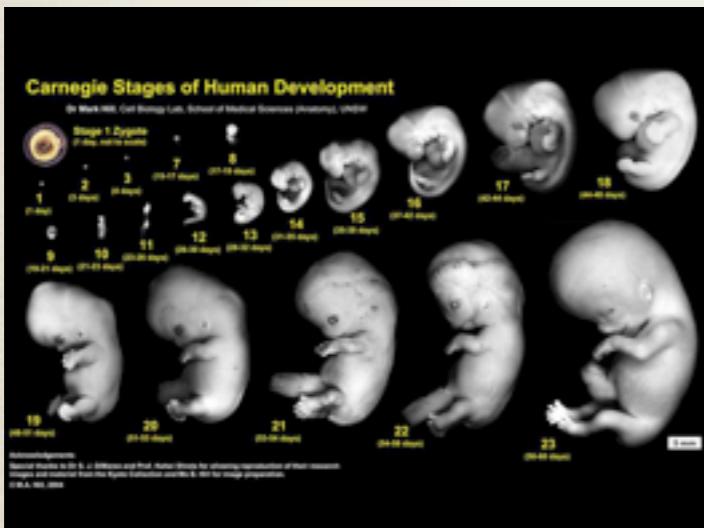


How consistent are halo positions
and velocities from one
timestep to the next?

Quantitative Tests



How consistent are halo positions
and velocities from one
timestep to the next?



How consistently can the growth of
structure be traced from the
halo catalogs?

Quantitative Tests

All tests performed using a new gravitational consistency code under development for repairing merger trees and halo catalogs.



$$F = \frac{GM_1 M_2}{r^2 + r_{vir}^2}$$

Gravitational Acceleration

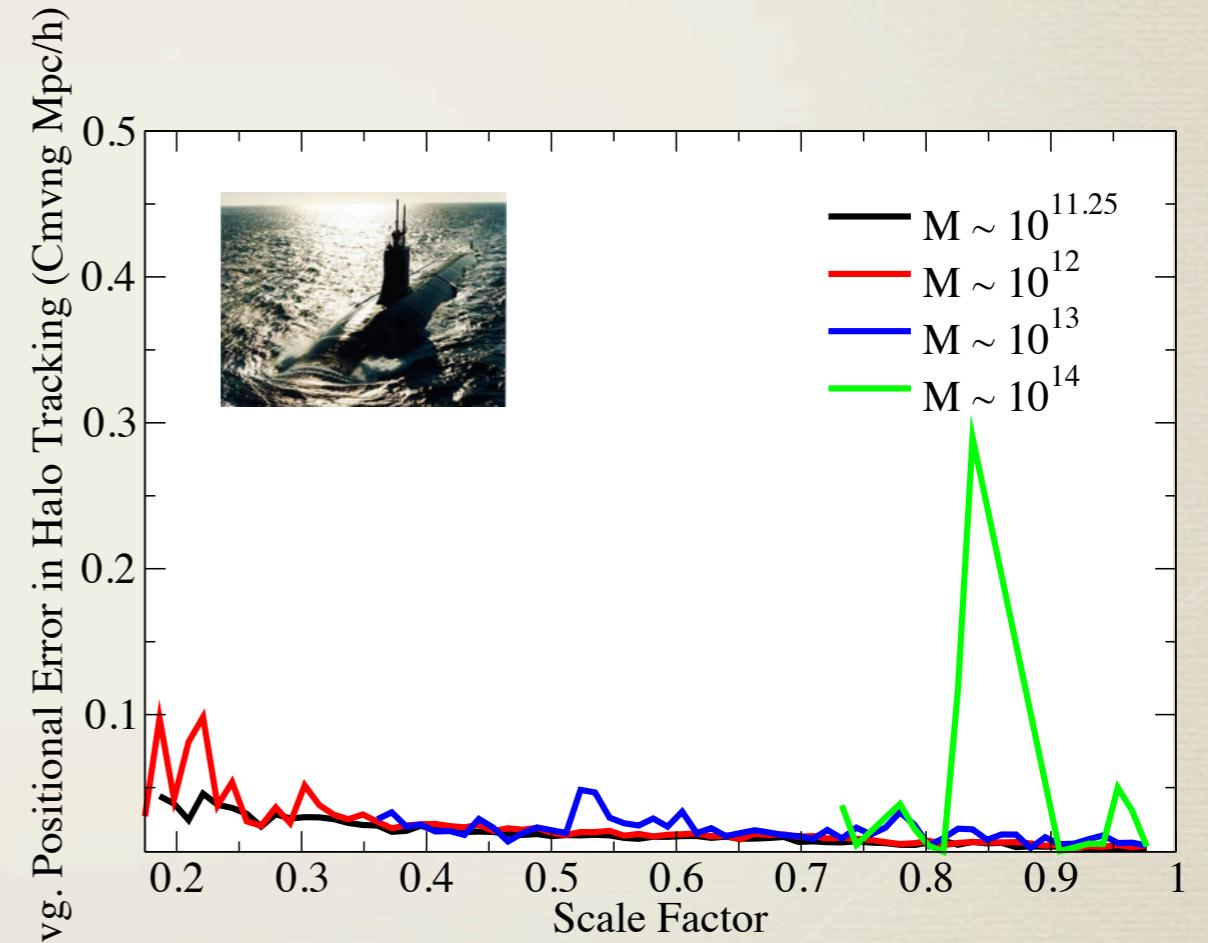
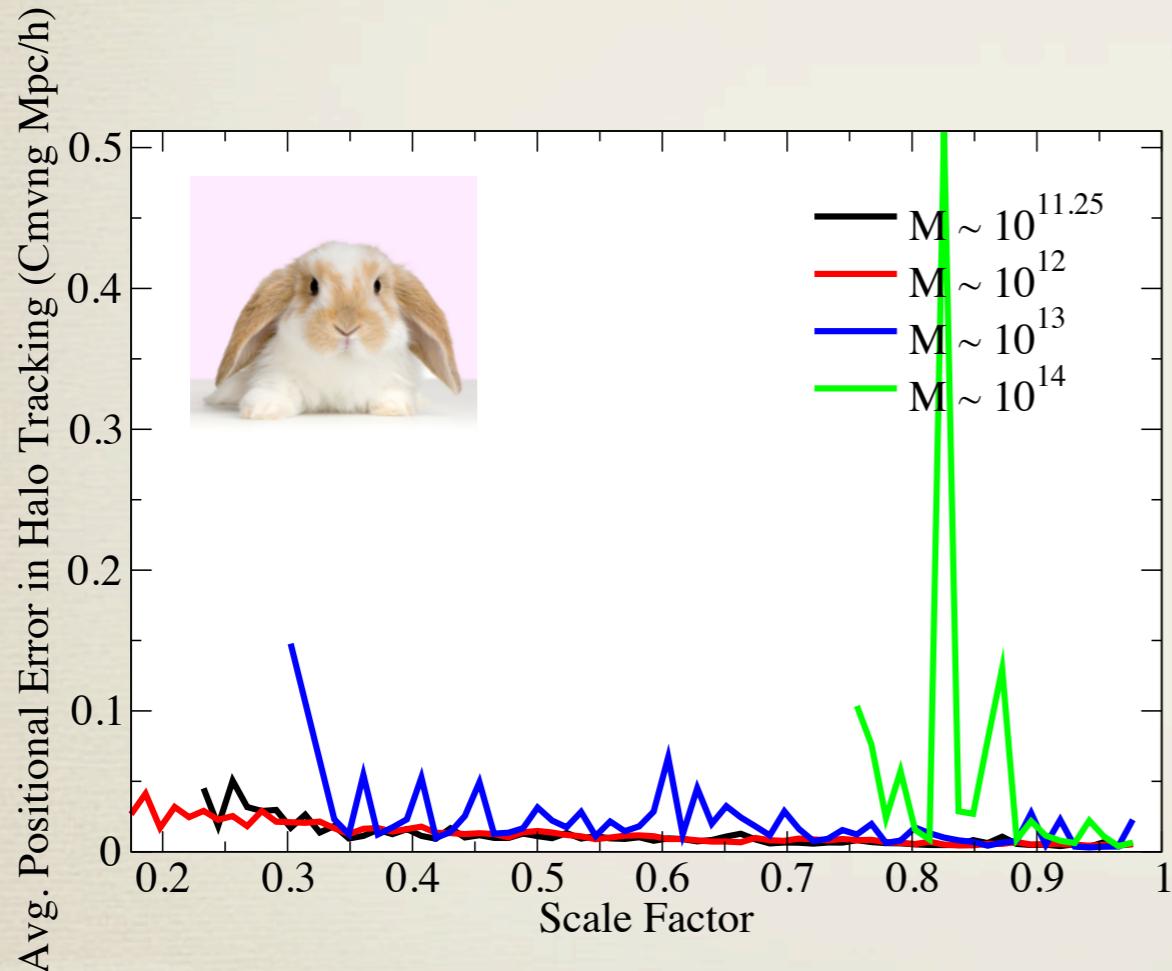
$$\frac{dF}{dr} = \frac{2GM_1 M_2}{r^3} > T_{min}$$

Tidal Merger Criterion

Quantitative Results

Quantitative Results

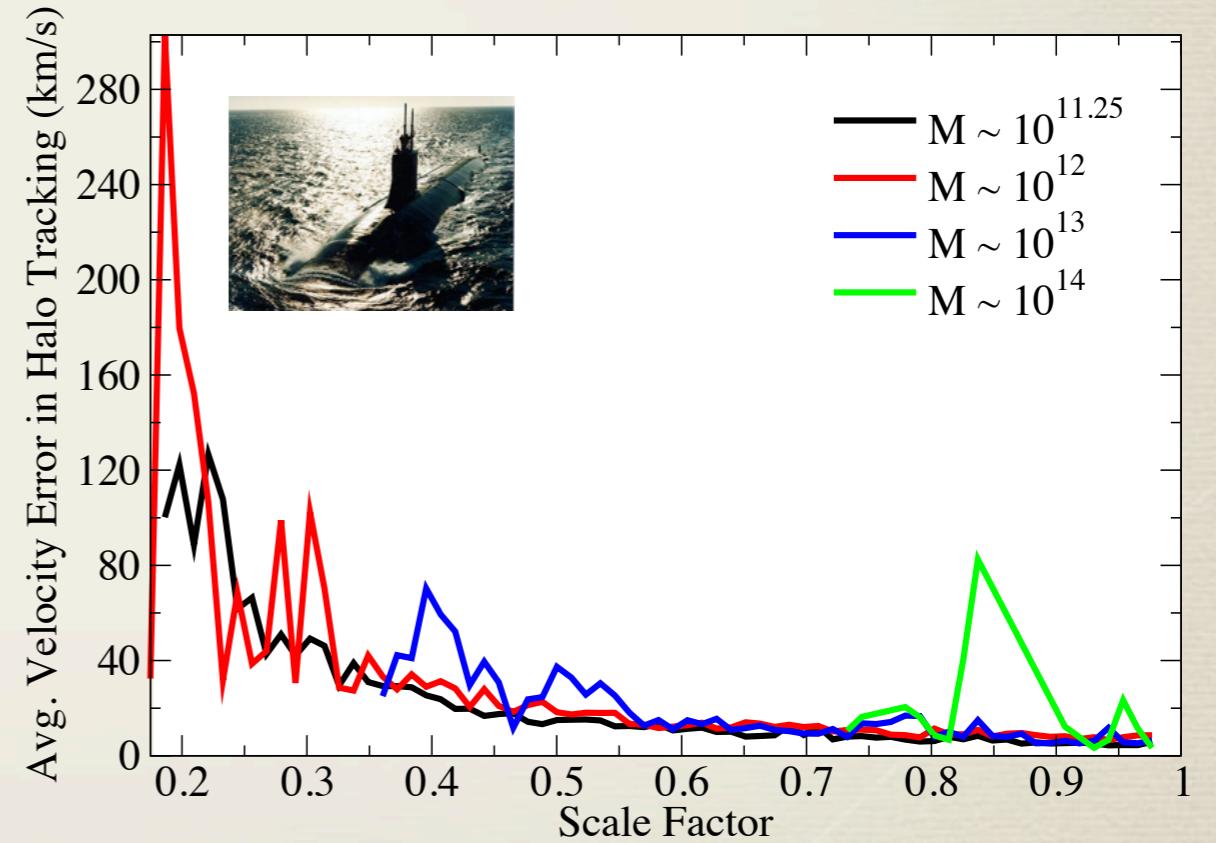
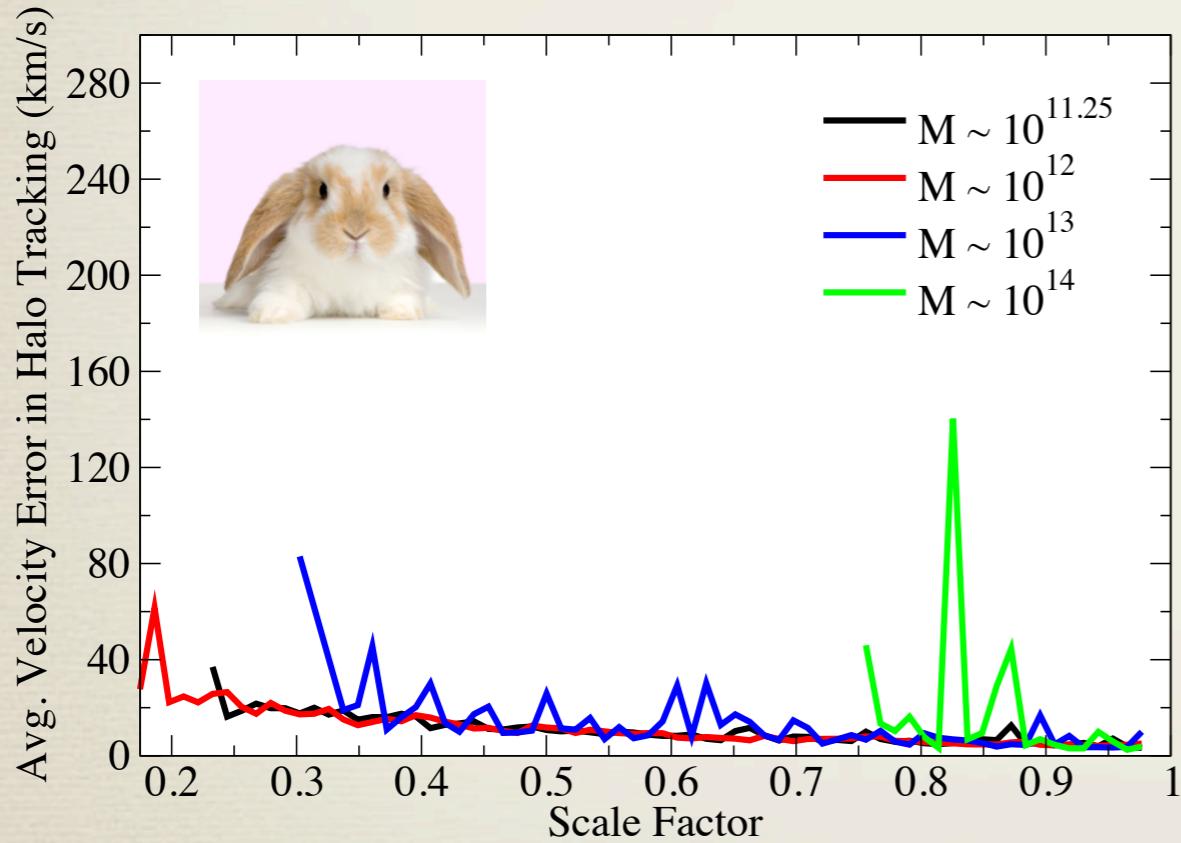
Positional Consistency:
How robust are halo properties?



(Force resolution of simulation: 15 kpc/h)

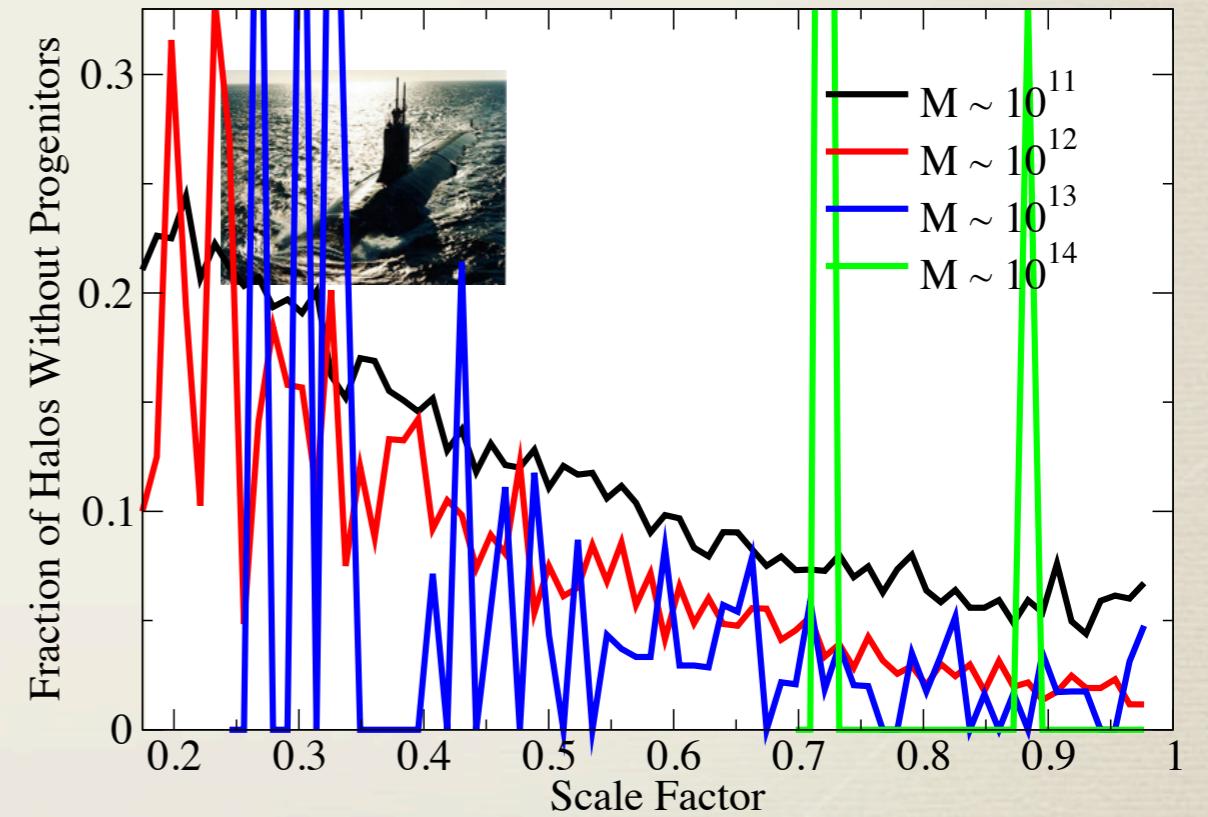
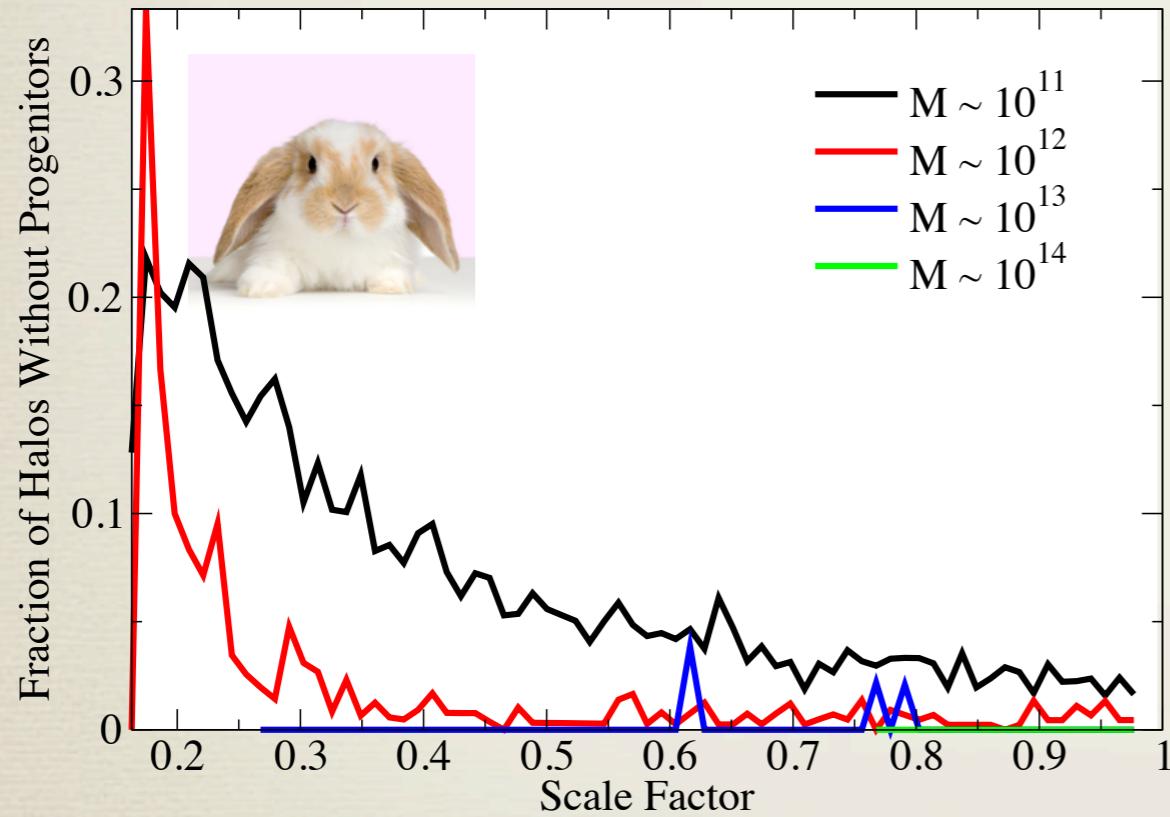
Quantitative Results

Inertial Consistency:
How robust are halo properties?



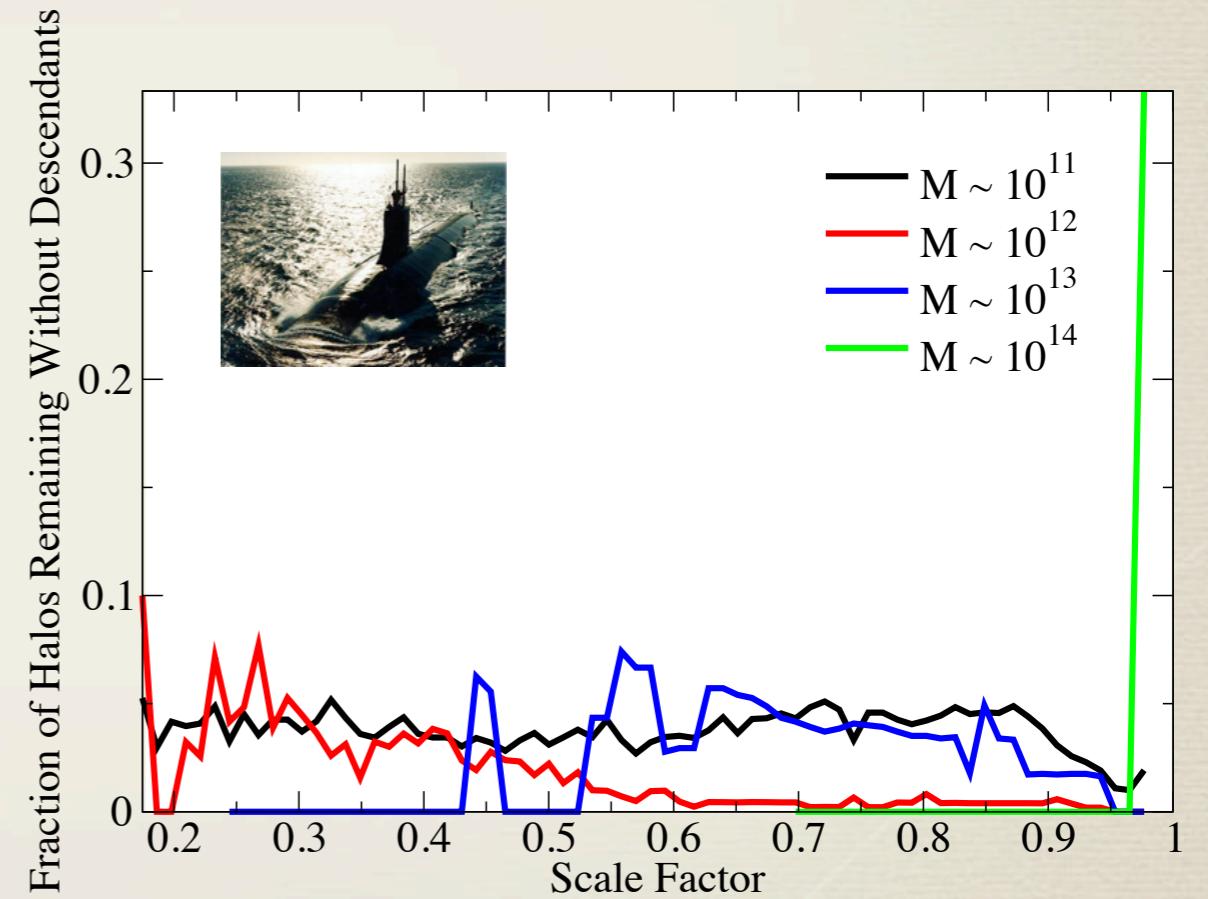
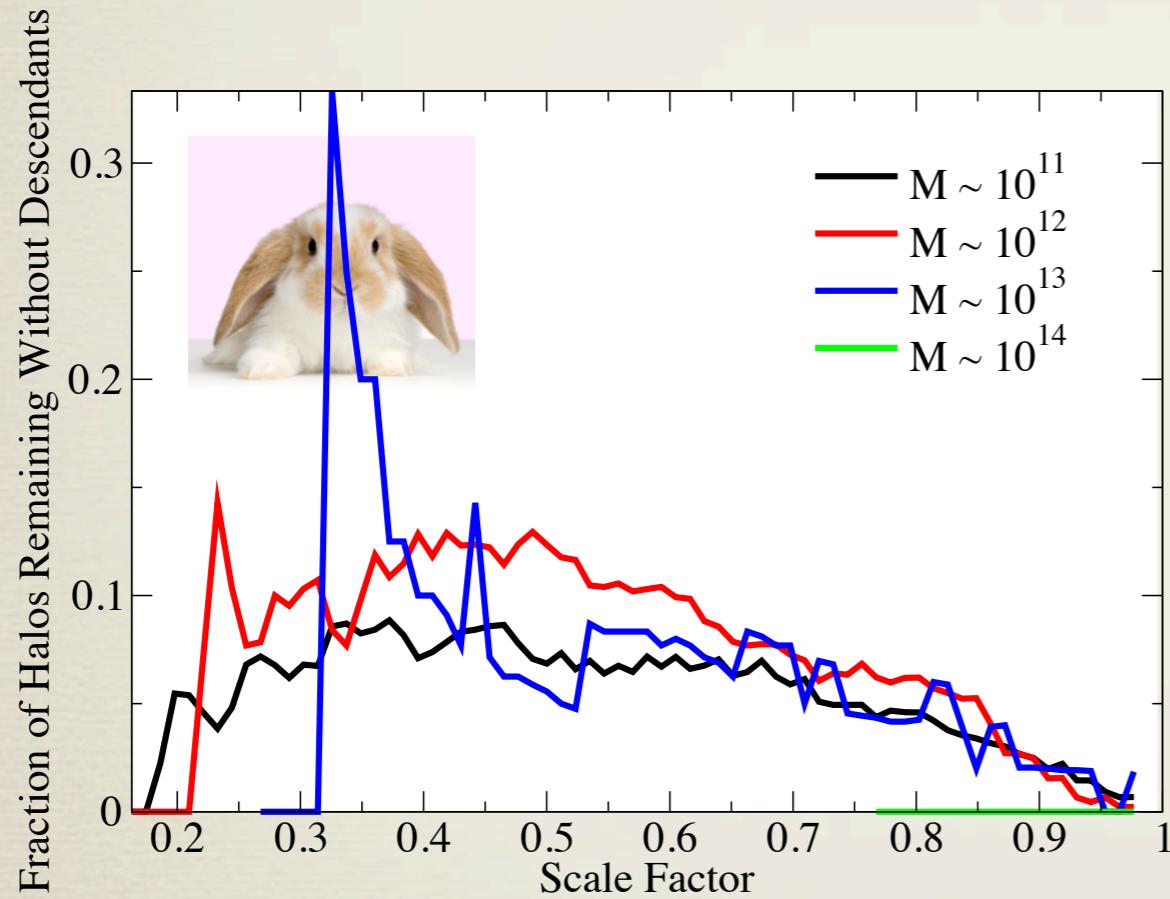
Quantitative Results

Fraction of halos missing at the previous timestep:
How useful are the catalogs for merger trees?



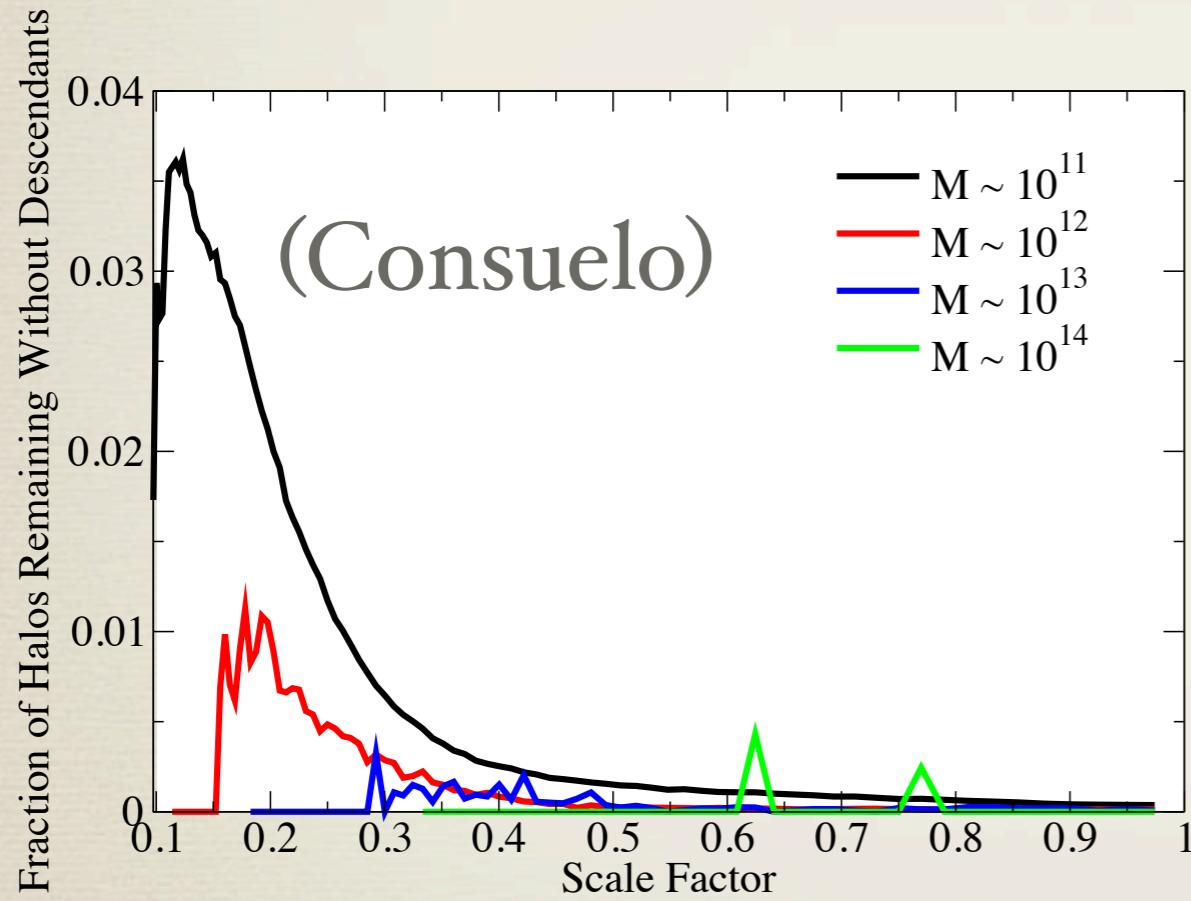
Quantitative Results

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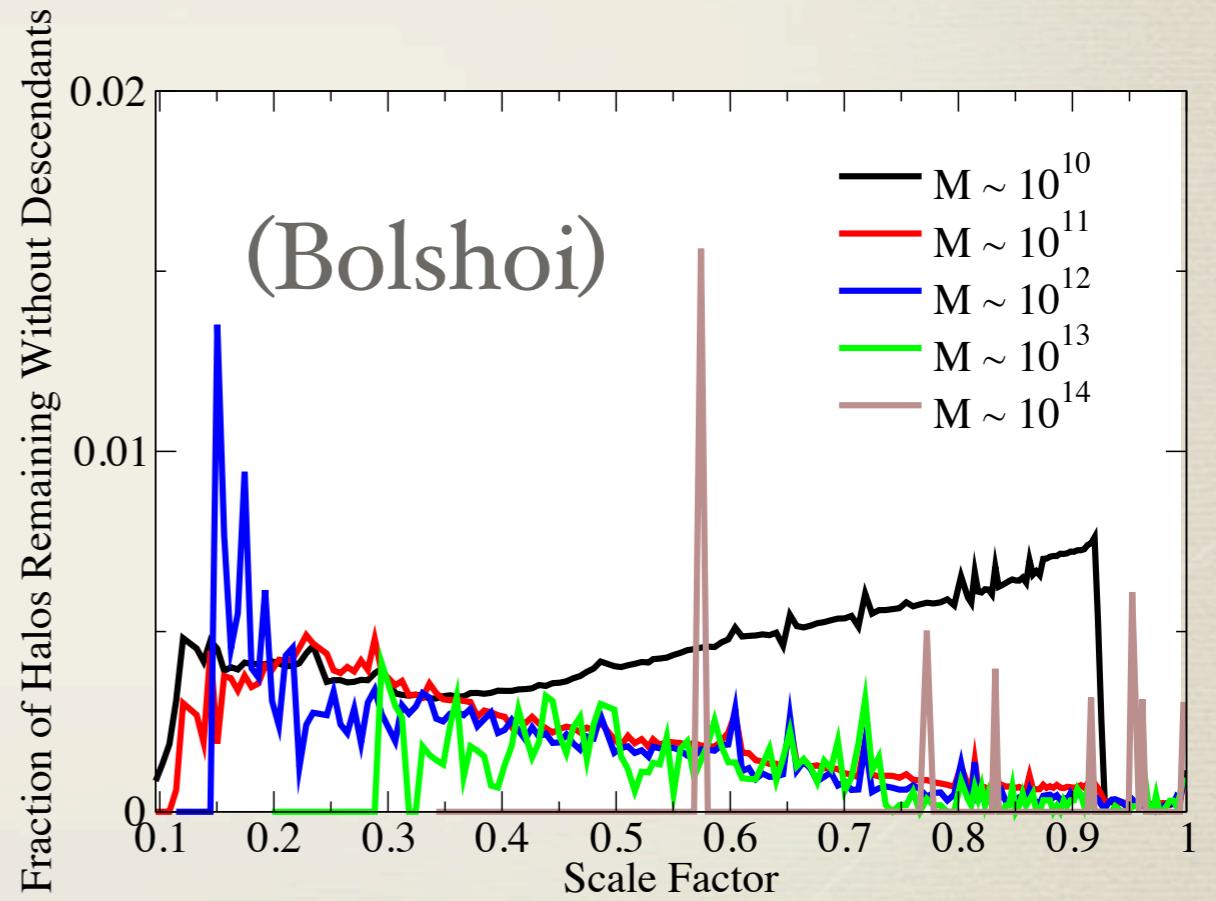


Quantitative Results

Fraction of halos missing at the next timestep
Side note: Increased Resolution Helps a Great Deal!

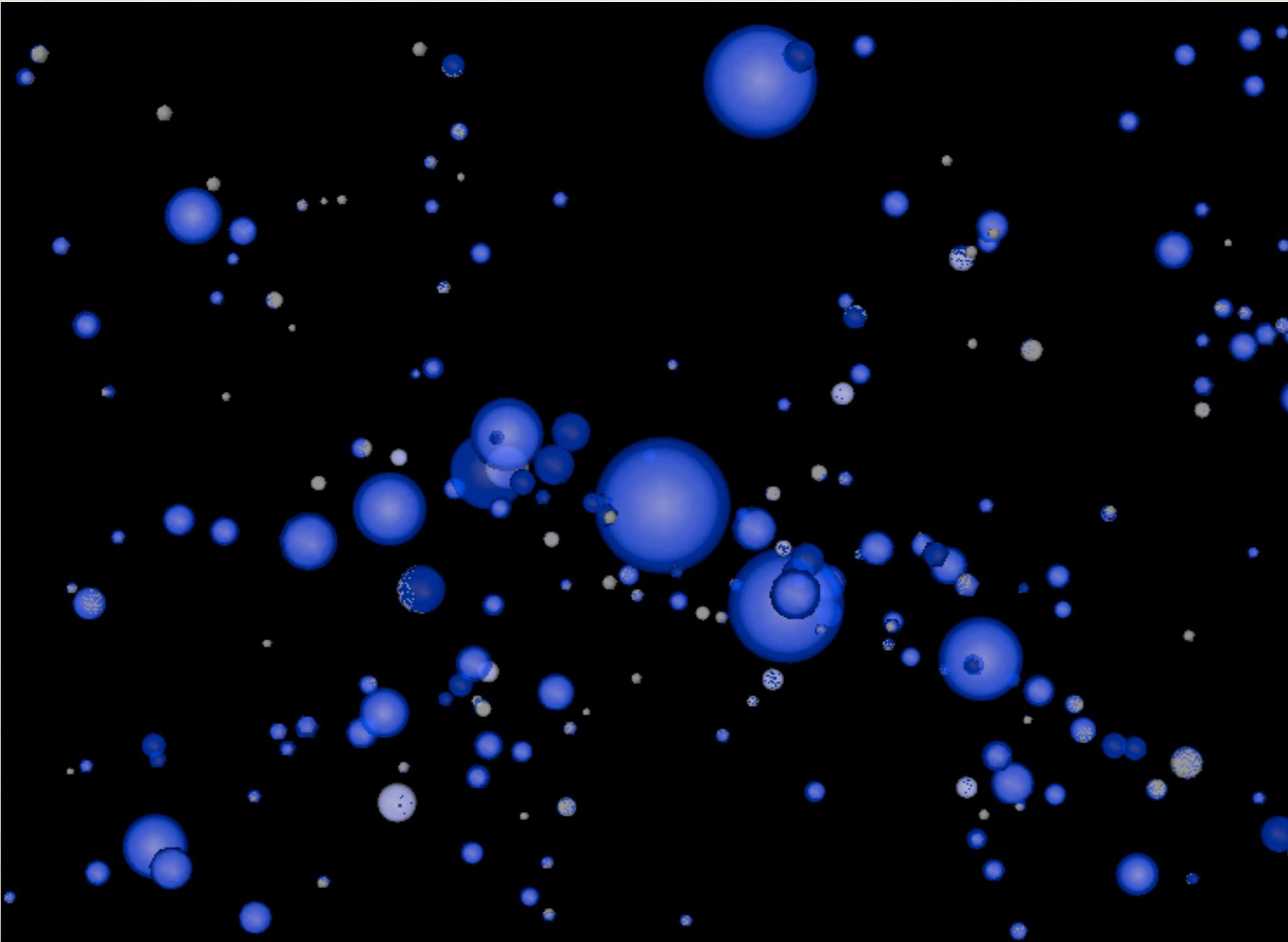


(GADGET-2)
(2.7 billion particles)



(ART)
(8.6 billion particles)

Halo Finders in Action!



Thanks for your attention!

Peter Behroozi

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Quantitative Results

Halo Tracking Consistency

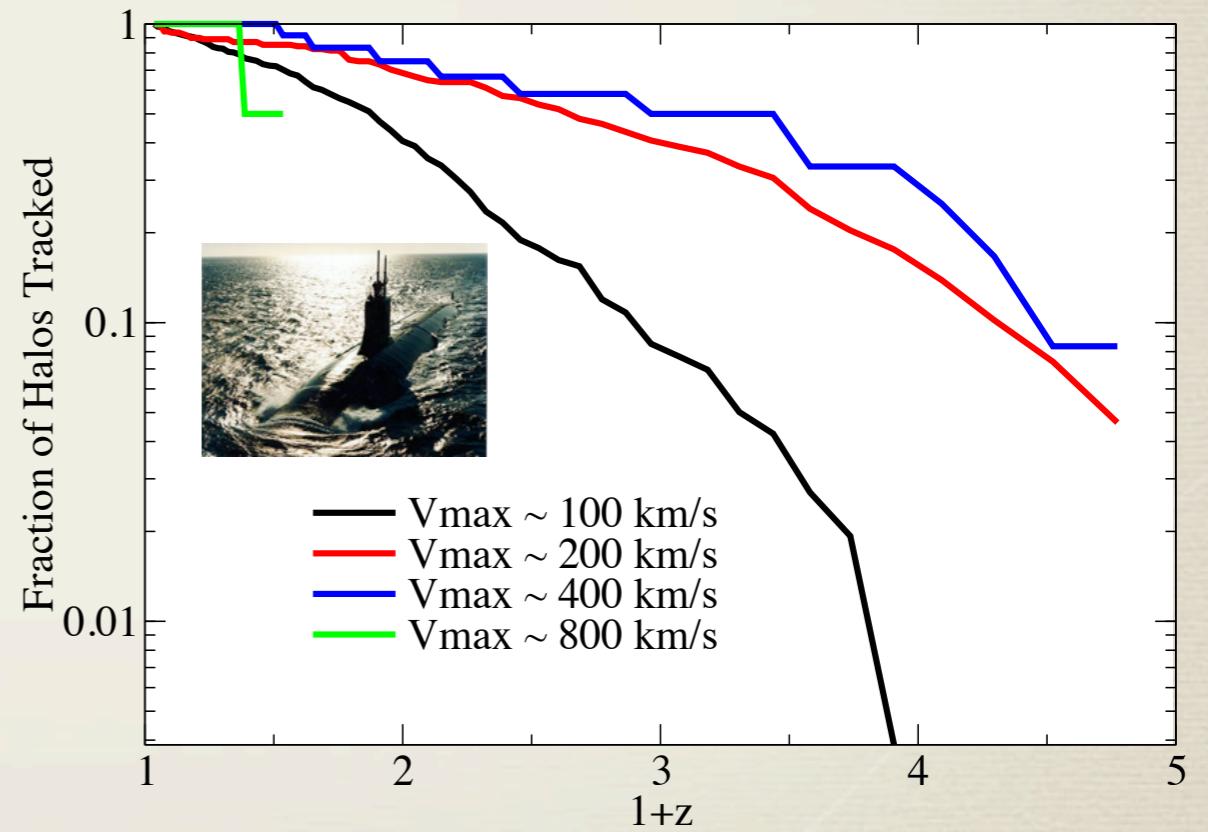
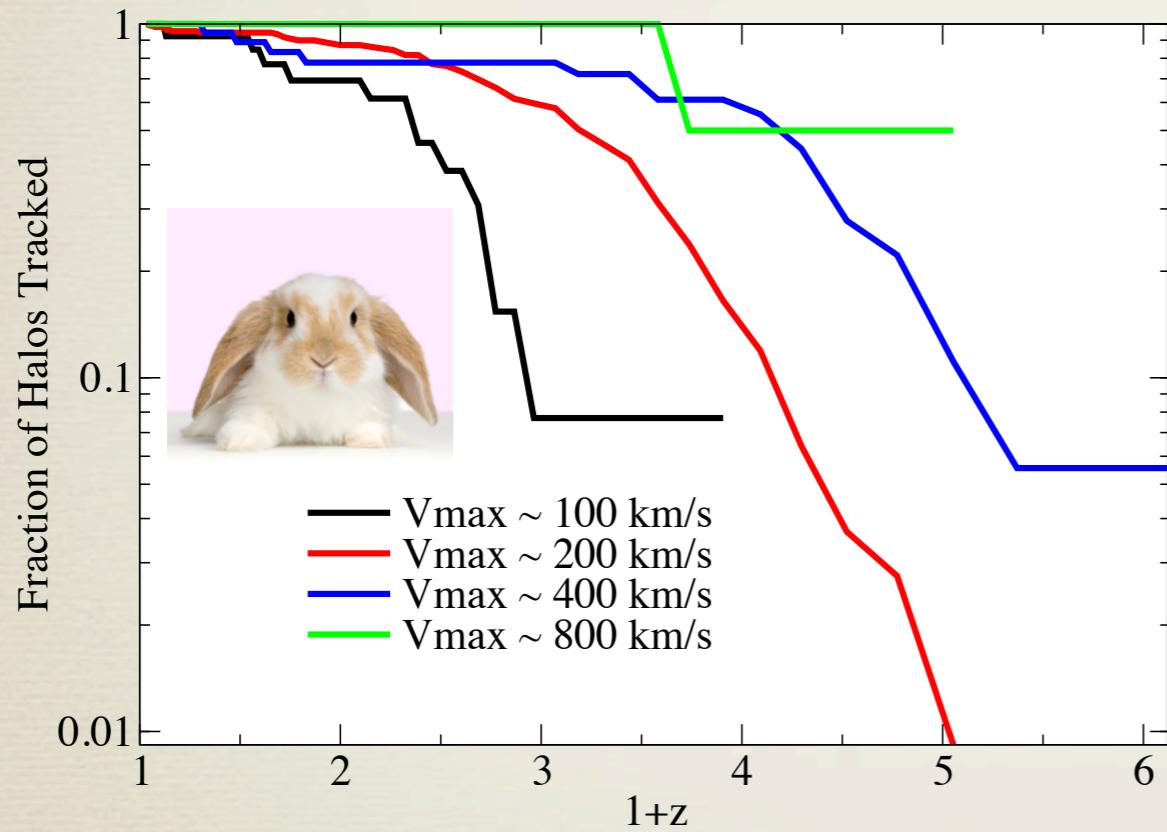


Image Credits



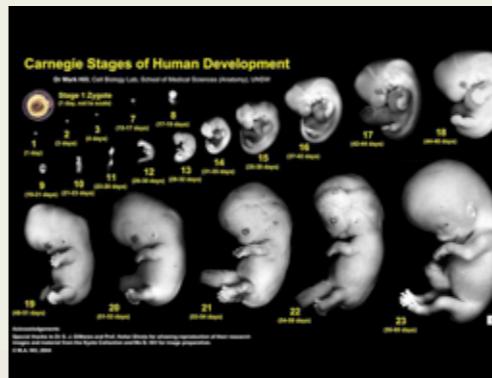
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