cosmICweb

Online Database for Cosmological Initial Conditions for Zoom-in Simulations

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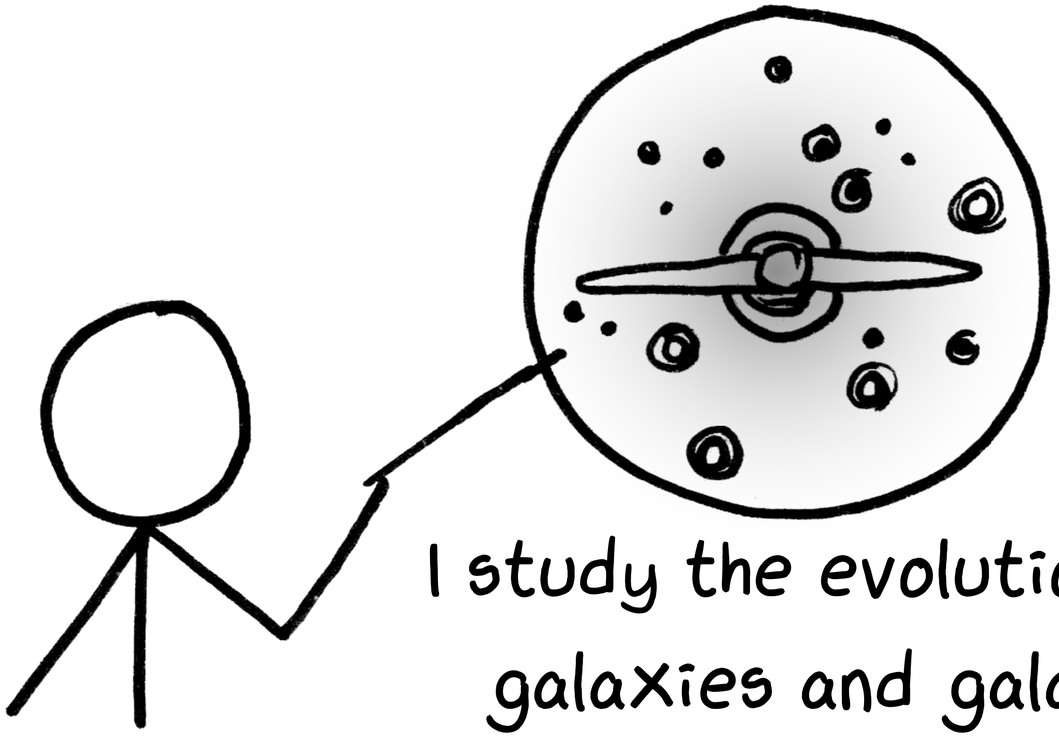
Hello, my name is Clusty.

I am a cosmologist!

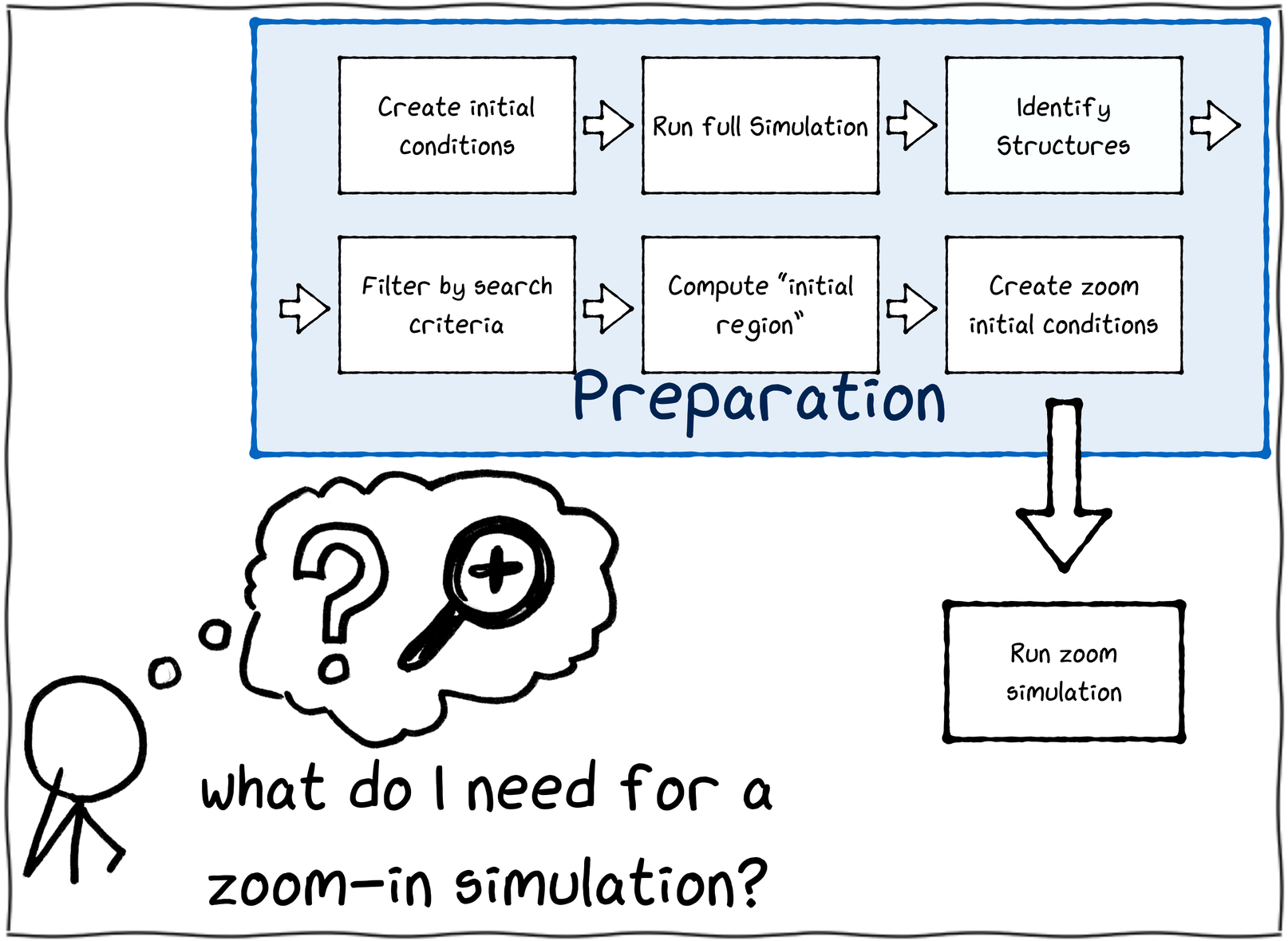
drawings by Theresia Herget



I study the evolution of galaxies and galaxy clusters!

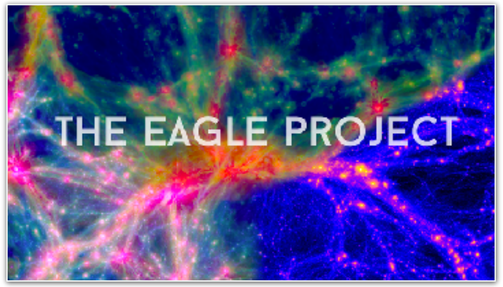
For this, I use zoom-in simulations to both resolve large structures and small details.

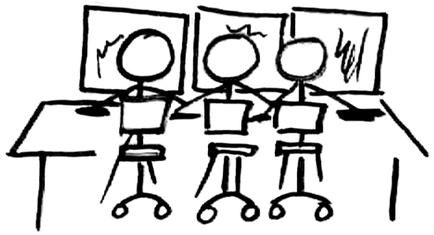
drawings by Theresia Herget



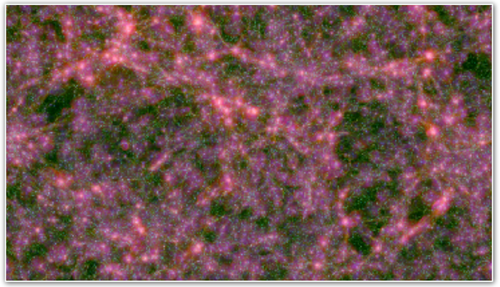
drawings by Theresia Herget

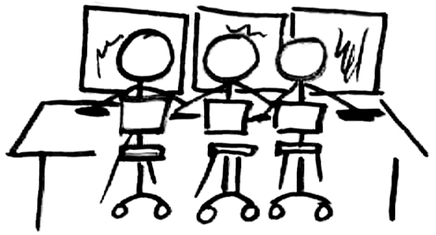
EAGLE



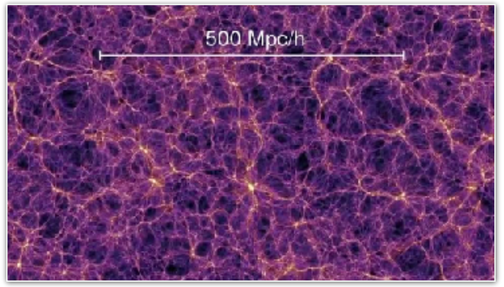


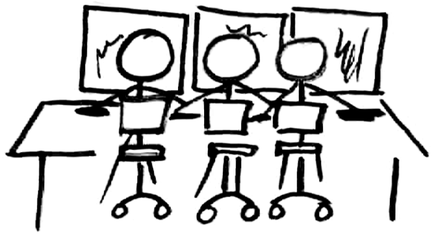
HORIZON AGN





MILLENNIUM XXL

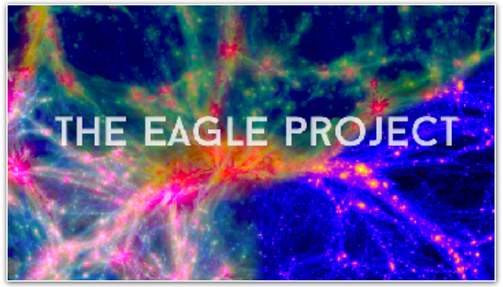




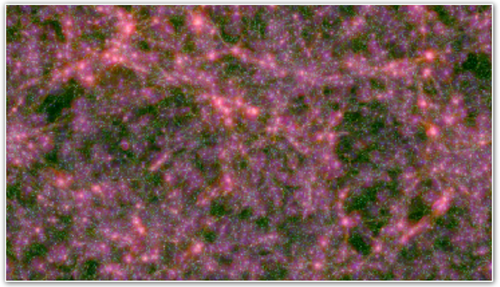
But other people have already done that!

drawings by Theresia Herget

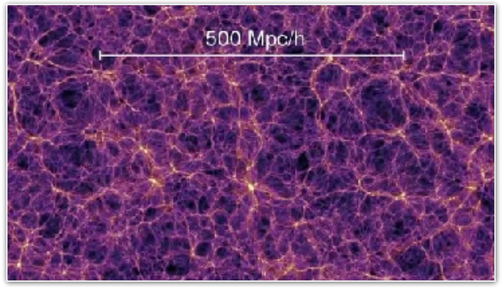
EAGLE

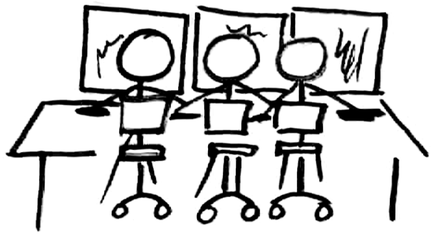


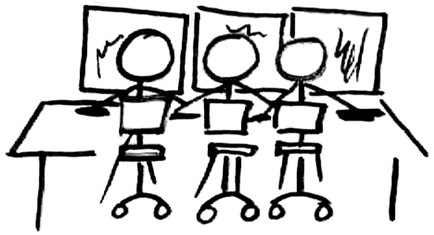
HORIZON AGN

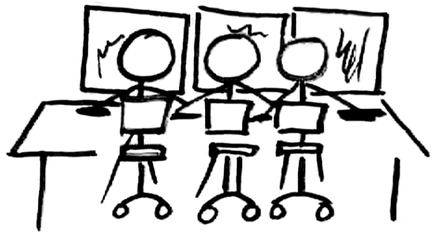


MILLENNIUM XXL

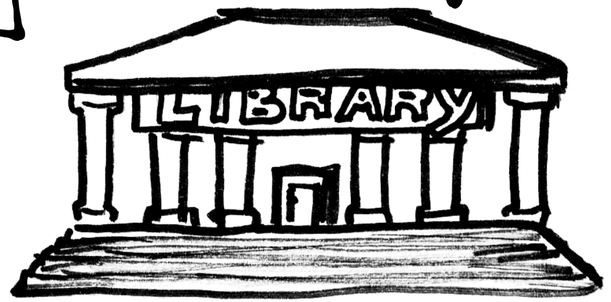








If only that data would be available ...



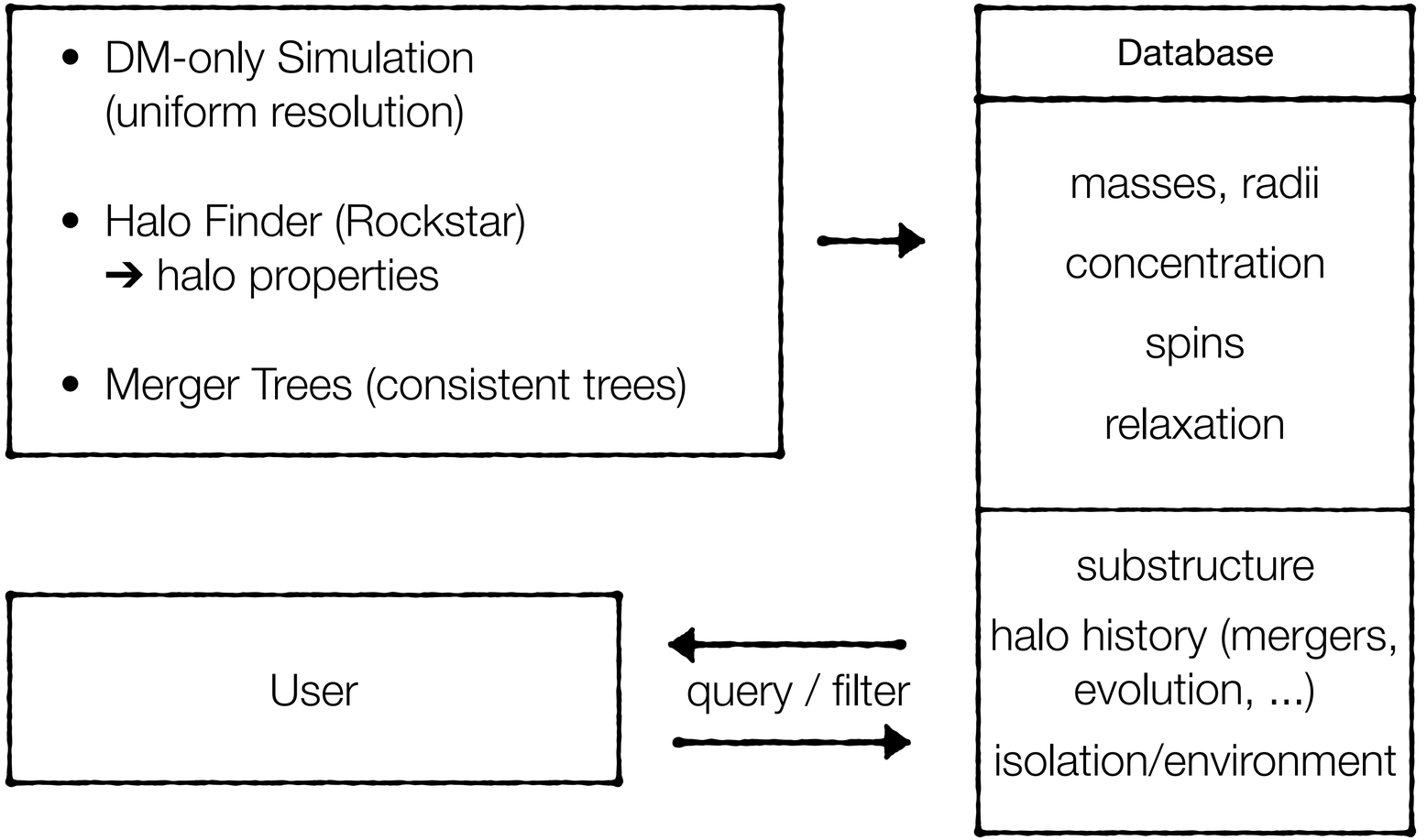
cosmICweb

drawings by Theresia Herget

Scope of **cosmICweb**

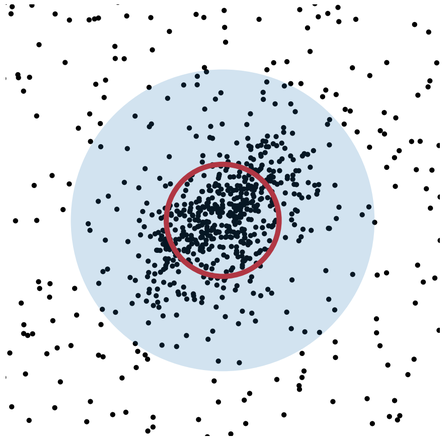
Finding the right objects to re-simulate	queryable / searchable halos with properties and merger-trees
Obtaining initial conditions for these objects	precomputed minimum-bounding ellipsoids of main halos **batch processing** for statistical studies
Referencing objects in articles / papers	Allow users to tag halos and create link / DOIs

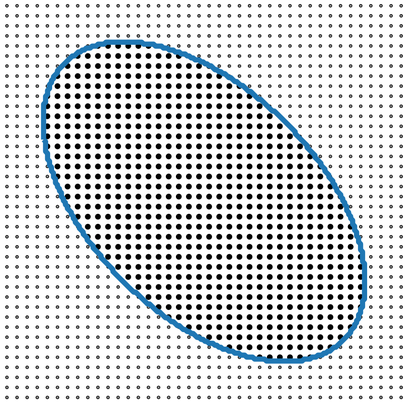
1. Finding Halos



Rockstar: Behroozi et al. 2011 *Consistent Trees: Behroozi et al. 2013*

2. Zoom Initial Conditions





minimum bounding ellipsoid

IC Ellipsoids
center, shape (different boundaries)

+ ICs of simulation

↓

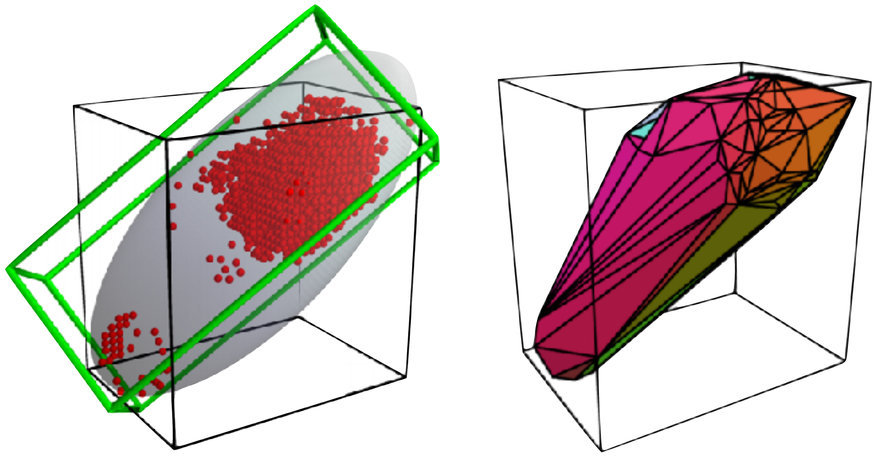
MUSIC

↓

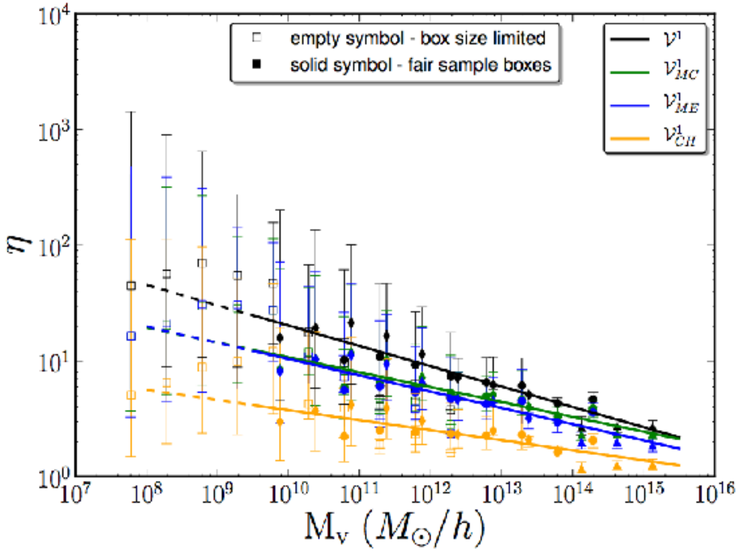
zoom ICs for various codes

MUSIC: Multi-scale initial conditions for cosmological simulations (Hahn, Abel 2011)

IC Ellipsoids



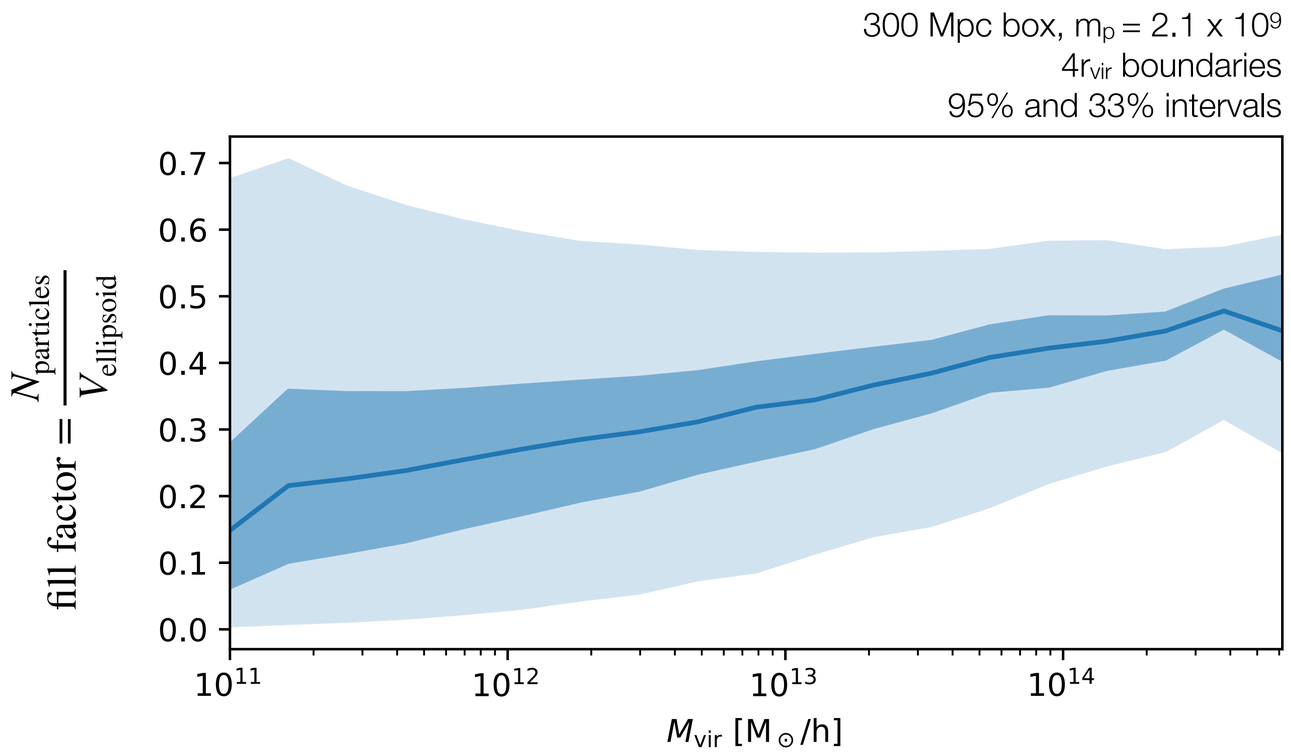
Oñorbe et al. 2013



$$\text{inefficiency } \eta = \frac{V_{\text{ellipsoid}}}{N_{\text{particles}}}$$

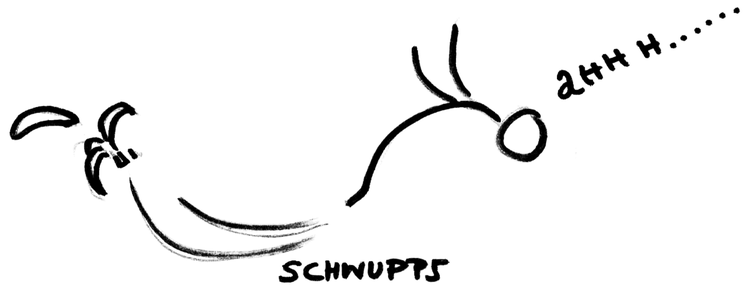
Oñorbe et al. 2013

IC Ellipsoids



Live Preview

what can possibly go wrong...



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Outlook

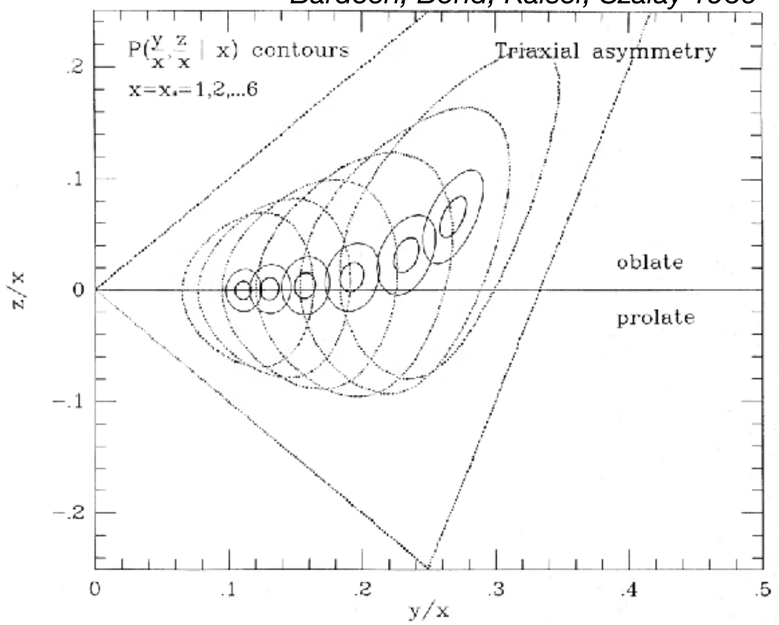
- Add more simulations!
  - VIRGO Consortium: Eagle (100 Mpc), P-Millennium (800 Mpc), Millennium XXL (4 Gpc)
  - HORIZON AGN (?)
  - FIRE simulations
  - local universe simulations by Jenny Sorce
- DOIs for references
- various documentation / UI / performance improvements
- integration with MUSIC 2.0

Release: end of this year

Feedback / ideas are more than welcome!
Interested in **testing / trying out**?

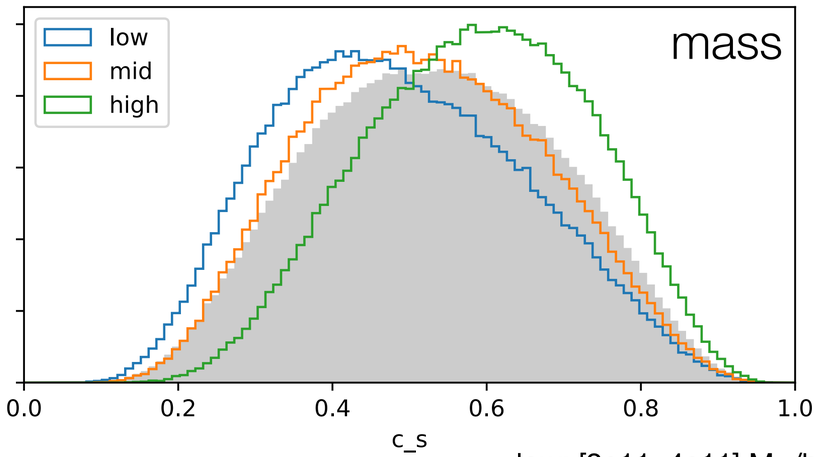
Proto-halo statistics

Bardeen, Bond, Kaiser, Szalay 1986



Ellipticity of peaks in a Gaussian random field

Buehlmann+ 2018, in prep

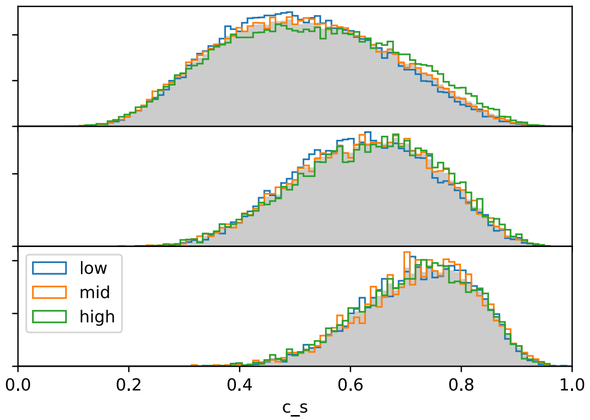


low: [2e11, 4e11] $M_\odot/h$
mid: [2e12, 4e12] $M_\odot/h$
high: [1e13, 1e14] $M_\odot/h$

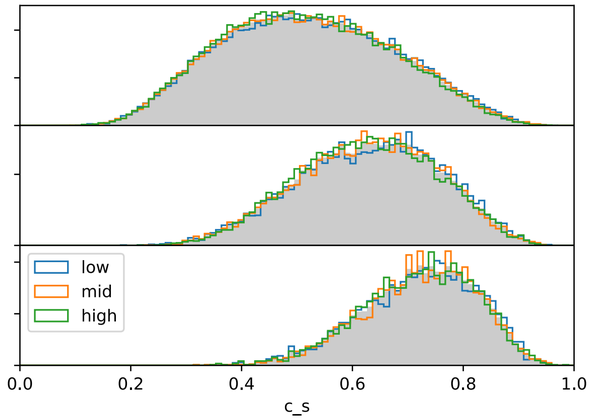
sphericity: $c_s = \frac{3a_3}{\sum a_i}$

Proto-halo statistics

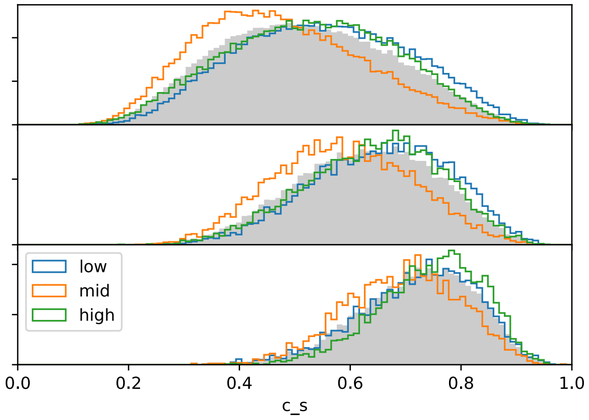
concentration



x_{off} (relaxedness)



$D_{1,1}$

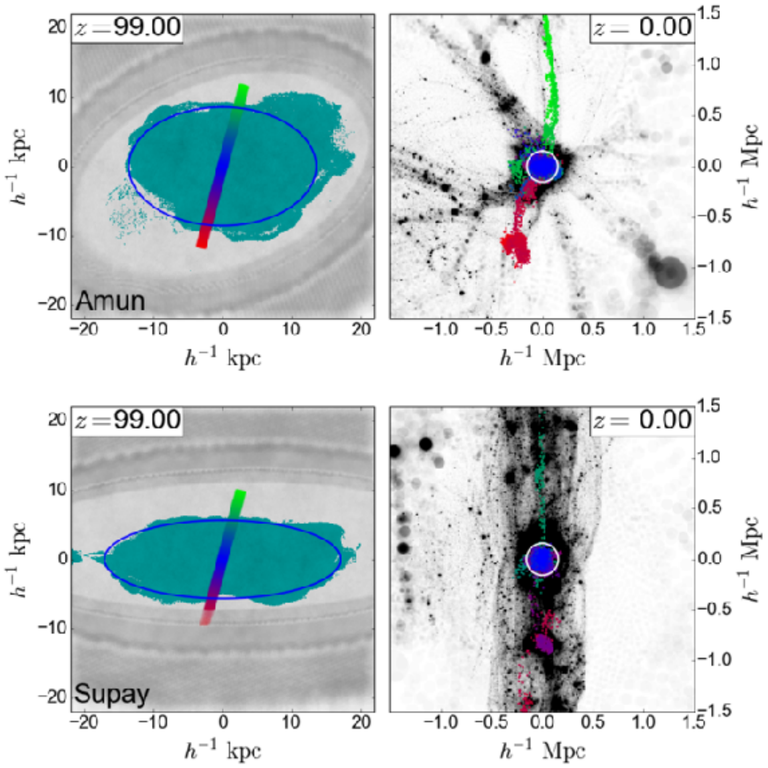


shown are the lower, mid, and upper third of the property parameters within each mass bin.

sphericity: $c_s = \frac{3a_3}{\sum a_i}$

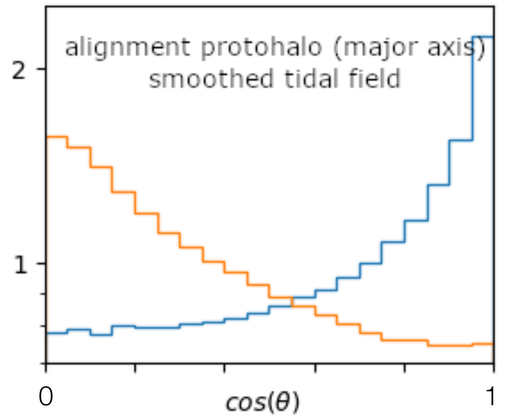
Buehlmann+ 2018, in prep

Proto-halo alignments



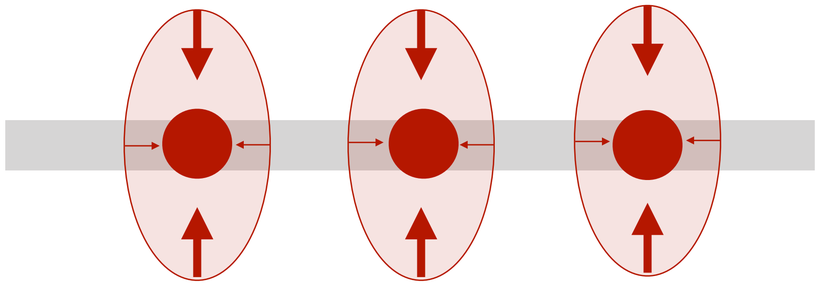
Borzyszowski, Poricani et al. 2016

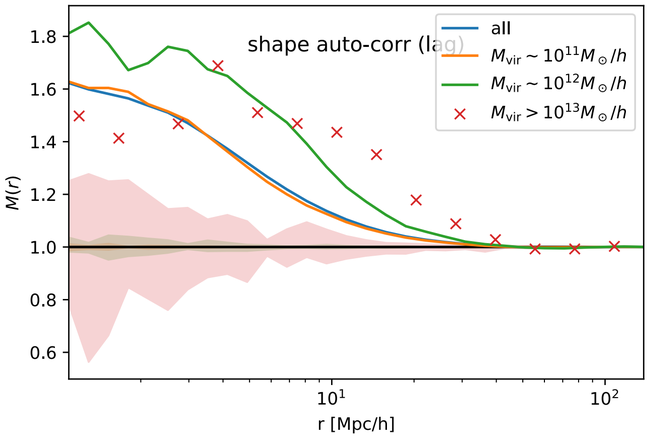
Alignment of the proto-halo major axis with the tidal field (blue: major axis, orange: minor axis)

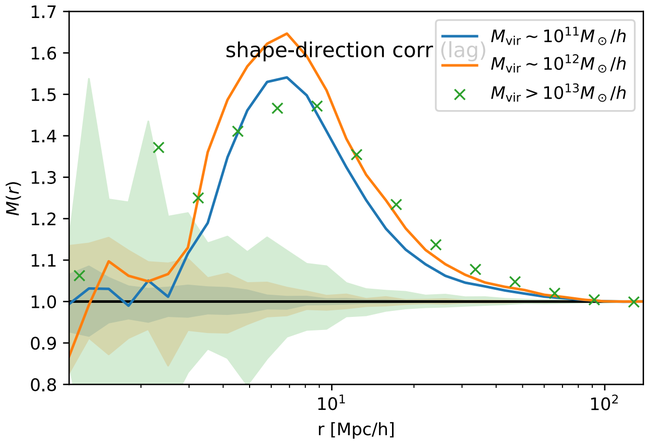


Buehlmann+ 2018, in prep

Proto-halo alignments







Marked correlation function:

$$M(r) = \frac{\sum m(\boldsymbol{x}) m(\boldsymbol{y}) \cdot I(|\boldsymbol{x}-\boldsymbol{y}| - r)}{\bar{m}^2 \sum I(|\boldsymbol{x}-\boldsymbol{y}| - r)}$$

Buehlmann+ 2018, in prep