Cluster centroids and peak variability from Illustris simulations

Intro

Why is it important to study the profile and centroid of galaxies?
DM maps are expensive. We want to:

- know which galaxy summary statistics will be allow us to stack the clusters best
- put a lower limit of the variability of galaxy cluster centroid and DM for cluster that are not going through major mergers

Goals

- characterize the variability (over time) for clusters which can only be done from a simulation
- compare with observations

Methods

sections that need inputs from CfA people

properties of simulated clusters

- Which sets of simulation do we look at - full physics?
- What format do the simulation data come in?
- What are the resolutions? (this will limit how precisely we can find the centroids - how does this translate to observation resolution?)
- Cluster finder - has someone used a galaxy-cluster finder for the simulation already ?

Basic checks to examine if the clusters look realistic

- do the DM halos of clusters look like NFW halos, and describe the concentration
  - triaxiality of DM halos?
- examine number of galaxies in a cluster (down to 5 magnitudes fainter than the BCG)
- examine color properties - do we recover the red sequence?

Proposed aspects of the snapshots to look at

- low redshift - redshift between 0.05 and 1.2 not hard lower / upper limit
- 3D quantities
- projected quantities

single cluster

- track properties of the most massive cluster(s)

compute stat of individual clusters then compare

compare

- clusters in same snapshot within some mass range
- clusters across snapshots

proposed quantities to compute / things to examine within a cluster

- DM density peak

- galaxy number density centroid / peaks
- galaxy luminosity centroid (weighted average) / peak (mode)
  - weighted by rest frame luminosity in
    - g-i bands (any other suggestions?)
  - what color cut (red sequence or not) / redshift cuts gives the tightest separation of galaxy centroid from DM peak
- BCG(s) identification

Let's just call the distance of different galaxy summary stat and the DM peak as δs.

Results

Figures

- δs as a function of time for the most massive cluster(s) (indicating any major merger)
- δs as a function of mass of cluster

- number of member galaxies as a function of DM mass of clusters
  - out to r500c (TBD)
  - within 5 magnitude difference from BCG (TBD)
- 3D / direction of δs if there is one big merger this might be interesting to look at

Discussion

- compare to observations- if applicable

References or relevant literature

Other interesting quantities / aspects to examine

- Correlation between colors and distance of galaxies from DM centroid
- how well velocity dispersion constrains the cluster mass
- X-ray peak (very optional - depends on how easy or hard this is / if the gas dynamics are realistic enough)