Construction of a catalog of galaxy clusters in collision process.

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21 de abril de 2014

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- Millenium

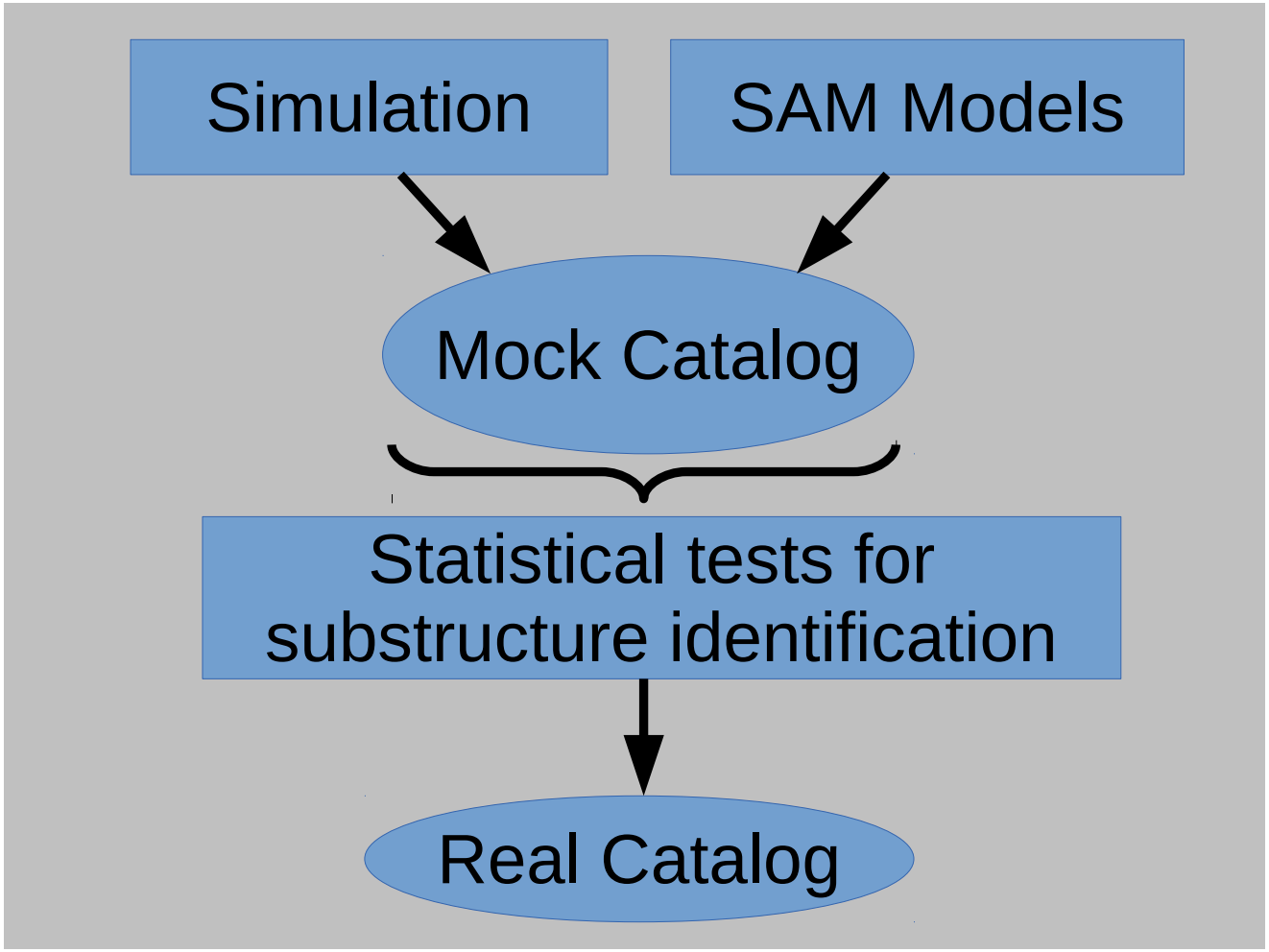
Statistical tests for identification of substructures.

- The Dressler-Shectman test
- Iterative Dressler-Shectman test.
- Gaussian mixture..

Results.

- Real catalogs of galaxy clusters.

Future work.


Simulation
SAM Models
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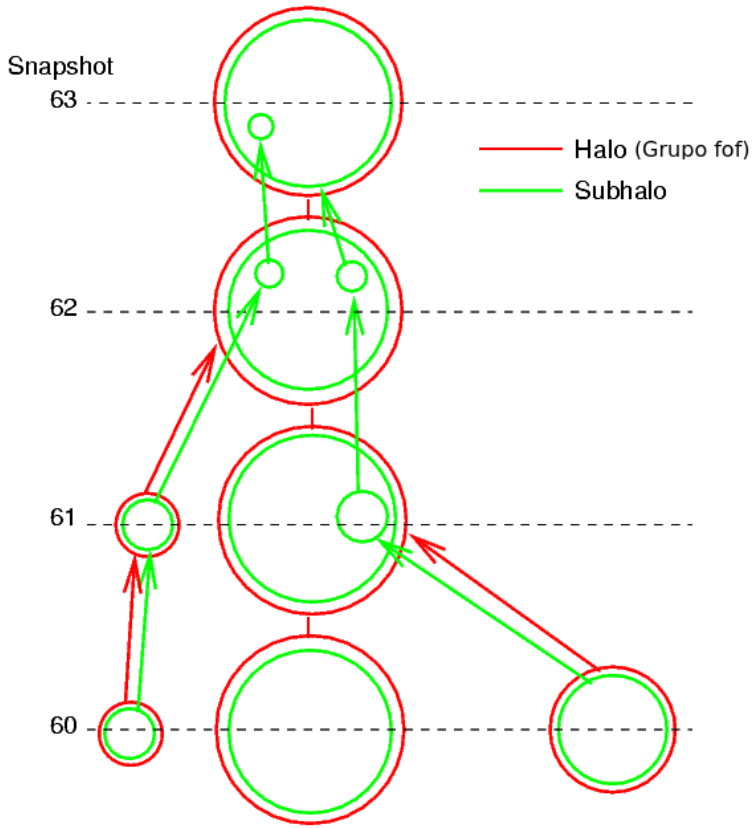
- $Snapshots = 64$

- Millenium simulation: *Springel et al. 2005*.
- WMAP results: *Spergel et al. 2003*.

Study of the merger trees.

- Based on the subhalos merger trees, we construct the merger tree for every fof group in the simulation.



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- *Pinkney et al. 1996*
  - They say that this is the best test known so far for substructure identification.
  - The test efficiency is lower when the substructures are aligned along the line of sight, and also when the cluster under consideration have less than 30 galaxy members.
  - They recommend to look for significant values of the skewness moment on radial velocity distribution.
  - This test can be used to identify fof-group substructures accreted in a major merger event up to 3 Gyr later. This time interval is equivalent to 10 snapshots in the simulation.

- Is not possible to derived a theoretical distribution for Δ in order to build a proper hypothesis test for each cluster. To overcome this we compare the obtained Δ for a given cluster with the distribution of Δ obtained from a set of Monte Carlo simulations. For each simulation the velocities are shuffled among the positions.

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- We define the p-value as

$$p = \frac{N(\Delta_{MC} > \Delta)}{N_{MC}} \tag{1}$$

Iterative Dressler-Shectman test.

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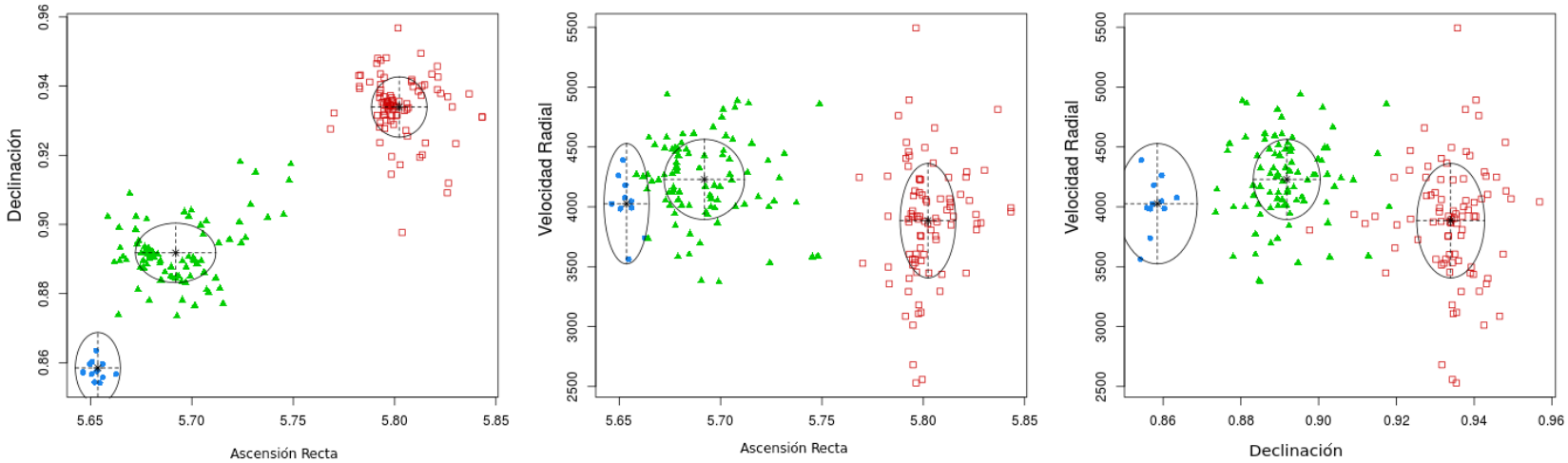
- The algorithm converges if the number of galaxies between 2 steps is the same.

Gaussian mixture. (*Mclust*)

The application of the DS test give us a group of galaxies with high probability to lie in a substructure. Then, in order to define substructures we identify clumps of galaxies based on their proximity.



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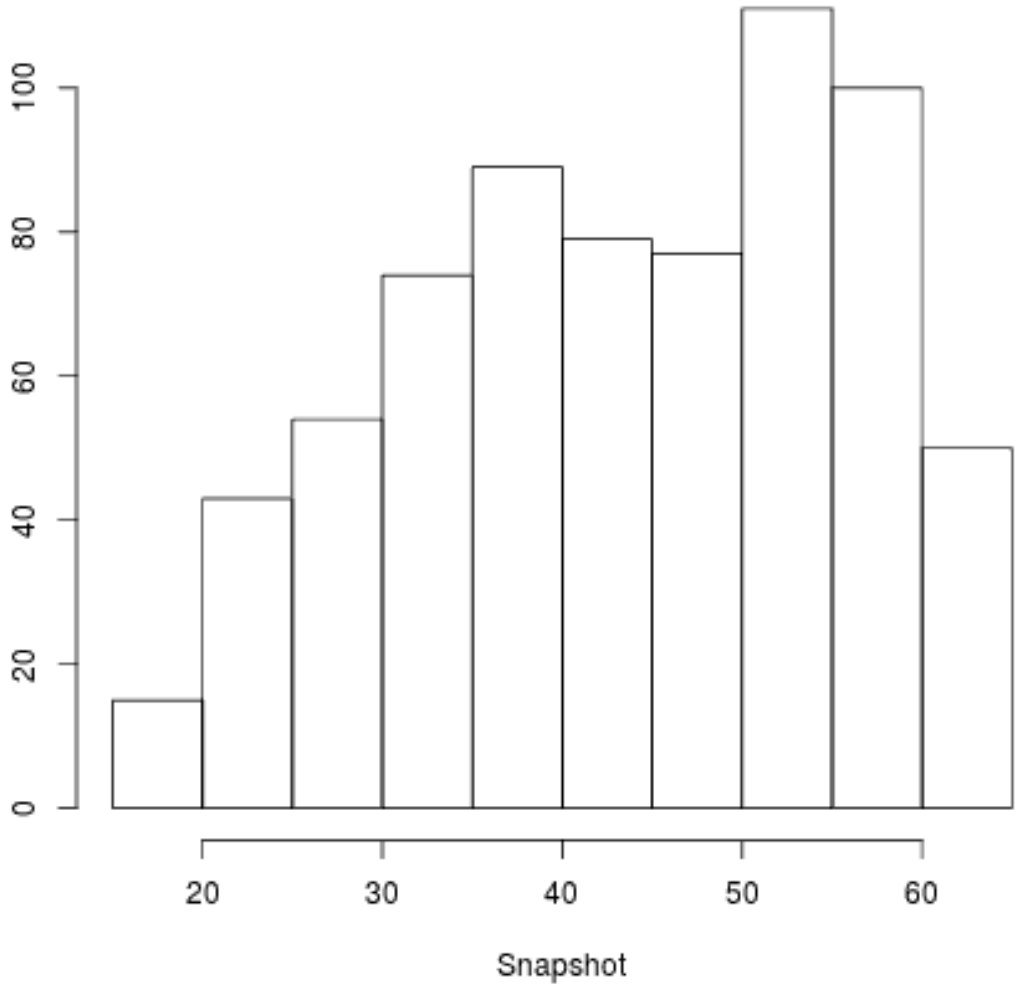
- We find that 1448 clusters have substructure ($p < 0{,}15$).
- If we consider only the clusters whose radial velocity skewness is significantly different from zero, the sample is reduce to 715 clusters.


0
20
40
60
80
100
20
30
40
50
60
Snapshot

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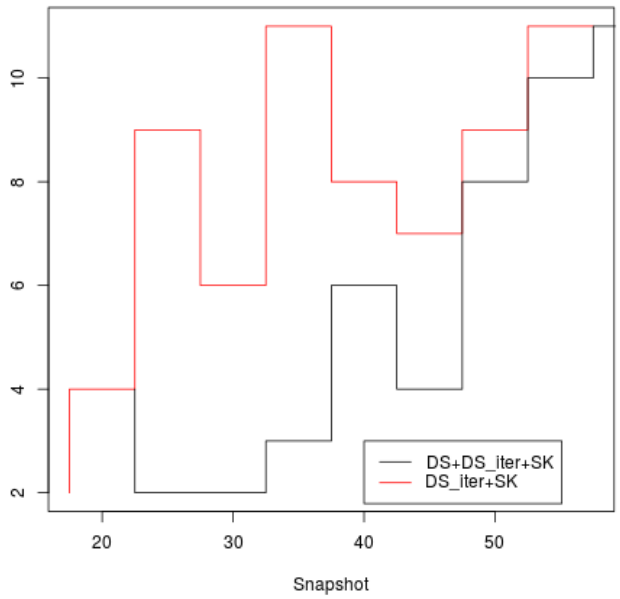
- Over those 119, only 46 clusters have been detected for the traditional DS test complemented with the skewness test.



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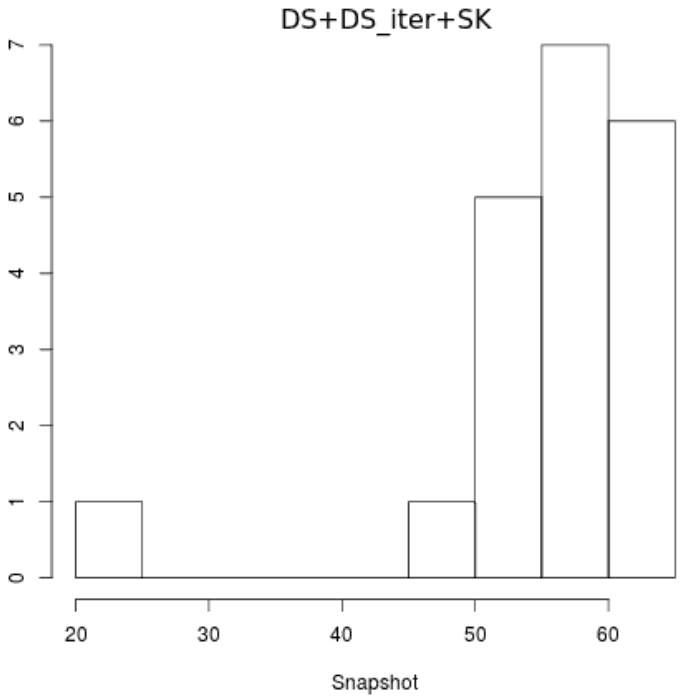
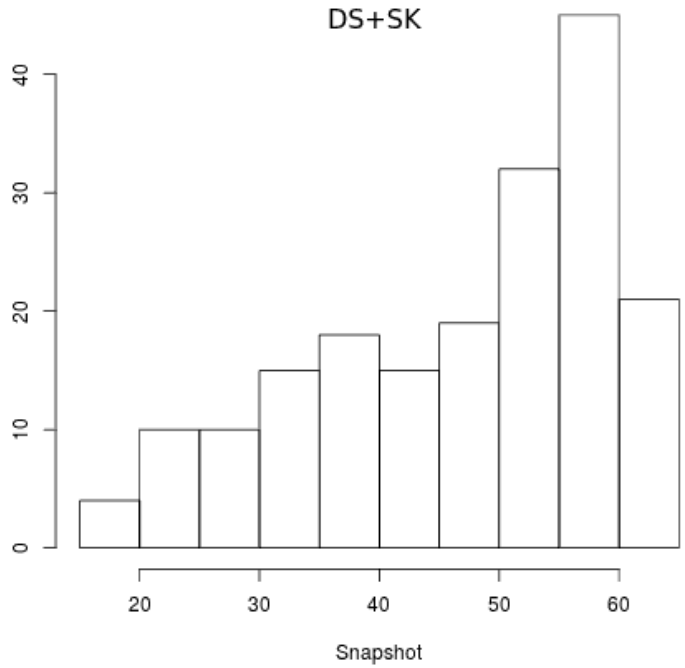
- Over the sample of 46 clusters, 20 systems have a relative occupation higher than 0.5.





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- After that, we estimate the velocity dispersion and the virial radius.

$$\begin{aligned} R_{vir} &= \frac{\pi}{2} \frac{ngal(ngal-1)}{\sum_{i>j}^{ngal} R_{ij}^{-1}} \\ \sigma &= \frac{\sqrt{\pi}}{ngal(ngal-1)} \sum_{i=1}^{ngal-1} \omega_i g_i \\ \omega_i &= i(ngal-i) \\ g_i &= v_{i+1} - v_i \end{aligned} \tag{2}$$

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- We compare the virial radius of the identified groups with the virial radius of the subhalos, finding that we are overestimating the real values.
- We compare the velocity dispersion of the identified groups with the velocity dispersion of the associated subhalos, finding that our values are in good concordance with the real values.

With this association between groups and subhalos in the mock, we find 3 cases:

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Of the 715 clusters, we find 28 with 2 substructures with a relative occupation higher than 0,5 while each group have more than 3 galaxy members. From this 28, in 19 we find the type 0 subhalo and a type 1 subhalo (case 1), in 4 we find 2 type 1 subhalos (case 2) and in 5 we identify a false substructure (case 3).

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Application of the method of detection to real catalogs.

Catalog	Berlind et al.	Tempel et al.	Eke et al.	Mock
Galaxy survey	SDSS DR3	SDSS DR8	2dF	-
N° galaxy clusters	8148	77858	28877	-
$N^\circ clusters(N_{gal} > 30)$	77	389	144	2854
$pval > 0{,}15$	30	246	112	1448
$pval > 0{,}15 + SK$	30	132	60	715
Ds iter	20	86	41	46
Mclust	15	80	38	44

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- Study the physics properties of the galaxies that belong to the identify substructures.
- Perform astrophysical test over our sample of colliding cluster candidates of the catalog looking for impose some constraints on dark matter particle properties.


THANK YOU