The properties of galaxy groups in the Millennium simulation and in the SDSS DR7

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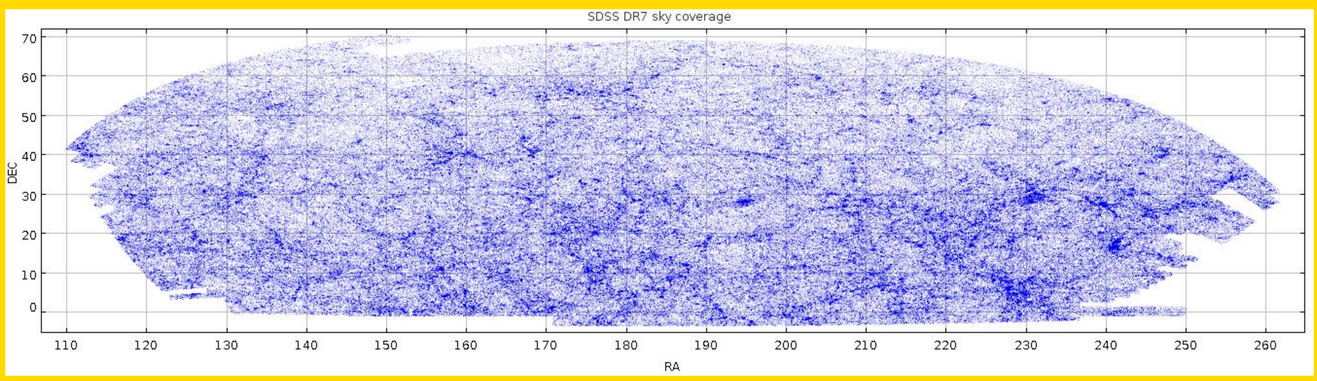
Introduction

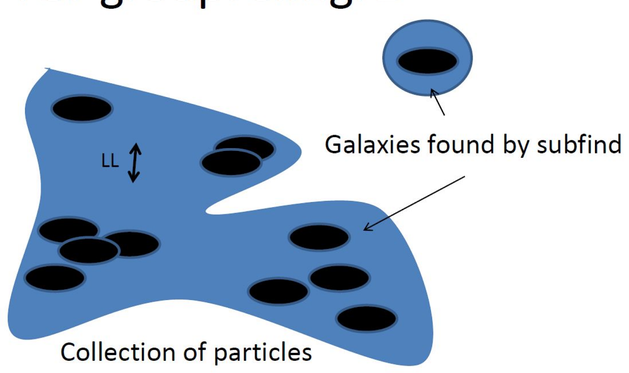
The Millennium N-body simulation and SDSS DR7 galaxy and galaxy group catalogs are used to study the structure of the dark matter halos, the distribution of subhaloes inside the main halos and the correspondence between dark matter halos and galaxies. We test hypothesis that galaxy groups are galaxy systems hosted by shared main dark matter halo. The comparison between simulations and observations reveal clear differences between widely used semi-analytical galaxy models used for galaxies in the Millennium simulations, and the real galaxy properties in the observations.



Observational data

For observational data SDSS-DR7 data is used. In particular we use Tago et. al (2010) catalogoue. SDSS-DR7 contains 697920 galaxies, but after the extraction only 583362 remain. In order to compare observational data with simulation we use magnitude limited grous, with absolute magnitude upper limits -18, -19, -20 and -21. In the different samples we have 5463, 12590, 18973, 9130. Unfortunately nearly a half of the groups are pairs. For this reason analysis is also carried out separately for groups with 2, 3-9 and 10 or more members.

Fof-group: Simgr1



Galaxy groups in simulation

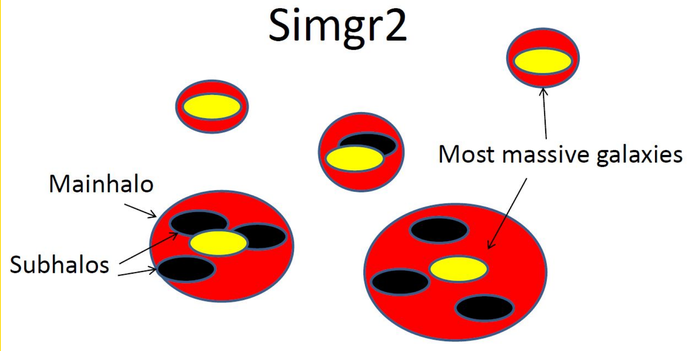
For simulation data Virgo consortium Millennium simulation (Springel et al. (2005)) data is used. For galaxy models Bertone et al. (2007) and Font et al. (2008) data is used. We study the model using 3 separate group definition for simulation data.

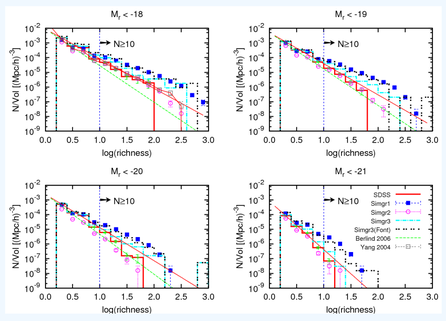
Firstly (Simgr1) we select simulation particles at a fixed linking lenght, equal to 0.2. Then we use subfind algorith (Springel et al. (2005)) to find the representative haloes. These groups we call fof-galaxy groups, see figure to the left. Simgr1 can have quite a lot substructure.

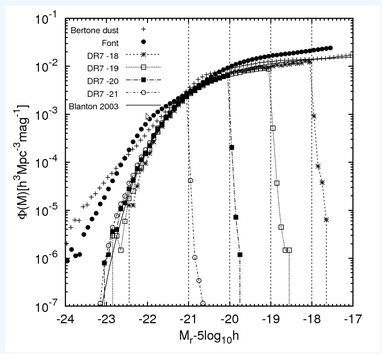
The substructures of Simgr1 are used for Simgr2 definition. We find from the fof-groups halo sub-halo structures. These groups consist of a main galaxy (main halo) and satellite galaxies (subhaloes), see figure to the right. So Simgr2 is a collection of haloes.

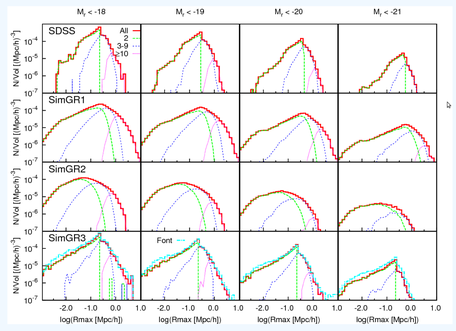
For the third simulation groups we use the galaxies data of Millennium and construct magnitude limited groups from it with exact the same methods and parameters, limits etc as were the observational groups constructed in Tago et al (2010).

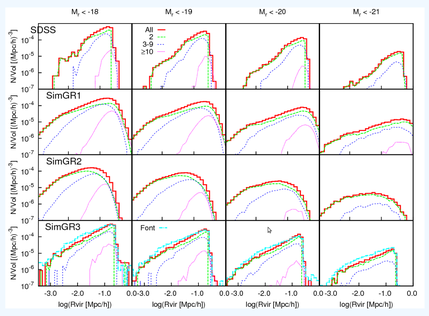
Mainhalo-subhalos group: Simgr2











Results:

* Comparision of group richness (left up), viral radius (left bottom), maximum separation (right up) and velocity dispersion (right bottom) was carried out.

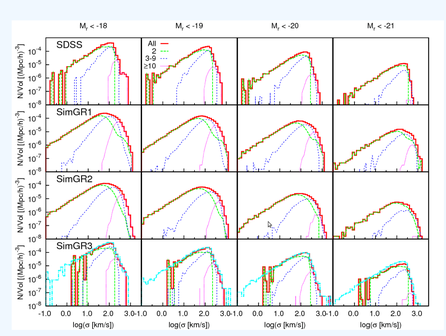
* In groups that have more than 10 members the parameters are in rather good agreement.

* This dosen't hold for galaxy pairs.

* Comparision shows, that very likely the fof-groups are corresponding to halo subhalo groups.

* Best fit is always with Simgr3, but this is natural.

* There is still a need for improvements for dark matter luminosity function (up centre)



References

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