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 catalogues are used to study the structure of the dark matter haloes, the distribution of subhaloes inside the main haloes and the correspondence between dark matter haloes and galaxies. We test hypothesis that galaxy groups are galaxy systems hosted by shared dark matter halo. The comparison between simulations and observations reveals clear differences between widely used semi-analytical galaxy models used for galaxies in the Millennium simulations and the real galaxy properties in the observations.

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 length, equal to 0.2. Then we use subfind algorithm (Springel et al. 2005) to find the representative haloes. These groups we call Fof-groups, see figure to the left. Simgr1 can have quite a lot of 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).

Results:
* Comparison of group richness (left up), virial 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 doesn’t hold for galaxy pairs.
* Comparison 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
Springel V. et al., 2005, Nature, 435, 629

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