THE NEW GALAXY SAMPLE FROM SDSS DR9 AT $0.003 \leq Z \leq 0.1$

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ABSTRACT. To test the relationships between morphological types of galaxies in pairs/groups and their physical properties (luminosity, mass, color index, the radial velocity, the inverse concentration index, the absolute magnitude, the radius of the de Vaucouleurs or scale radius, etc.) on a larger sample of the local Universe, we need the more representative data. With this aim we processed and prepared a sample of galaxies with $0.003 \leq z \leq 0.1$ based on the latest SDSS DR9. The initial sample was about 724,000 objects and, consequently, 407,000 galaxy images after the preliminary processing. Because of the large number of duplicate and faulty images, we checked its carefully and obtained finally about 260,000 galaxies in the studied sample at $z < 0.1$. We discuss this procedure and properties of the studied galaxy sample.

Key words: Galaxies, SDSS DR9.

1. Introduction

The study of galaxy groups and clusters is an important clue to the conditions of galaxy evolution as well as to the role of intragalaxy/intracluster gas dynamics and hierarchical clustering in the process of galaxy formation. The major physical characteristics are "mass-to-luminosity" ratio as well as dependencies of morphological type on such parameters as the color index, diameters, absolute magnitude etc., i.e. in context of the dense environmental influence. For example, the rich clusters contain mainly the elliptical and SO galaxies while the poor groups account them for only 10-20% of the population. This well-known problem is still discussed as concerns with the processes that effect on the morphological changes of galaxies during encounters or intrinsic processes connected with a stellar density, star formation rate or ram-pressure stripping. To evaluate a better model for the relation between the baryonic component of a galaxy and its massive dark halo as well as a common halo of galaxy group/cluster, which should be supported by the reliable observational data is still also under development.

In the previous works of our team by Dobrycheva et. al. (2012), Melnyk et. al. (2012), Pulatova et al. (2013), Vavilova et al. (2009), Melnik et al. (2009), Melnyk et al. (2008) we have studied physical properties of galaxies in poor groups (from isolated galaxies till 10 group members) selected from SDSS DR5 and other databases as well as for the galaxy systems in the Local Supercluster (Melnyk et al. (2006), Vavilova et al. (2005), Karachentseva et al. (2005, 1994a, 1994b)) and X-ray clusters (Babyk et al. (2012, 2013)) as concerns also with the visible and dark matter distribution. See, also, the recent papers in context of our research by Tempel et al. (2012, 2011), Carollo et al. (2013), Luparello et al. (2013), Blanton et al. (2012), Szabo et al. (2013), Sheldon et al. (2011), and Vollmer (2007). So, for continuation of our research we need the more representative galaxy sample to construct a distribution of galaxies in pairs/groups in a way proposed by Elyiv et al. (2009), namely to apply the modified Voronoi tessellation for identifying the galaxy groups of different population with the better defined morphological types, spectra and other galaxy data.

2. The Sample

The main aim of this work was to create a good quality sample of nearby galaxies with $z < 0.1$ for analyzing its properties in context of the tasks aforementioned in Introduction. We worked with a sample of the latest SDSS DR9. "The SDSS observes galaxies in five photometric bands (u, g, r, i and z) centered at (3551, 4686, 6165, 7481 and 8931 A). The photometric and spectroscopic observations were conducted with the 2.5-m SDSS telescope at the Apache Point Observatory in New Mexico, USA" (www.sdss3.org). We downloaded the file, which contains the list of all spectra for a given data release with associated parameters from the 2D and 1D pipelines. This sample was conformed to FITS standard, therefore the fv program for work with the sample was used, because of fv is appropriated with graphical program for viewing and editing any FITS format image or table.

The preliminary preparation of the sample had several steps: limitation by z; checking for non-galaxy objects; checking for faulty and duplicate objects. In order to avoid congestion on the server, the list was currently limited to 1000 objects and submitted our list in 10 bins by z (Table 1, Col. 1). So, after limiting the sample by redshifts $0.003 < z < 0.1$, it contained 724,000 objects and required the significant cleaning. First of all, the quasars and star-like objects were removed and, consequently, 407,000 galaxy objects were left after this rejecting (Col. 2). It is known that SDSS gives several duplicate images for the same galaxies in many cases. We used SDSS DR9 Image List Tool and own IT-code to find duplicate objects as well as we inspected visually each final galaxy image in our sample. As result, the sample has contained more 360,000 galaxies after this reduction (Col. 3).

Table 1: Quantitative distribution of galaxies in the studied SDSS DR9 sample before and after processing/rejecting faulty objects

redshifts	with duplicates	without duplicates
$0.003 \le z < 0.01$	5240	3782
$0.01 \le z < 0.02$	10900	8687
$0.02 \le z < 0.03$	29825	25492
$0.03 \le z < 0.04$	35723	31579
$0.04 \le z < 0.05$	39593	34803
$0.05 \le z < 0.06$	43459	39116
$0.06 \le z < 0.07$	56101	50429
$0.07 \le z < 0.08$	67787	61445
$0.08 \le z < 0.09$	66229	59345
$0.09 \le z < 0.1$	52289	47900
total	407146	362588

Because of this sample is being used for identifying galaxy groups by the method of Voronoi tessellation, which is sensitive to the boundary effects, we taken it into account and obtained the sample consisting of 290,000 galaxies (Fig. 1). We note that the "Legacy targets are those taken as part of the SDSS Legacy survey, which is the wide-field survey of galaxies brighter than r=17.77 (Main Sample), Luminous Red Galaxies, and QSOs" (*www.sdss3.org/dr9/algorithms/photo − z.php*). This recommendation required the new reduction. Namely, we limited our sample by magnitude $modelMag\_r < 17.7$.

3. Astronomical corrections

To take into account completeness of the sample, it should be limited according to the dependencies on the luminosity from redshift, as well as the evolution to the k-corrections, and the luminosity depending on the distance, as well as galactic extinction.

K-correction is a correction to an astronomical object's magnitude (or equivalently, its flux) that allows a measurement of a quantity of light from an object at a redshift z to be converted to an equivalent measurement in the rest frame of the object. The K-corrections for galaxies of different morphological types are necessary to interpret the magnitude-redshift relation, the luminosity function of galaxies and for most of the spectrophotometric studies of distant objects (see Poggianti (1997)). For the calculation of k-correction we used code by the M.R. Blanton (2002). The version of the K-correction code ($v1\_11$) implementing the calculations described here, along with electroplates and filter curves, is publicly available (physics.nyu.edu/ mb144/kcorrect). The whole of the code was used through the Research Systems, Incorporated, IDL language; everything except for the template-fitting also exists in stand-alone C programs (which call the same routines, guaranteeing consistency).

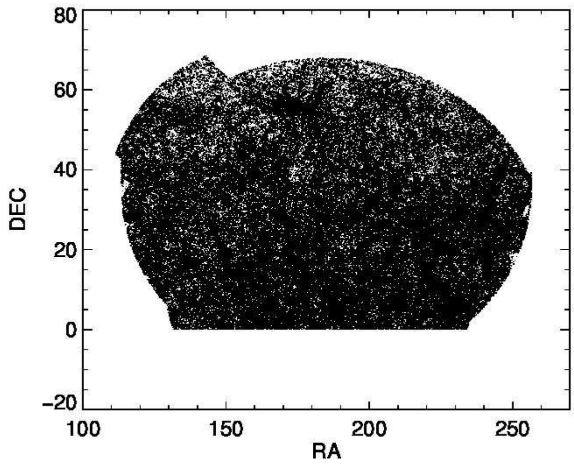

Figure 1: Angular-redshift completeness of the SDSS DR9 sample of nearby galaxies

"The spectra released in DR9 have not been corrected for Galactic extinction, because the SDSS includes a substantial number of spectra of Milky Way stars whose extinction would differ from that given in the Galactic dust maps, as they don't lie beyond the full dust column. The extinction is a relatively small effect over most of the survey area, since the median E(B-V) over the survey is around 0.04; however, for some SEGUE pointings the reddening can be substantially larger". Following this SDSS recommendation, we took into account the extinction coefficients by Yuan et al. (2013) for our SDSS DR9 sample (Fig. 2).

As result of all the aforementioned reject procedures and astronomical corrections, we created the new galaxy sample about of nearby 260,000 galaxies till $z < 0.1$ based on SDSS DR9 (Fig. 3). Now this sample is being used to analyze the physical properties (luminosity, morphological type, color index, the radial velocity, the inverse concentration index, the absolute magnitude, the radius of the de Vaucouleurs, mass-to-luminosity ratio etc.) of galaxies in groups.

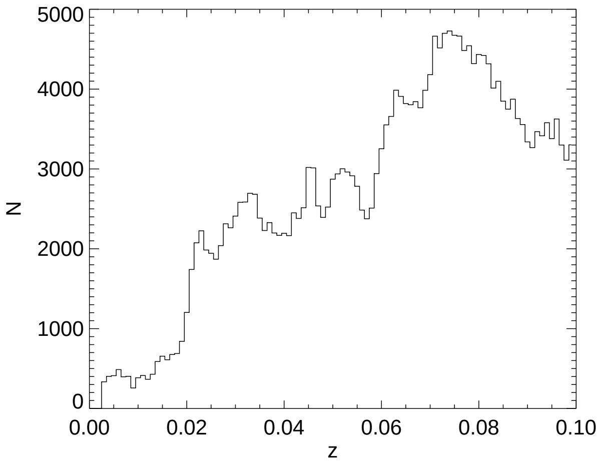

Figure 2: The distribution of nearby galaxies from SDSS DR9 within $0.003 \leq z \leq 0.1$

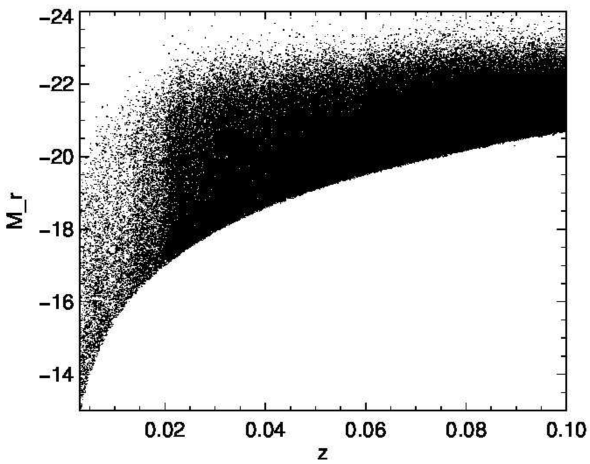

Figure 3: Luminosity versus redshift relation for nearer galaxies from SDSS DR9

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