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THE SLOAN GREAT WALL FROM THE SDSS DATA RELEASE 4

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Using the MAIN galaxy data from the SDSS Data Release 4 (SDSS4), we further study the Sloan Great Wall by three-dimensional cluster analysis. Because the basic properties of Main galaxies change with redshift, we select 50942 Main galaxies having the same redshift region ($0.07 \leq z \leq 0.09$) as the Sloan Great Wall from the Main galaxy sample, and construct our SubMain sample. From the SubMain sample, 2013 isolated galaxies are identified at dimensionless radius $r = 1.4$. We perform the comparative studies of galaxy properties among the Sloan Great Wall, isolated galaxies and the SubMain sample in different redshift bins. It turns out that the statistical properties of luminosities and sizes of galaxies for the Sloan Great Wall, isolated galaxies and the SubMain sample are almost the same, the proportion of early-type isolated galaxies is relatively low. We also find that mean color of member galaxies of the Sloan Great Wall is redder than that of isolated galaxies. These results indicate that some properties of galaxies may be closely correlated with the environment or clustering.

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1. Introduction

The Great Wall, the largest virialized systems known, is a system of thousands of galaxies arrayed across the cosmos in the form of a vast, crumpled membrane. It is far too large and too massive to have formed by the mutual gravitational attraction of its member galaxies. By observing the cone diagram of slices in the certain declination range, Geller and Huchra (Geller and Huchra 1989) first discovered the Great Wall in CFA survey (hereafter, refers to the CFA Great Wall), which stretches from 9^{h} to 16.7^{h} in right ascension, and is located at a median redshift of $z = 0.02918$, with a length of about 240 Mpc in co-moving coordinates. The occurrence of such super-large-scale structure is undoubtedly important constraints on the models for the formation and evolution of the universe. According to Geller and Huchra analyses (Geller and Huchra 1989), the cold dark matter model succeeded admirably in explaining the clustering of galaxies on scales ≤ 10 h^{-1}Mpc and the qualitative appearance of the large-scale galaxy distribution. Dark matter composed of weakly interacting massive particles. These particles have low velocities so that they are bound in smaller perturbations. Galaxies form where the density contrast exceeds some threshold (Kaiser 1984). However, the occurrence of super-large-scale structure as the CFA Great Wall in the distribution of galaxies is a serious challenge to the cold dark matter model. Geller and Huchra indicated that hot dark matter model may be an good alternative (Geller and Huchra 1989). In this model, the candidate particle is the massive neutrino. "Free streaming" of the particles at the epoch of galaxy formation washes out fluctuations on smaller scales, and the velocities of the particles are so large that they are not bound in smaller perturbations. So, this model can easily explain the occurrence of super-large-scale structures, but it fails on small scales.

In the Sloan Digital Sky Survey (SDSS), a larger Great Wall is discovered (Gott *et al.* 2005), hereafter, refers to the Sloan Great Wall which is located at a redshift of $z = 0.0734$, almost a factor of 3 further than the CFA Great Wall. Its total length in co-moving coordinates is 450 Mpc, thus 80% greater than the CFA Great Wall. Using three-dimensional cluster analysis (Einasto *et al.* 1984), Deng *et al.* (Deng *et al.* 2006a) separated such super-large-scale structures from the Main galaxy sample of the SDSS Data Release 3 (Abazajian *et al.* 2005). This made it possible that properties of the Great Wall can be studied fully. Deng *et al.* (Deng *et al.* 2006a) only analyzed two Main galaxy subsamples corresponding to two regions of the North of the Galactic plane: one region at the celestial equator and another at high declination. In the region at the celestial equator, they discovered two compact super-large-scale structures: the Sloan Great Wall and the CFA Great Wall. The Sloan Great Wall is located at a median redshift of $z = 0.07804$, with a total length of about 433 Mpc and a mean galaxy density of about six times that of the whole Main galaxy sample. The CFA Great Wall is located at a median redshift of $z = 0.03058$, with a total length of about 251 Mpc. Comparing basic properties of member galaxies in the Sloan Great Wall with those in the CFA Great Wall, they found that the mean luminosity and size of member galaxies, the proportion of early-type galaxies in the Sloan Great Wall are larger than those in the CFA Great Wall. In the region at high declination, similar super-large-scale structures were not observed.

Galaxy properties are strongly correlated with local environment, for example, galaxies in dense local environments (*i.e.*, clusters or groups) have high proportion of early type morphologies *e.g.*, (Oemler 1974, Dressler 1980, Whitmore, Gilmore, Jones 1993) and low SFRs *e.g.*, (Balogh *et al.* 1997, 1999, Poggianti *et al.* 1999). In order to investigate correlations between local environment and galaxy properties, some authors even measured local galaxy density within the distance to the 5th nearest galaxy and studied galaxy properties as a function of the local galaxy density *e.g.*, (Goto *et al.* 2003). The Sloan Great Wall is the largest dense system observed to date. Undoubtedly, it is of interest to study the influence of such super-large-scale dense environment on galaxy properties for understand of the correlations between environment and galaxy properties.

Our paper is organized as follows. In Section 2, we describe the data to be used. The cluster analysis is discussed in Section 3. In Section 4, we present basic properties of the Sloan Great Wall. In Section 5, comparisons between galaxy properties in the Sloan Great Wall and those of isolated galaxies are performed. Our main results and conclusions are summarized in Section 6.

2. Data

The Sloan Digital Sky Survey (SDSS) is one of the largest astronomical surveys to date. The completed survey will cover approximately 10000 square degrees. York *et al.* (York *et al.* 2000) provided the technical summary of the SDSS. The SDSS observes galaxies in five photometric bands (u, g, r, i, z) centered at (3540, 4770, 6230, 7630, 9130 Å). The imaging camera was described by Gunn *et al.* (Gunn *et al.* 1998), while the photometric system and the photometric calibration of the SDSS imaging data were roughly described by Fukugita *et al.* (Fukugita *et al.* 1996), Hogg *et al.* (Hogg *et al.* 2001) and Smith *et al.* (Smith *et al.* 2002), respectively. Pier *et al.* (Pier *et al.* 2003) described the methods and algorithms involved in the astrometric calibration of the survey, and present a detailed analysis of the accuracy achieved. Many of the survey properties were discussed in detail in the Early Data Release paper (Stoughton *et al.* 2002). Galaxy spectroscopic target selection can be implemented by two algorithms. The MAIN Galaxy sample (Strauss *et al.* 2002) targets galaxies brighter than $r < 17.77$ (r-band apparent Petrosian magnitude). Most galaxies of this sample are within redshift region $0.02 \leq z \leq 0.2$. The Luminous Red Galaxy (LRG) algorithm (Eisenstein *et al.* 2001) selects galaxies to $r < 19.5$ that are likely to be luminous early-types, using color-magnitude cuts in g, r, and i. Because most LRGs are within redshift region $0.2 \leq z \leq 0.4$, two samples mentioned above actually represent the distribution of galaxies located at different depth.

The SDSS has adopted a modified form of the Petrosian (1976) system for galaxy photometry. The Petrosian radius $r_{\rm P}$ is defined to be the radius at which the local surface-brightness averaged in an annulus $0.8r_{\rm P}$–$1.25r_{\rm P}$ equals 20% of the mean surface-brightness within radius $r_{\rm P}$:

$$\frac{\int_{0.8r_{\rm P}}^{1.25r_{\rm P}} dr2\pi rI(r)/[\pi(1.25^2-0.8^2)r_{\rm P}^2]}{\int_0^{r_{\rm P}} dr2\pi rI(r)/[\pi r_{\rm P}^2]} = 0.2\,,$$

where $I(r)$ is the azimuthally averaged surface-brightness profile. The Petrosian flux $F_{\rm P}$ in any band is then defined as the total flux within a radius of $2r_{\rm P}$: $F_{\rm P} = \int_0^{2r_{\rm P}} 2\pi r dr I(r)$. The aperture $2r_{\rm P}$ is large enough to contain nearly all of the flux for typical galaxy profiles, but small enough that the sky noise in $F_{\rm P}$ is small. Theoretically, the Petrosian flux (magnitude) defined here should recover about 98% of the total flux for an exponential profile and about 80% for a de Vaucouleurs profile. The other two Petrosian radii listed in the Photo output, R_{50} and R_{90}, are the radii enclosing 50% and 90% of the Petrosian flux, respectively.

The SDSS4 sky coverage can be separated into three regions. Two of them are located in the North of Galactic plane, one region at the celestial equator and another at high declination. The third lies in the South of Galactic plane, a set of three stripes near the equator. Each of these regions covers a wide range of survey longitude.

In our work, we consider the Main galaxy sample. The data is download from the Catalog Archive Server of SDSS Data Release 4 (Adelman-McCarthy *et al.* 2006) by the SDSS SQL Search (with SDSS flag: bestPrimtarget=64) with high-confidence redshifts ($Z_{\rm warning} \neq 16$ and $Z_{\rm status} \neq 0$, 1 and redshift confidence level: $z_{\rm conf} > 0.95$) (`http://www.sdss.org/dr4/`). From this sample, we select 260928 Main galaxies in redshift region $0.02 \leq z \leq 0.2$ and construct the Main galaxy sample in which 76932 Main galaxies are located in one region of the North of the Galactic plane at the celestial equator.

When calculating the luminosity distance we use a cosmological model with a matter density $\Omega_0 = 0.3$, cosmological constant $\Omega_\Lambda = 0.7$, Hubble's constant $H_0 = 100h$ km s^{-1} Mpc^{-1} with $h = 0.7$.

3. Cluster analysis

Cluster analysis (Einasto *et al.* 1984) used here is actually the friends-of friends algorithm by which the galaxy sample can be separated into individual systems at a given neighborhood radius R. Starting from one galaxy of the sample, we search all galaxies within a sphere of radius R around it, and call these close galaxies "friends". These "friends" and the starting galaxy are considered belonging to the same system. Around new neighbors, we continue above procedure using the rule "any friend of my friend is my friend". When no more new neighbors or "friends" can be added, then the procedure stops and a system is identified. Apparently, at small radii, most systems are some isolated single galaxies, the rest being close double and multiple galaxies. At larger radii groups and clusters of galaxies and even superclusters will be formed. By selecting different neighborhood radii, we can probe the structures at different scales.

Cluster analysis is an effective method for investigating super-large-scale structures of universe. Einasto (Einasto *et al.* 1984) studied the structure of the Local Supercluster using cluster analysis. They found that clusters and strings of galaxies are main structures in the supercluster. In order to explore the existence of super-large-scale structures in the distribution of the clusters, Deng *et al.* (Deng *et al.* 1996) studied the structures in the two-dimensional distribution of Abell-ACO clusters of distance classes $D = 5$ and $D = 6$ by two-dimensional cluster analysis. It was found that there are real structures on the scale of ≥ 100 h^{-1} Mpc in the distribution of rich clusters. In the Southern Galactic subsample of $D = 5$, Deng *et al.* (Deng *et al.* 1996) discovered about 400 h^{-1}Mpc long "The Great Wall of galaxy clusters".

The mean density of galaxies is $\bar{\rho} = N/V$ (N is the number of galaxies contained in the volume V). The radius of the sphere with unit population is $R_0 = (3/4\pi\bar{\rho})^{1/3}$. In our analysis, we express all distances in dimensionless radii $r = R/R_0$. For the Main galaxy sample, R_0 is about 7.477 Mpc.

4. Basic properties of the Sloan Great Wall

Fig. 1 shows how the galaxy number of the richest system changes with increasing dimensionless radius r. For small radii, the galaxy systems by cluster analysis consist mostly of isolated galaxies, close double and multiple galaxies, few systems form cores of groups and conventional clusters of galaxies. For very big radii, systems merge into a very large, less dense region. Because we study the properties of compact super-large-scale structures, the dimensionless radius region is limited in $0.6 \leq r \leq 0.8$. At $r = 0.6$, the richest system contains only 260 galaxies. It is around redshift $z = 0.045$. At $r = 0.61$ and $r = 0.62$, a filamentary structure (a segment of the CFA Great Wall) is formed in the redshift region $0.02 \leq z \leq 0.036$. With growing dimensionless radius r the richest system forming in our Main galaxy sample becomes more and more large. When the dimensionless radius reaches 0.66, a compact super-large-scale structure is formed. It contains 4844 galaxies,

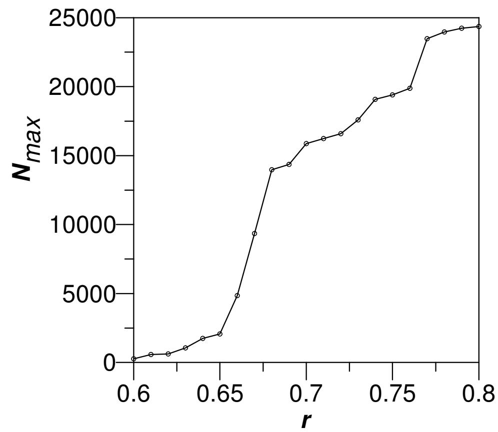


Fig. 1. Relation of the galaxy number $N_{\rm max}$ of the richest system with dimensionless radius r.

and is around redshift $z = 0.078$. When comparing it with the Sloan Great Wall separated by Deng *et al.* (Deng *et al.* 2006a) (forming at $r = 0.69$), we notice that this compact structure is one segment of the Sloan Great Wall (it stretches from 139.2° to 211.8° in right ascension) in the right ascension region $143.4° \leq RA \leq 190.7°$. At $r = 0.67$, several large-scale structures in different redshift regions merge into a unit. We further explore the clustering properties of our Main galaxy sample in the dimensionless radius region $r = 0.660 \rightarrow 0.670$, find that at $r = 0.664$ large-scale structures in different redshift regions begin to merge into a unit. So, $r = 0.663$ is defined as the upper limit of the dimensionless radius separating the Great Wall from our Main galaxy sample. At $r = 0.663$, two compact super-large-scale structures are formed around redshift $z = 0.078$. They respectively contains 4951 galaxies (from 143.4° to 190.7° in right ascension) and 3421 galaxies (from 186.3° to 211.8° in right ascension). When comparing them with the Sloan Great Wall separated by Deng *et al.* (Deng *et al.* 2006a), we find that these two compact super-large-scale structures are two segment of the Sloan Great Wall in the different right ascension region. They compose our Sloan Great Wall sample, which totally contains 8372 galaxies, located at a median redshift of $z = 0.07746$, and stretches from 143.4° to 211.8° in right ascension. Its total length is about 419 Mpc (luminosity distance), and the thickness at the median redshift approximately 55 Mpc. Fig. 2 shows the distribution of right ascension and redshift distance cz for the Sloan Great Wall.

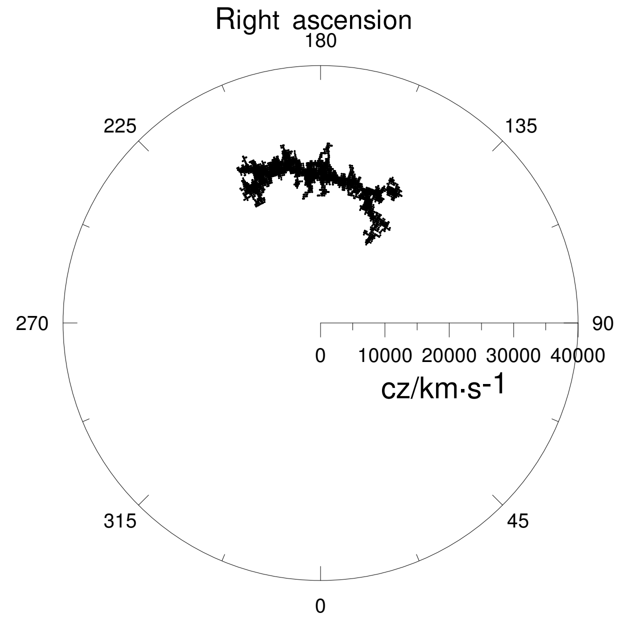


Fig. 2. The distribution of right ascension and redshift distance cz for the Sloan Great Wall.

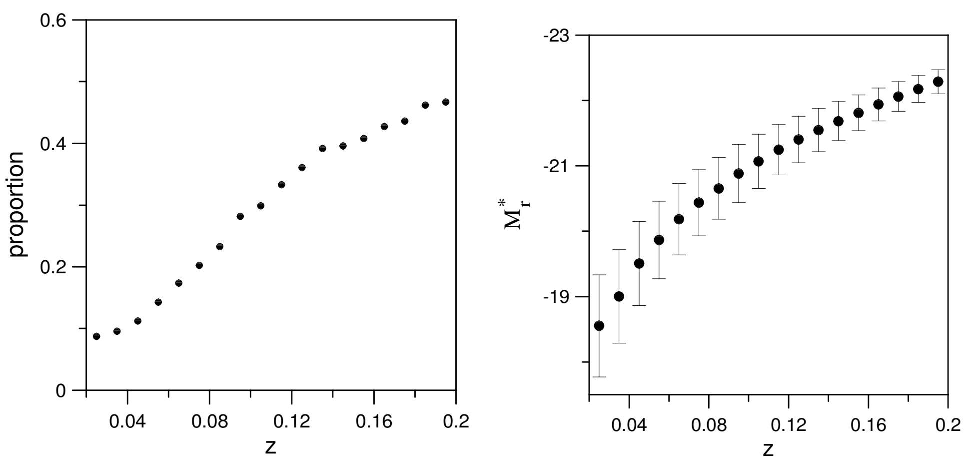
Considering that the $3D$ topology of large scale structure is sponge-like (Gott, Dickinson, Melott 1986, Vogeley *et al.* 1994, Hikage *et al.* 2002), it should not be surprising that such super-large-scale structure is observed in a relatively large galaxy sample. Simulations made by some authors (Colley *et al.* 2000, Cole *et al.* 1998) also showed that the Great Wall can be produced from random phase Gaussian fluctuations in a standard flat-ΛCDM model .

It has been known for a long time that many properties of galaxies depend strongly on luminosity *e.g.* (de Vaucouleurs 1961, Kormendy 1977, Bower *et al.* 1992, Blanton *et al.* 2003a, Shen *et al.* 2003, Baldry *et al.* 2004, Balogh *et al.* 2004, Kelm *et al.* 2005), for example, more luminous galaxies are redder. The Main galaxy sample is an apparent-magnitude limited sample, in which the number of bright galaxies increases with increasing redshift z. In such sample, the mean luminosity and many other properties of galaxies apparently change with redshift z. Figs. 3, 4 show the proportion of early-type galaxies, mean luminosity, mean size and mean $\mathrm{g} - \mathrm{r}$ color as a function of redshift z for the Main galaxy sample, respectively. We divide the whole redshift region into 18 bins of width 0.01. Error bars represent standard deviation in each redshift bin. The absolute magnitude M_{r} is calculated from the r-band apparent Petrosian magnitude, using a polynomial fit formula (Park *et al.* 2005) of the K-correction (Blanton *et al.* 2003b) within $0 < z < 0.3$:

$$K(z) = 2.3537(z - 0.1)^2 + 1.04423(z - 0.1) - 2.5\log(1 + 0.1)\,.$$

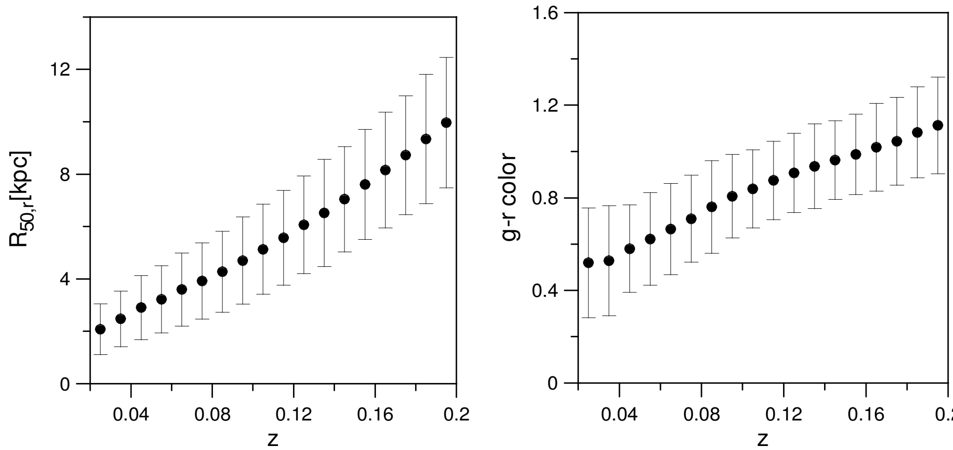
The r-band R_{50} ($R_{50,r}$) is selected as the parameter of galaxy size. In this paper, the concentration index $c_i = R_{90}/R_{50}$ is used to separate early-type (E/S0) galaxies from late-type (Sa/b/c, Irr) galaxies (Shimasaku *et al.* 2001). Using about 1500 galaxies with eye-ball classification, Nakamura *et al.* (Nakamura *et al.* 2003) confirmed that $c_i = 2.86$ separates galaxies at S0/a with a completeness of about 0.82 for both late and early types. As seen in Figs. 3, 4, on the average, with increasing redshift z the luminosities and sizes of galaxies, the proportion of early-type galaxies increase. Apparently, the difference of galaxy statistical properties between the Sloan Great Wall and the CFA Great Wall found by Deng *et al.* (Deng *et al.* 2006a) is actually due to the effect of this radial selection function.

About 85.6% galaxies of the Sloan Great Wall are in the redshift region $0.07 \le z \le 0.09$. In this redshift region, we select 50942 Main galaxies from the Main galaxy sample, and construct our SubMain sample. In order to compare basic properties of galaxies in the Sloan Great Wall with those in the SubMain sample, we divide the redshift region $0.07 \le z \le 0.09$ into 5 bins of width 0.004, and perform the comparative studies of galaxy properties between the Sloan Great Wall and the SubMain sample in different redshift bins . As seen from Figs. 5, 6, basic properties of galaxies in the Sloan Great Wall are almost the same as those in the SubMain sample.



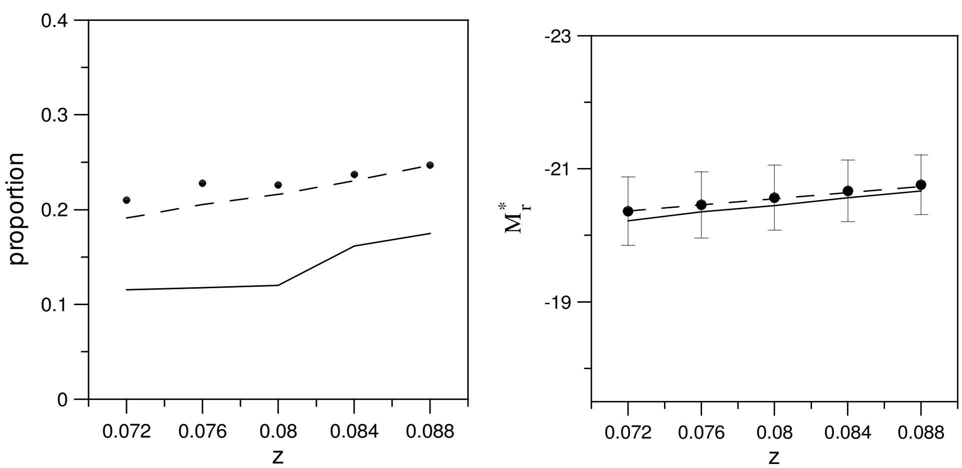
(a) (b)

Fig. 3. The proportion of early-type galaxies (a) and mean luminosity (r-band) (b) as a function of redshift z for the Main galaxy sample.



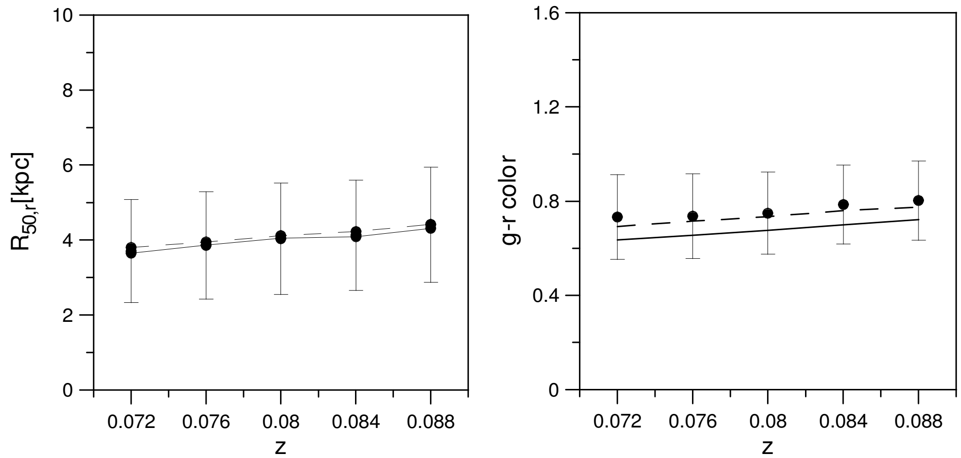
(a) (b)

Fig. 4. Mean size ($R_{50,r}$) (a) and mean g–r color (b) as a function of redshift z for the Main galaxy sample.



(a) (b)

Fig. 5. The proportion of early-type galaxies (a) and mean luminosity (r-band) (b) as a function of redshift z for the Sloan Great Wall(dot), the SubMain sample (dashed line) and isolated galaxies (solid line). Error bars represent standard deviation in each redshift bin for the Sloan Great Wall.



(a) (b)

Fig. 6. Mean size ($R_{50,r}$) (a) and mean g–r color (b) as a function of redshift z for the Sloan Great Wall (dot), the SubMain sample (dashed line) and isolated galaxies (solid line). Error bars represent standard deviation in each redshift bin for the Sloan Great Wall.

5. Comparisons between galaxy properties in the Sloan Great Wall and those of isolated galaxies

Isolated galaxies are a group of special and rare galaxies in the universe. They often are located in very low-density environments or are isolated from neighbors, and can serve as an interesting sample for studies of the effects of sparse environment on galaxy properties (Adams, Jensen, Stocke 1980, Haynes, Giovanelli 1980, Haynes, Giovanelli, Chincarini 1984, Koopmann, Kenney 1998). The Sloan Great Wall represents most compact and largest galaxy system in the universe. In this paper, we will compare statistical properties of galaxies in the Sloan Great Wall with those of isolated galaxies in different redshift bins. Undoubtedly, this research is beneficial to understanding of influence of environment on galaxy properties.

We use three-dimensional cluster analysis (Einasto *et al.* 1984) and extract isolated Main galaxies from the SubMain sample. By cluster analysis, the sample can be separated into isolated galaxies, close double and multiple galaxies, galaxy groups or clusters. At larger radii, most galaxies of the sample form groups or clusters, few galaxies are isolated. These isolated galaxies should be a good sample for studies of three-dimensional isolated galaxies. According to analyses of Deng *et al.* (Deng *et al.* 2006b), isolated galaxies identified at dimensionless radius $r \geq 1.2$ can be defined as genuinely isolated in three-dimensional space. In this paper, we extract 2013 isolated galaxies at dimensionless radius $r = 1.4$ (R_0 for the SubMain sample is 4.43 Mpc) from the SubMain sample.

Many previous works showed galaxies in dense environments (*i.e.*, clusters or groups) have high proportion of early type morphologies *e.g.*, (Oemler 1974; Dressler 1980; Whitmore, Gilmore, Jones 1993; Deng et al. 2006c), while galaxies in the lowest density regions (isolated galaxies) have lower proportion of early-type galaxies *e.g.*, (Deng *et al.* 2006b). In Fig. 5(a), we again notice this kind of difference between galaxies in dense environments and isolated galaxies. In the Sloan Great Wall, the proportion of early-type galaxies is about 22.17%, and approximates to that (21.83%) of the SubMain sample, while the proportion of early-type isolated galaxies is only 14.46%. These results further show that the morphological type of galaxies is closely correlated with the environment.

The clustering of bright and faint galaxies is different (Davis *et al.* 1988, Hamilton 1988, Park *et al.* 1994, Loveday *et al.* 1995, Norberg *et al.* 2001, Zehavi *et al.* 2002, Blanton *et al.* 2003a). Park *et al.* (Park *et al.* 2005) conclusions showed that bright galaxies exist preferentially in the densest regions of the universe. If structure in the Universe grows due to the subsequent mergers of dark matter halos, and massive galaxies are the result of merging of smaller ones, then high density of galaxies seems helpful to produce a bright galaxy. In Fig. 5(b), we compare mean luminosity of galaxies in the Sloan Great Wall with that of isolated galaxies in different redshift bins, but do not observe significant difference between them. This shows that the luminosity of galaxies is not closely correlated with the environment. Similar conclusion was ever obtained by Deng *et al.* (Deng *et al.* 2006c). They compared statistical properties of galaxy luminosity in the compact galaxy group sample with those in random group sample and found that the two samples have the same statistical properties of luminosity. These results are not apparently consistent with previous conclusions.

As seen in Fig. 3 and 4, basic properties of galaxies apparently change with redshift z in an apparent-magnitude limited sample. In such a sample, faint galaxies are mainly located in low redshift region, while bright galaxies are predominantly located in high redshift region. Thus, when we explore the difference of clustering of bright and faint galaxies, it is not easy to determine whether it is due to different redshift region of bright and faint galaxies or luminosity difference. In this paper, we perform comparative study of galaxy properties in the same redshift bins between galaxies located in different environments. In principle, our method may be more reasonable.

In Fig. 5(a), we note that the early-type galaxy proportion of the Sloan Great Wall and isolated galaxies only covers the range 0.1–0.25. In really dense enviroment of compact galaxy clusters it can reaches 0.7 for E+S0.

This may mean that the two samples are not different enough to show a strong dependence of galaxy properties on enviroment.

Fig. 6(a) shows that there is also no significant difference of mean size between member galaxies of the Sloan Great Wall and isolated galaxies. As is well-known, the galaxy sizes are correlated with luminosity (Kormendy 1977, Shen *et al.* 2003). Shen *et al.* (Shen *et al.* 2003) showed that the dependence of galaxy sizes $R_{50,r}$ on the luminosity is quite different for early- and late-type galaxies, $R_{50,r} \propto L^{0.6}$ for early-type galaxies ($c_i > 2.86$); for late-type galaxies ($c_i < 2.86$), $R_{50,r} \propto L^{0.21}$ at the faint end ($L \ll L_0$, L_0 is the luminosity corresponding to $M_0 = -20.52$), and $R_{50,r} \propto L^{0.53}$ at the bright end ($L \gg L_0$). Fig. 5(b) shows that galaxy luminosity has almost no correlation with environment. Thus, we can explain above results naturally.

Galaxy colors are an important quantity that characterizes stellar contents of galaxies. Some studies showed that clustering of galaxies depends on color (Brown *et al.* 2000, Zehavi *et al.* 2002, Blanton *et al.* 2003a). Brown *et al.* (Brown *et al.* 2000) explored the dependence of clustering properties of galaxies on color, and found that the galaxy correlation function is strongly dependent on color, with red galaxies more strongly clustered than blue galaxies by a factor of ≥ 5 at small scales. In Fig. 6(b), we compare mean $\mathrm{g} - \mathrm{r}$ color of galaxies in the Sloan Great Wall with that of isolated galaxies in different redshift bins, and find that the $\mathrm{g} - \mathrm{r}$ color of member galaxies of the Sloan Great Wall is redder than that of isolated galaxies on the average. This further confirms that clustering properties of galaxies depend on color.

6. Summary

The Sloan Great Wall is the largest galaxy system observed to date. Using the MAIN galaxy data from the SDSS Data Release 4 (SDSS4), we further study the Sloan Great Wall by three-dimensional cluster analysis. Because the basic properties of Main galaxies change with redshift (on the average, with growing redshift z the luminosities and sizes of galaxies, the proportion of early-type galaxies increase), we select 50942 Main galaxies having the same redshift region ($0.07 \leq z \leq 0.09$) as the Sloan Great Wall from the Main galaxy sample, and construct our SubMain sample. From the SubMain sample, 2013 isolated galaxies are identified at dimensionless radius $r = 1.4$. The comparative studies of galaxy properties among the Sloan Great Wall, isolated galaxies and the SubMain sample in different redshift bins are performed. The main conclusions can be summarized as follows:

- The statistical properties of luminosities and sizes of galaxies for the Sloan Great Wall, isolated galaxies and the SubMain sample are almost the same. These properties of galaxies may have no correlation with the environment or clustering.

- In the Sloan Great Wall, the proportion of early-type galaxies is about 22.17%, and approximates to that (21.83%) of the SubMain sample, while the proportion of early-type isolated galaxies is only 14.46%. In different redshift bins, the early-type proportion of member galaxies of the Sloan Great Wall is apparently higher than that of isolated galaxies. This indicates that the morphological type of galaxies is closely correlated with the environment.

- The g–r color of member galaxies of the Sloan Great Wall is redder than that of isolated galaxies on the average. This further confirms that clustering properties of galaxies depend on color.

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