LARGE-SCALE DISTRIBUTION OF GALAXIES WITH DIFFERENT LUMINOSITIES

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Analyses for complete samples of galaxies and clusters of galaxies showed that the two-point correlation function of galaxy-galaxy and cluster-cluster have form of power law with power indices about -1.8 (Peebles, 1980; Bahcall and Soneira, 1983). Because the completeness of a sample means that we have observed completely the objects brighter than a given apparent magnitude in certain sky region. But, we know that a complete sample will be lack of faint objects at distant region. If we attempt to avoid the influences of any non-intrinsic properties on the analysis, we have to use the samples which are complete in certain interval of absolute magnitude.

In this work, we present a tentative analysis based on the data given by CfA survey (Huchra, et al., 1982). To determine the absolute magnitude of galaxies we must know their distances from us. If we adopt the observed redshifts as the indicator of distances, the peculiar motion of galaxies will distort the positions along the line of sight and may influence the reliability of the analysis results. So, we have to investigate if the influence of the peculiar motion of galaxies is severe for the analysis. Geller and Huchra (Geller and Huchra, 1983) have presented a catalog of galaxy groups included in the CfA survey with average velocity and the dispersion of velocity σ for each group. We can use the dispersion of velocity to estimate the peculiar motions of galaxies. Because the peculiar motion will produce larger effect for nearer galaxies, we would limit our sample to consist of galaxies with observed redshift larger than 1000 km/s. Under this restriction, there is no group with value of $\sigma/\bar{v}$ larger than 25%, and more than 71% groups with values of $\sigma/\bar{v}$ less than 10%. It means that if we take the redshift as the indicator of galaxy distances for the restricted sample, the error caused by the peculiar motion will not be fatal to our analysis.

According to the method given by Geller and Huchra, we have corrected the velocity of each galaxy for a dipole Virgo-centric flow, then use the finally obtained redshift value to calculate the distance of

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every galaxy. Because faint galaxies can only be observed within a small redshift and the very bright galaxies are too few to give a significant statistical analysis, we restrict our sample to galaxies with absolute magnitude M between -19.0 and -22.0. We divide the sample into three subsamples A, B, and C with different luminosities. There are 392, 533, and 387 galaxies within the absolute magnitude ranges -19.0- -20.0, -20.0- -21.0, and -21.0- -22.0 in samples A, B, and C, respectively.

We have calculated the two-point correlation functions for each subsample and compared them with the average two-point correlation function of Monte Carlo samplings in the same regions with the same numbers of objects as those of the subsamples. If the difference between the two-point correlation functions of our subsamples and the corresponding average correlation functions of Monte Carlo samplings is larger than 3σ, we say that our sample is significantly clustering (or anti-clustering) on the corresponding scales.

In the figures, we give the two-point correlation functions of samples A, B, and C (solid lines), respectively. We can see from these figures that at small scales the faint and bright galaxies are all clustering, but at larger scales they approach to random distribution. The regression analysis of the two-point correlation function of each group in the significantly clustering range of scales gives

$$\xi(r) = 55.76\ r^{-1.54}, \qquad \text{for group A,}$$

$$\xi(r) = 30.39\ r^{-1.06}, \qquad \text{for group B,}$$

$$\xi(r) = 41.47\ r^{-0.87}, \qquad \text{for group C.}$$

The correlation coefficients are 0.98, 0.95, and 0.85, respectively. It shows that the power indices decrease monotonously as the luminosity of galaxies decreasing. The clustering scales of these three sub-samples are about 10 Mpc, 19 Mpc, and 30 Mpc, respectively.

From the analyses given above, we may draw following conclusions:

1. The galaxies with different luminosity may have quite different characters in their large-scale distribution. It seems that the fainter galaxies are clustering in smaller scale but the brighter galaxies are clustering in larger scale.

2. The systematic change of the power indices in the two-point correlation functions and in the clustering scales might indicate that the large-scale distribution of luminous matter in the universe may depend on the luminosity of galaxies. In order to know the real distribution of whole luminous matter we must determine the large-scale distribution of galaxies with various luminosities.

3. The regularities appeared in the results of analyses seem to show that they could not be caused by the approximation of neglecting the peculiar motions, because the peculiar motion does not like to be possible to give a systematic change as the luminosity changing.

4. CfA survey is not deep enough to give a sample for making analyses in a large enough region with faint enough galaxies. So that, the conclusions we obtained may still be influenced by the local conditions and the peculiar motions of galaxies. If one could get data from survey

which is complete to $15^{m}.5 - 16^{m}.0$, more dicisive conclusions can be obtained.

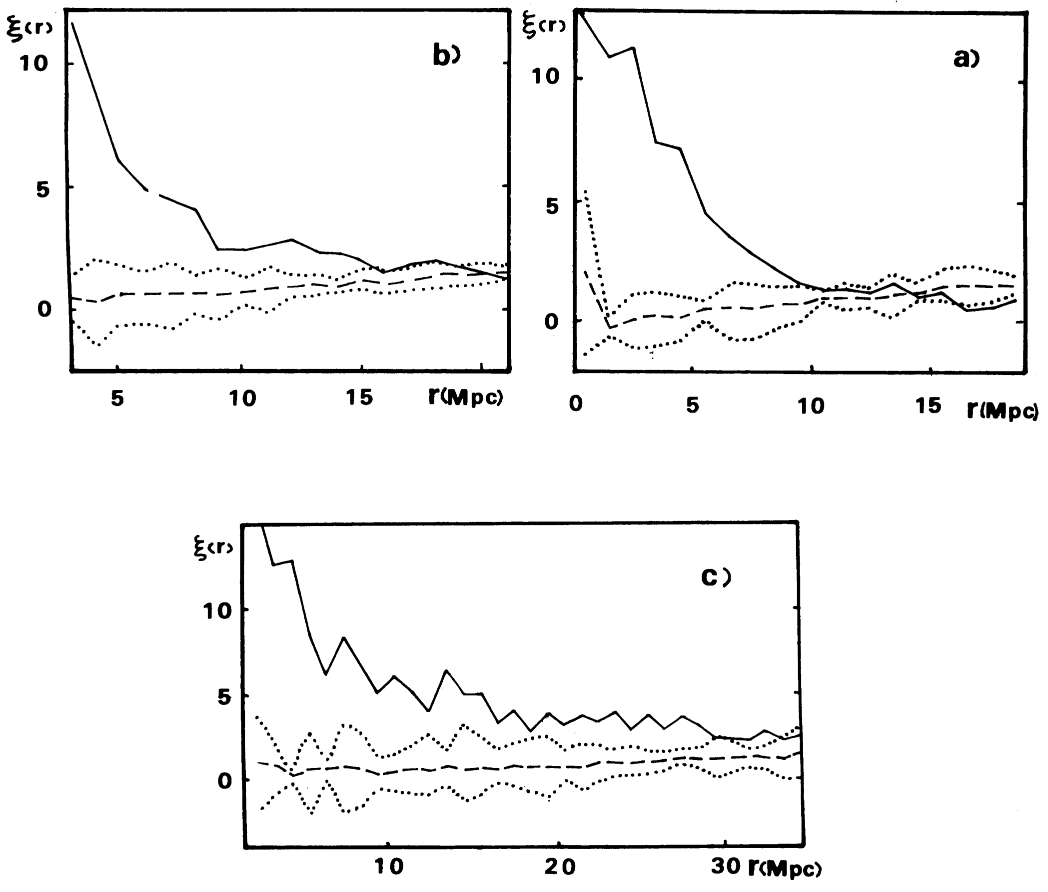

Figure. The two-point correlation functions for subsamples A (fig.a), B (fig.b), and C (fig.c). The dashed lines are the average two-point correlation function given by Monte Carlo samplings, and the dotted lines are the $\pm 3\sigma$ lines.

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DISCUSSION

CHINCARINI: Did you determine the percent of morphological type for each luminosity bin you used?

XIA: There are about 24% elliptical and lenticular galaxies, 66.6% spiral galaxies and 9.3% irregular galaxies in group A. In groups B and C, the percentage of different morphological galaxies are respectively 26.5%, 68.9%, 4.6%, and 25.2%, 66.9%, 7.9%.

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