Monthly Notices
of the
ROYAL ASTRONOMICAL SOCIETY

Mon. Not. R. Astron. Soc. **416,** 2027–2040 (2011) doi:10.1111/j.1365-2966.2011.19178.x

Studying the dynamical properties of 20 nearby galaxy clusters

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Accepted 2011 June 2. Received 2011 June 1; in original form 2010 October 17

ABSTRACT

Using SDSS-DR7, we construct a sample of 42 382 galaxies with redshifts in the region of 20 galaxy clusters. Using two successive iterative methods, the adaptive kernel method and the spherical infall model, we obtained 3396 galaxies as members belonging to the studied sample. The 2D projected map for the distribution of the clusters members is introduced using the 2D adaptive kernel method to determine the cluster centres. The cumulative surface number density profile for each cluster is fitted well with the generalized King model. The core radii of the cluster samples are found to vary from 0.18 Mpc h^{-1} (A1459) to 0.47 Mpc h^{-1} (A2670) with a mean value of 0.295 Mpc h^{-1}.

The infall velocity profile is determined using two different models: Yahil approximation and Praton model. Yahil approximation is matched with the distribution of galaxies only on the outskirts (infall regions) of many clusters of the sample, while it is not matched with the distribution within the inner core of the clusters. Both Yahil approximation and Praton model are matched together in the infall region for about nine clusters in the sample but they are completely unmatched for the clusters characterized by a high central density. For these clusters, Yahil approximation is not matched with the distribution of galaxies, while Praton model can describe well the infall pattern of such clusters.

The integrated velocity dispersion profile shows that there are different behaviours within the cluster's virialized region, while it exhibits a flattened-out behaviour outside the virialized region up to the turnaround radius. Under the assumption that the mass follows galaxy distribution, we determine the mass and mass profile by two independent mass estimators; projected mass and virial mass methods. The virial mass profile is corrected by applying the surface pressure term which reduces the virial mass by about 14 per cent. The projected mass profile is larger than the corrected virial mass profile for nearly all clusters by about 28 per cent. The virial mass agrees with the NFW mass and Praton mass at $r_{\rm v}$. The virial mass profile within 1.5 Mpc h^{-1} is fitted with the NFW mass profile. The concentration parameter ranges from 1.3 to 39.17, and has a mean value of 12.98.

Key words: galaxies: clusters: general.

1 INTRODUCTION

Acquiring a knowledge of the physics of the beginning, evolution and fate of our Universe requires understanding the distribution, formation, dynamics and evolution of matter on a large scale. Galaxy clusters, which are the most massive gravitationally bound galaxy systems, play an important role in the study of large-scale structure formation (Fadda et al. 1996; Girardi et al. 1998), as well as in understanding the physics of the Universe as a whole.

Studying the properties of galaxy clusters based on old catalogues is affected by the projection effect. New and deep redshift surveys (e.g. Sloan Digital Sky Survey, hereafter SDSS) for galaxies on a nearly whole sky help us to overcome this problem. However, the redshift information is distorted by some factors, e.g. small-scale structure, large-scale structure and observational errors. This distortion leads to difficulties in determining the real cluster members which is the most important factor to study the dynamics of galaxy clusters. There are many methods used to determine cluster members. Some of them are based on statistical rules and others are based on the dynamical status of the system. Enhanced methods were introduced in the last two decades to determine the clusters'

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