Properties of The Brightest Cluster Galaxy and Its Host Cluster

H.Katayama,K.Hayashida and F.Takahara (*Department of Earth and Space Science, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan*)

Abstract

We investigate the relation between the brightest cluster galaxy (BCG) and its host cluster. A BCG is a bright and massive elliptical galaxy in a cluster of galaxies. The luminosity of a BCG is 10 times larger than that of normal field galaxy and the mass of a BCG is about $10^{13}M_{\odot}$ which corresponds to that of galaxy group.

In order to explain the origin of BCGs, the following three models are proposed: (1) star formation from cooling flow. In this model, intracluster gas gradually condenses at the center of the cluster and forms the BCG. (2) "Galactic cannibalism" or the accretion of smaller galaxies. In this model, dynamical friction accounts for the formation of the BCG. These two models predict the BCG evolves with the evolution of cluster. (3) Galaxy merging in the early history of the formation of the cluster. In this model, the property of BCGs is determined no later than cluster collapse. In any model, the formation of BCGs is related to the collapse and formation of its host cluster.

The relation between the BCG and its host cluster was studied by Edge (1991). Edge (1991) found that the optical luminosity of the BCG is positively correlated with the X-ray luminosity and temperature of its host cluster. Edge (1991) concludes that these correlations indicate that the BCG responds to the overall cluster properties.

In order to investigate the other relation between the BCG and its host cluster, we analyzed ROSAT archival data and compared the displacement between the X-ray peak and the BCG with the Z parameter of the fundamental relation found by Fujita and Takahara (1999). It is found that the displacement is larger with decreasing Z. Furthermore, the large Z clusters tend to have a regular X-ray profile, which implies a relaxed system.

The fundamental parameter Z depends mainly on the virial density ρ_{vir}, and is considered to be related to the formation epoch of the cluster, i.e., large Z clusters are old clusters and small Z clusters are young clusters. Therefore, this result implies that the displacement of BCGs correlates with the dynamical equilibrium state and the BCG falls into the center of cluster with the evolution of its host cluster.

We also investigate the relation between the absolute magnitude of the BCG and the fundamental parameter Z. In contrast to the negative correlation with the displacement, the absolute magnitude of the BCG is not correlated with the fundamental parameter Z. This result suggests that the evolution of the BCG is not correlated with the evolution of its host cluster. This is also negative evidence for the cooling flow and galactic cannibalism models that attempt to account for the origin of the BCG, since these models expect that the BCG evolves with the evolution of its host cluster. Therefore, our result supports the model that the BCGs have an earlier origin than their host cluster.

CATEGORY: CLUSTERS OF GALAXIES