Temperature Map of Clusters in Core Region of Shapley Supercluster

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Abstract. Since a spatial distribution of gas temperature in each member cluster provides us informations of interactions, it is useful for understanding their dynamics. Though two poor clusters show isotropic temperature maps, the maps of three Abell clusters are asymmetric. It seems to be due to a cluster-cluster merging or a group infalling.

The study of member clusters in the dense region is important to understand cluster evolution. Obtained characteristic of each member is similar to those of non-member clusters. It means that the members are growing in the same way as non-member clusters.

1. Introduction

Shapley Supercluster appears to be a high-concentration region involving 25 Abell clusters within a radius of 50 h_{50}^{-1} Mpc. The core region is defined to be a region ranging east and west over 15 Mpc, which involves three Abell clusters and two poor clusters. We present results of $\sim$300 ksec *ASCA* eight pointing observations of the core region (fig 1). A3558 is the brightest member of them and has a distribution of galaxy number density elongating northwest and southeast. Many groups and clusters of galaxies are aligned along this major axis of A3558. In this core region, the infall of matters along this axis seems to be dominant. From these characteristics and results of *ASCA* observation of A3558 (125 ksec, 3×10^5 cts), we discuss the dynamical structure of A3558.
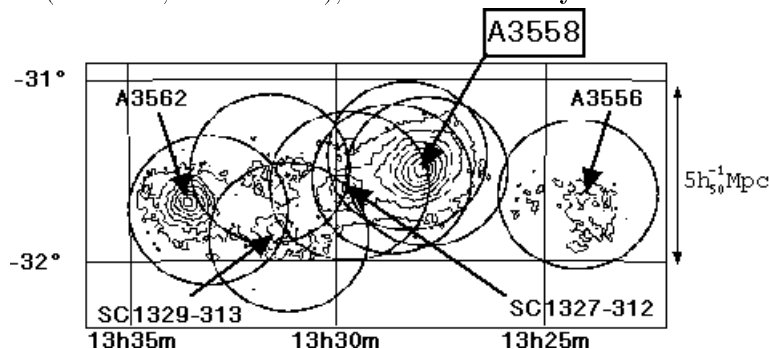

Figure 1.   *ASCA* image contour. Circles show GIS regions.

2.   Results of *ASCA* Data Analysis

Obtained image of the core region is shown in fig 1. Three Abell clusters show asymmetric temperature maps and two poor clusters show isotropic ones. From spectra of each member, total mass of core region is $\sim 2\times 10^{15}$ $M_\odot$ and gas mass is $\sim 2\times 10^{14}$ $M_\odot$. The mean gravitational density is 25 ρ_c (ρ_c; critical density). As parameter relations of member clusters are consistent with those of nearby clusters, they seem to be not peculiar clusters.

X-ray image of A3558 shows an elongation. By subtracting an elliptical β model (Bardelli et al. 1996), we obtained a residual image. Excesses are seen at the center and southeast, and a depression is at northwest. The central excess dominating $\sim 9\%$ is due to a central galaxy. Moreover this residual shows an asymmetric structure to the spheroidal major axis. We estimate temperature from hardness ratio with *SimASCA*, assuming spherical symmetry. Obtained temperature map (fig 2) of A3558 has the gradient along the major axis, and temperature ranges from 5.0 keV to 6.5 keV. Abundance map (fig 2) is also obtained from intensity ratio map of iron line and continuum with isothermal distribution. Non-isothermality obtained above causes the uncertainty on abundance of $\sim 10\%$. Peculiar regions ($r<4'=320$ kpc), P1$\sim$3, are shown by circles in fig 2. They are a hot-depression region, a excess region and a metal rich region, respectively. Spectra reveal that P1 is a significantly hot region and P3 is a significantly high abundance region. As the redshift of iron line energy of P3 coincides with mean value of A3558, high abundance of P3 is thought to be originated from A3558. Iron mass in the P3 region is estimated to be $6\times 10^{8}M_\odot$.
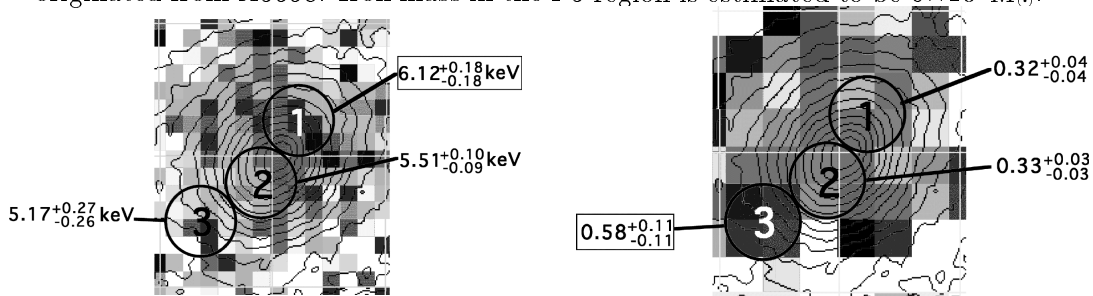

Figure 2.   Temperature map (left panel) and abundance map (right panel). Contours show *ASCA* GIS X-ray images. Parameters of circled regions are estimated from spectral fittings. The radius of circles is $4'$.

3.   Discussion and Conclusions

The mean density of core region, 25 ρ_c indicates that Shapley core is not virialized yet but collapsing to form virialized halo. Even in the highest number density of clusters, interactions of clusters are week. X-ray image of A3558 elongates northwest-southeast and is slightly asymmetric to the axis. There are temperature gradient along the axis, but no extremely hot or cool regions. These are thought to be arisen by a head-on merging of clusters before 3 Gyr, and/or an off-set merging. One possibility of high abundance region is a remnant of merged cluster core. However it may be difficult that the core is not destroyed. Another is due to AGNs. But no significant sign of AGNs is seen. The other is a likely metal rich group of galaxies. This group should have a typical group size and show no strong interaction with A3558.

References

Bardelli, S., Zucca, E., Malizia, A., Zamorani, G., Scaramella, R. , Vettolani, G. 1996, A&A, 305, 435