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ORIGINAL ARTICLE

Spatial orientation of angular momentum vector of galaxies in three merging binary clusters

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Abstract We present spatial orientations of angular momentum vectors of galaxies in three merging binary clusters A1750, A3395 and A3528. The axial ratio and intrinsic flatness of galaxy are used to convert two-dimensional given parameters into three-dimensional angular momentum vector of the galaxy. We have performed K-S, Kuiper and Fourier tests in order to examine non-random effects. The merging binary cluster A3395 that exhibits strongly distorted feature in its maps of temperature and surface brightness showed a random orientation in the spatial orientation of angular momentum vectors of galaxies. A weak anisotropic distribution in the angular momentum vectors of galaxies is noticed in the sub-structures of A3528. We suspect a relation between the stages of merging and the non-random alignments of galaxies in the sub-structures of the binary clusters. Possible explanation of the results will be discussed.

Keywords Galaxies: formation · Galaxies: statistics · Galaxies: clusters: general · Astronomical databases: miscellaneous

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1 Introduction

The clusters which show two clearly separated peaks of X-ray emission are known as merging binary clusters. These clusters show bimodal feature and asymmetric morphology. Optical and X-ray studies (e.g., Geller and Beers 1982; Slezak et al. 1994; Mohr et al. 1995) have shown that galaxy clusters are dynamically evolving systems, exhibiting a variety of substructure and asymmetric morphologies.

The merging binary clusters A3528, A3395 and A1750 were observed using both ROSAT and ASCA (Donnelly et al. 2001). Using the broad energy response of ASCA (0.5–10.0 keV), gas temperatures in these clusters were studied. The spatial resolution of ROSAT was used to determine the cluster surface brightness distribution. Donnelly et al. (2001) compiled a list of radial velocities of the galaxies and analyzed the mean velocities and dispersions in the clusters. These results are used to estimate the virial masses of the merging subclusters as well as a comparison to the X-ray results.

In order to understand the evolution of galaxies in the cluster it is essential to know when and how they have formed and how their structures/substructures and constituents have been changing with time. In this work, we study spatial orientation of angular momentum vectors of galaxies in merging binary clusters. Our aim is to examine non-random effects in the galaxy alignments, in the framework of three different scenarios: 'pancake model (Doroshkevich 1973; Shandarin 1974),' the 'hierarchy model (Peebles 1969)' and the 'primordial vorticity theory (Ozernoy 1978)'. In order to study the angular momentum of galaxies, the sample should be restricted to rotationally supported galaxies. Spirals and barred spirals are rotationally supported system (Kashlinsky 1982; Fall 1982) whereas ellipticals are known to be supported by