JOURNAL OF THE KOREAN ASTRONOMICAL SOCIETY
29: S53 ~ S54, 1996

COMMON FEATURES OF SPATIAL ORIENTATION OF DISK GALAXIES IN THE COMA AND VIRGO CLUSTER

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ABSTRACT

Based on the database of 128 disk galaxies (66 S0, 62 S and Irr) mailnly compiled from Kent and Gunn (1982) and Doi et al.(1995) which is complete down to $m < 15.6$ mag within a radius of 3 °, the orientation of spin vectors of disk galaxies of the Coma cluster has been analyzed. The results confirm the morphological dependence of the orientation of disk galaxies found from the analsis of the Virgo cluster. Common features of orientation of disk galaxies of both clusters are outlined.

I. INTRODUCTION

The study of orientation of spin vectors of galaxies (SVs hereafter) is a key tool to probe directly the epoch of origin and formatiom of galaxies and clusters and the large scale structure of the universe. In a study on the orientation of SVs of disk galaxies of the Virgo cluster, we have probably detected morphological dependence of SV orientation (Hu et al. 1995), e.g. there are two distinct excesses of the SV orientation of disk galaxies in the Virgo cluster in the directions perpendicular and parallel to the Local Supercluster plane with respect to the expected radom distribution for the spirals. However, only one excess in the direction parallel to the plane, and no excess in the perpendicular direction, is found for the lenticulars. Lacking of disk galaxies near the direction perpendicular to the center of the Virgo cluster on the histograms of azimuthal distribution hint orientation of SV of disk galaxies tend to point towards the cluster center. An appealing question is what about other clusters? In this paper we turn to the Coma cluster.

II. ANALYSES OF DISK GALAXIES IN THE COMA CLUSTER

We compiled a database of 128 disk galaxies(66 lenticulars, and 62 spirals and irregulars) of the Coma cluster which is complete to $m < 15.6$ within a radius of 3 ° from the cluster center. The member galaxies are judged by their radial velocities (from 4500 to 9900 kms^{-1}) and positions. Following the same method used in Hu et al.(1995), We study the orientation of SVs of disk galaxies in the Coma cluster in the supergalactic coordinate system where SGX and SGY axes are in the Local Supercluster plane, and SGZ is the direction of the supergalactic north pole. The basic great circle 'meridian' is set to pass through the Coma center. The polar coordinates of the Coma cluster center in this supergalactic system are SGL=0 ° , SGB=6.5 ° . The Coma cluster appears as an elliptic shape in the sky, the position angle of its major axis within a radius 3 ° from the center is 70 ° . In this case the SGX-SGY plane is roughly perpendicular to the major axis of the cluster. Gregory and Tifft(1976) detected a rotation around the cluster's major axis. If there is a plan parallel to SGX-SGY plane and passing through the center of the Coma cluster, it will be roughly perpendicular to the major axis of the cluster which we tentatively regarded as the cluster plane, and in fact the orientation effect is discussed with respect to. Based on PA and axial ratio of each galaxies measured by Doi et al.(1995), and assuming the intrinsic flatness of disk galaxies is 0.2, we calculated the polar angles θ and azimuthal angles ϕ of orientation of SV of each galaxy in this supergalactic coordinate system. θ is the an-

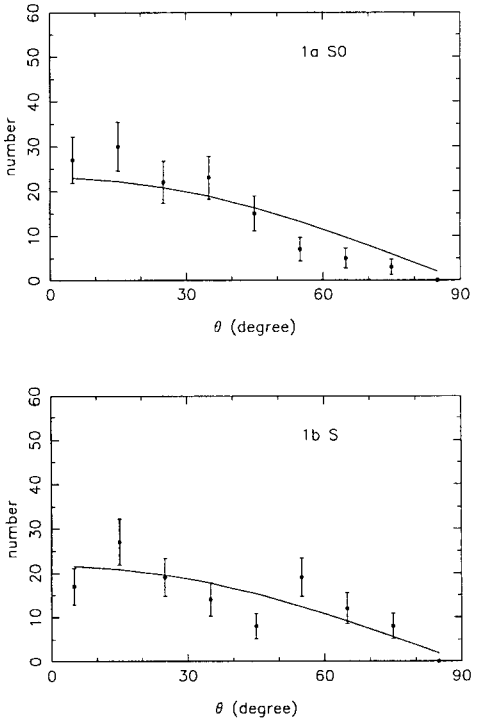

Fig. 1.— Histograms of the θ distributions for the lenticulars (a), and the spirals and irregulars (b).

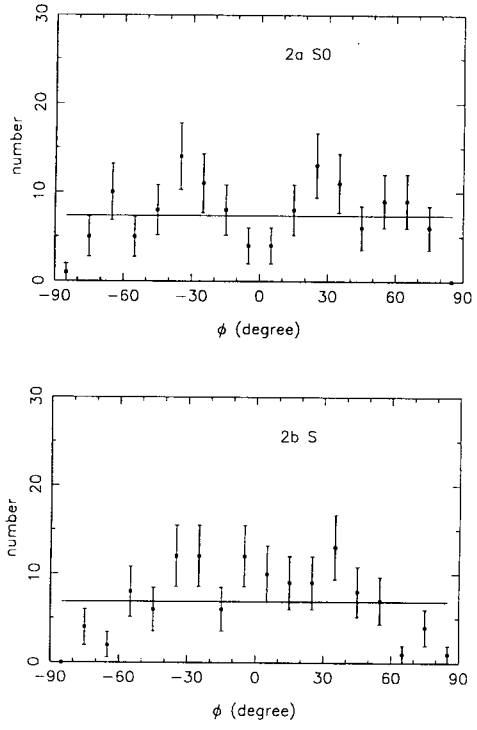

Fig. 2.— Histograms of the ϕ distributions for the lenticulars (a), and the spirals and irregulars (b).

gle between the orientation of SV and the SGX-SGY plane, and ϕ is the angle between the projection on the plane of SV and the SGX-axis, respectively. Fig.1 and 2 show the histograms of θ and ϕ distributions for subsets of the lenticulars(a), the spirals and irregulars(b) of our sample. The solid lines represent the expected isotropic distributions, the dots with $\pm\sigma$ bars represent the observational results.

Some interesting features common to those of the Virgo cluster(refer to Hu et al., 1995) in Fig. 1 and 2 are summarized as follows: (1) both two distinct humps at low($\sim$ 10 - 20 °) and high($\sim$ 50 - 60 °) θ, indicating excesses of the orientation of SVs of disk galaxies in the directions perpendicular and parallel to the cluster plane with respect to the expected random distribution, are found for the spirals. However, only one hump at low θ and no high θ hump, i.e. only one excess in the parallel direction and no excess in the perpendicular direction, is found for the lenticulars of the Coma cluster; (2) The deep dips (about 3 - 6 σ) near $\phi = \pm 90$, the direction perpendicular to the center of the cluster, are found for both the lenticulars and the spirals, which hints the projections on the cluster plane of SVs of disk galaxies tend to point towards the center of the Coma cluster (see also Kashikawa and Okamura,1992).

III. CONCLUSIONS

The new results derived from the Coma cluster, a regular cluster, confirms the morphological dependence of the orientation of spin vectors of disk galaxies found from the analysis of the Virgo cluster which is an irregular cluster (Hu et al. 1995). Common features of these two clusters which belong in two extreme morphological classifications might reveal universality of these features. Therefore the theories of formation and evolution of clusters of galaxies will be under greater challenge.

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