MORPHOLOGICAL TYPES OF 254 RICH PF GALAXY CLUSTERS

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ABSTRACT. We determined the morphological types for 254 rich galaxy clusters from the PF Catalogue of Galaxy Clusters and Groups. The data set contains the PF galaxy clusters, which have no ACO coinciding ones. The applied morphological scheme was combined of the prevalent classifications, such as Bautz-Morgan, Rood-Sastry etc approaches. We assigned the morphological types using numerical criteria and taking into consideration concentration to the cluster center, the signs of preferential direction or plane in the cluster, and the positions of the brightest galaxies. The features of the data set are discussed.

Key words: Galaxies: clusters: morphological types.

1. Introduction

The morphological types of galaxy clusters resulting from their outward appearance are physically related to the clusters and their member galaxies. It was reflected in different morphological schemes beginning from Abell (1958) and Zwicky et al.(1961-1968) papers. The classification characteristics took into consideration several different parameters: cluster richness (number of galaxies within a specific limiting magnitude), the central concentration, the presence of bright galaxies in the center of the cluster, the presence of peculiar galaxies, etc. The prevalent Bautz-Morgan (BM) classification scheme (Bautz & Morgan, 1970) is based on the relative contrast (dominance in extent and brightness) of the brightest galaxy to other galaxies in the cluster, ranging from type I to III in decreasing order of dominance. The Rood-Sastry (RS) system (1971) classifies clusters based on the geometry of the distribution of the ten brightest members (from cD, to binary B, core C, line L,flat F, and irregular I). The Rood-Sastry and Bautz-Morgan schemes are in agreement and complement each other. López-Cruz at al. (1997) and López-Cruz & Gaztanaga (2001) introduced the definition of a cD cluster, the complement to this class is called a non-cD cluster.

Panko (2013) proposed the morphological scheme accordingly to features of "The Catalogue of Galaxy Clusters and Groups" (Panko & Flin, 2006, hereafter PF). The morphological scheme combines the prevalent BM and RS approaches. The new scheme bases on the numerical criteria and takes into consideration both concentration to the cluster center and the signs of the presence of preferential direction or plane (hereafter flatness). Addition parameter – the role of Bright Cluster Members or cD galaxy presence was included to scheme too. The new morphological scheme was tested in the region $11^\circ \times 16^\circ$ centered to supercluster SCL 184 (Einasto et al., 1997) and contained 175 PF galaxy clusters with different richness (Panko, 2013).

2. Rich PF galaxy clusters and their morphology

The PF Catalogue was constructed on Münster Red Sky Survey Galaxy Catalogue (Ungrue et al., 2003, hereafter MRSS) as the observational basis. MRSS galaxies have no redshifts, unfortunately. Nevertheless, the list of clusters with all MRSS galaxies in the each cluster field allows to study the large-scale structures properties by statistical methods. From comparison positions of PF and ACO clusters (Abell, Corwin, Olowin, 1989) for 1056 PF objects with different richness BM morphological types were assumed. But only 247 such clusters are rich and have number of galaxies in its field ($N_g \geq 100$).

Panko et al. (in preparation) determined the the morphological types according Panko (2013) criteria for the 247 rich PF galaxy clusters having assumed BM types. The map of galaxy positions in rectangular coordinates was constructed for each cluster. The new types were assigned corresponding to concentration (C - compact, I - intermediate, and O - open), flatness (L - line, F - flat, and no symbol if no indication of flatness is present), and the role of bright galaxies (cD or BG if the BCM role is significant). Other peculiarities were noted as P. The designations can be combined, for example CFcD or ILP. From analysis of the each

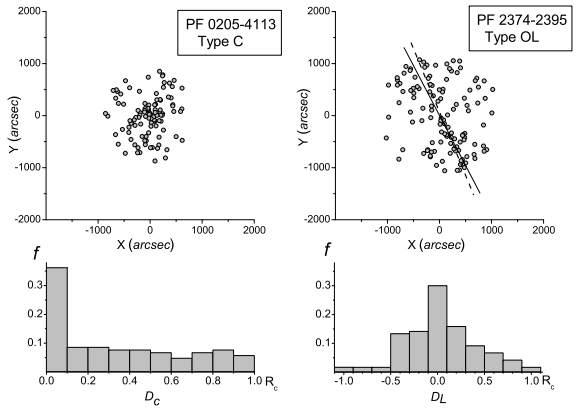

Figure 1: Galaxy clusters C and OL type and distribution of distance from cluster center D_c and from preferential line D_L of galaxies in the clusters (dashed line). The direction of the major axis od the PF 2374-2395 best-fitted ellipse is shown as solid line.

type frequencies it was shown:

– the sign of the flatness type is independent of concentration;

– role of BCMs is strongly connected with cluster concentration: the number of cD clusters is greatest in C-type;

– for L and F clusters a correlation between position angle for the major axes of the best-fit ellipse and the direction of the preferred plane was noted.

254 rich clusters without analogues in ACO catalogue were classified by the same way in present paper. Two cluster maps and their distribution of crucial distances in fractions of the mean cluster radius R_c are shown in Fig. 1. For C type cluster the distance from cluster center is decisive factor, and for PF 0205-4113 36% of galaxies placed inside of $0.1R_c$. For OL type cluster the distance to preferential line (dashed line in Fig. 1) is selected as decisive factor and 30.5% of galaxies concentrate in the $0.1R_c$ wide strip centered to the line. The direction of preferential line and major axis of the cluster best-fitted ellipse are close one to another, according to expectations.

The general difference in morphology of the two data sets is the frequency of clusters with strong structure. The number of C and LF types is significantly less between clusters without ACO analogues. We can explain it by the observational selection: open galaxy clusters in the magnitude range from 14^m to $18.^m3$ were lost.

3. Conclusion

We determined the morphological types using the numerical criteria for 254 rich PF galaxy clusters without ACO analogues. All types founded in another data set – 247 rich PF galaxy clusters having ACO analogues – are present in the new data set too. All criteria are correct and can be used in future work. The presence of preferential plane or direction in some clusters is statistically significant. Full rich PF cluster list with morphological types contains more than 500 clusters, so we obtain expanded observational basis for statistical research.

Acknowledgements. This research has made use of NASA's Astrophysics Data System.

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