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Open galaxy clusters with anisotropy signs

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Abstract

We analyzed the details of the morphology of 40 open rich galaxy clusters. Open rich galaxy clusters were selected from Catalogue of Galaxy Clusters and Groups PF (Panko & Flin, 2006). The morphology of clusters was studied according the Panko (2013) scheme. The morphological types in the scheme takes into consideration concentration towards the cluster center, indications of a preferential direction or plane, and the role of the brightest cluster galaxies using the "Clusters Cartography" program set (see Sviatoslav Yemelianov and Elena Panko poster). Additionally we divided our dataset according to galaxy ellipticity distribution. Single-mode distribution was attributed as elliptical galaxy population mainly (E-type). The second case – bimodal distribution corresponds to big part of disk (lenticular + spiral) galaxies in the clusters (D-type). We also find possible intermediate distribution attributed as ED or DE types.

Studied 40 open rich clusters were divided to two subsets: first one contains the clusters without anisotropy signs, clusters with preferential line or belt belong to second set. We found about 50% clusters in second subset have peculiarities. Brightest galaxies in the second subset are connected with overdence regions.

We suppose founded peculiarities connected with galaxy clusters evolution.

Key words: clusters of galaxies: morphological types

Introduction

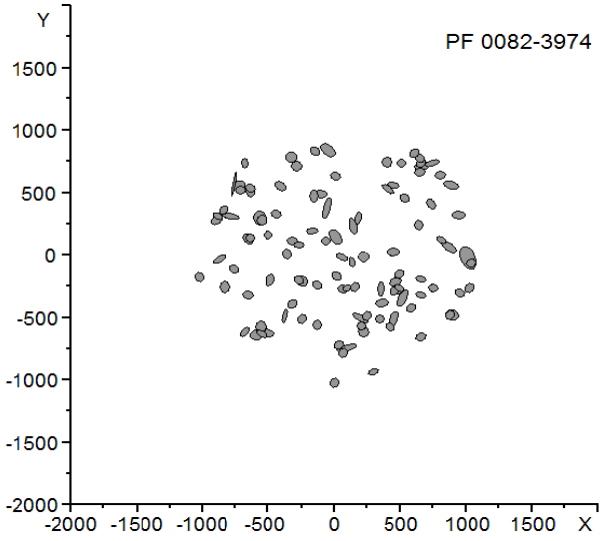
A number of different cluster properties have been used to construct morphological classification systems for clusters. There are cluster richness (number of galaxies within a specific limiting magnitude), the central concentration, the presence of bright galaxies in the center of the cluster, the presence of peculiar galaxies, etc.

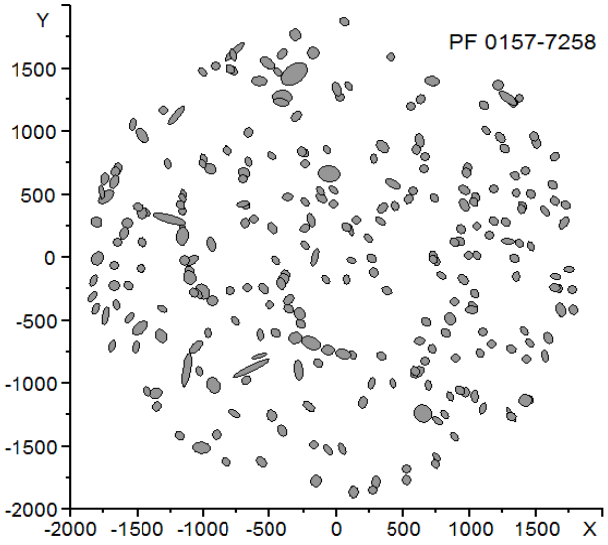
The variations in base parameters one can be interpret from evolution point of view. Adapted morphological scheme proposed by Panko (2013), describes 6 main types were distinguished: Concentrated C, Intermediate I, Open O, Line L, Flat F, and cD. The types correspond to the base divisions from regular to irregular clusters, but also note the presence of preferential direction or plane in each cluster. One can assumes open clusters as beginning point in galaxy cluster evolution. We selected 40 rich open clusters from The Catalogue of Galaxy Clusters and Groups (Panko & Flin 2006, hereafter PF) for examination of this assuming.

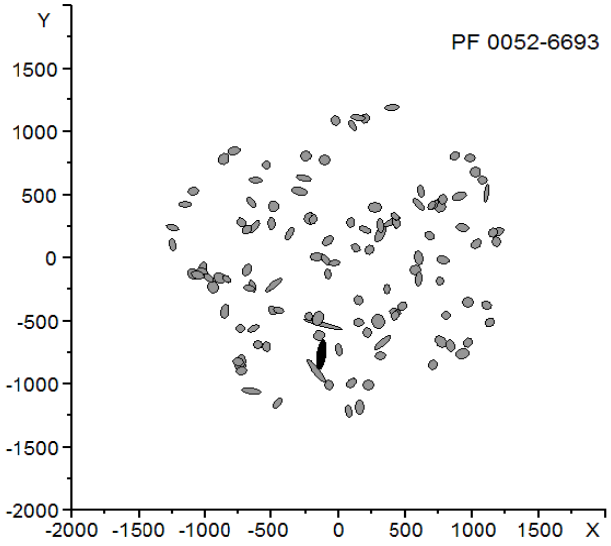
Observational data

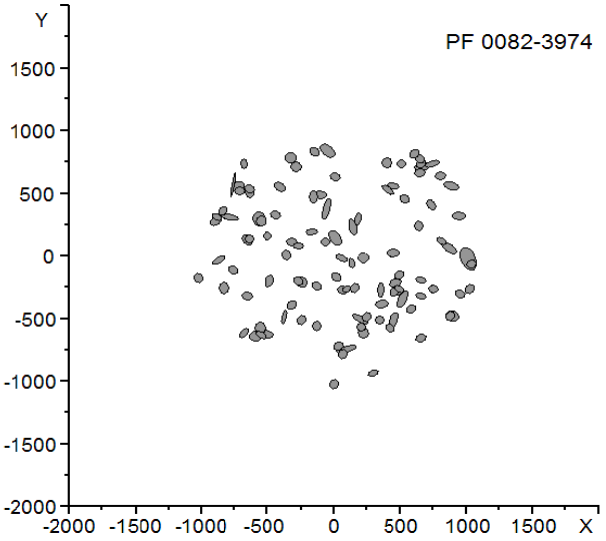
The Catalogue of Galaxy Clusters and Groups (Panko & Flin 2006, hereafter PF) was founded on the Muenster Red Sky Survey Galaxy Catalogue (Ungrue et al. 2003, hereafter MRSS). For each galaxy cluster in PF catalogue we have data for cluster member from MRSS. We used the data for visualization and analysis of selected galaxy clusters using "Cluster Cartography" program (Panko & Emelyanov, 2015).

Some open rich PF galaxy clusters from first subset

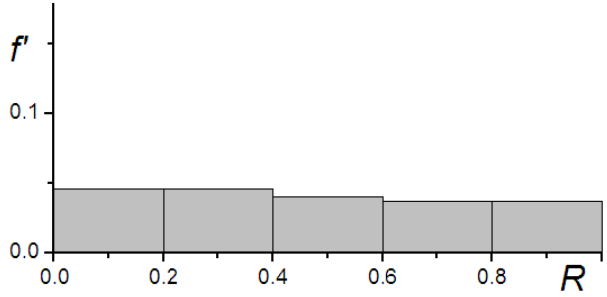




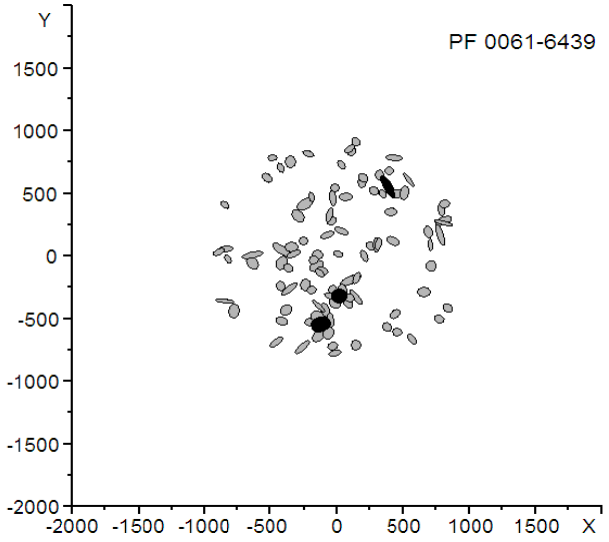


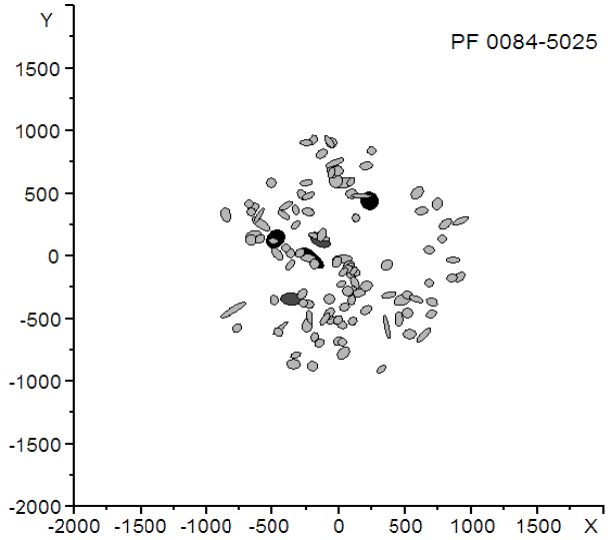


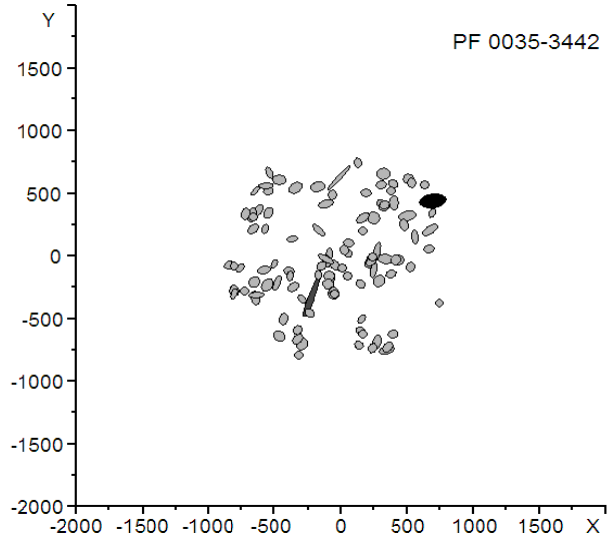
The clusters form first subset have no peculiarities, BGM noted as black symbols on the maps. Mainly BGM have no prevailing role. Local density variations (bottom) are random in the first subset.

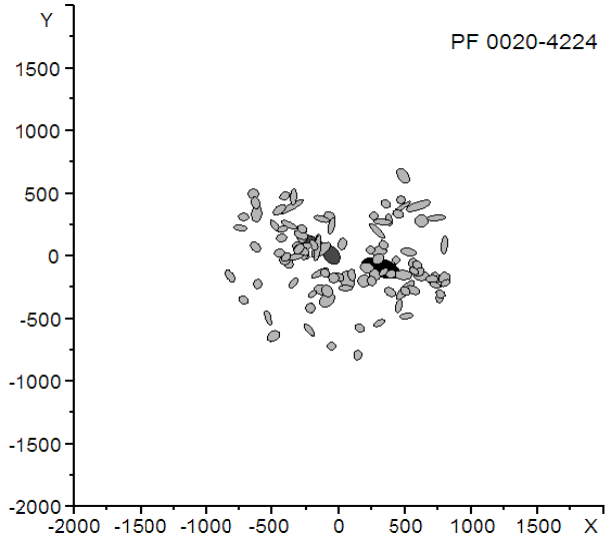


Some open rich PG galaxy clusters from second subset



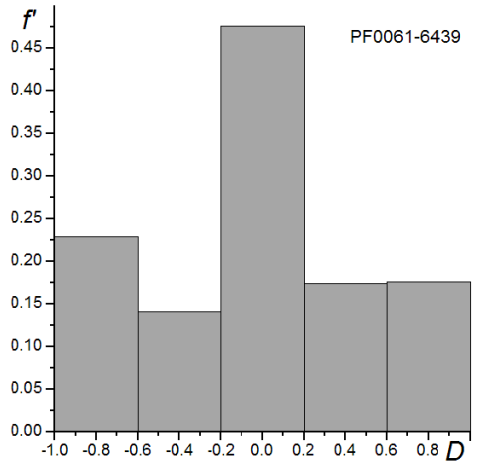




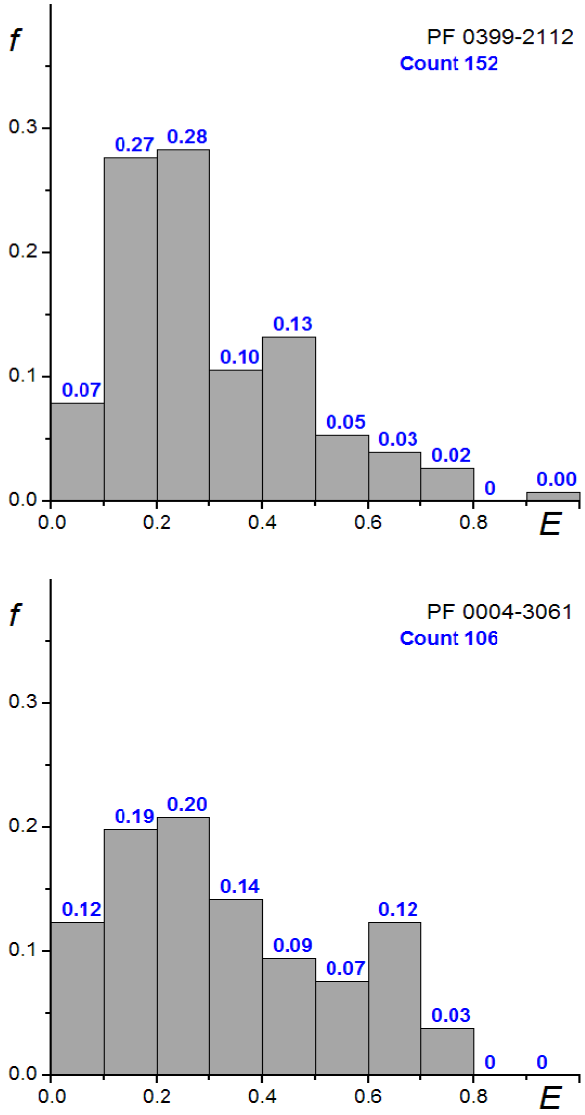


The clusters in second subset have local overdence regions. F-type cluster density distribution is shown in bottom panel.

A lot of the clusters in the subset have additional peculiarities too: BGM connected with overdence line or belt (left panel) or we found crossing overdence lines (right panel).



Galaxy ellipticity distribution



In a survey paper, Bahcall (1996) collected common properties for nearest clusters and superclusters of galaxies. In particular, she noted the difference between the typical galactic content of clusters and the different morphological types according BM and RS schemes.

The galactic content varied from E:S0:Sp= 3:4:2 for concentrated clusters to E:S0:Sp= 1:2:3 for open galaxy clusters. Panko & Flin (2014) showed, so hard dependence is not observed for farer galaxy clusters. More, they argued the shapes of galaxies in individual clusters appear to relate to local conditions.

We show difference between galaxy ellipticity distribution for ED (up) and D-types clusters on the left panel.

Results

We studied 40 rich open galaxy clusters. The morphology of the clusters we can describe as: 18 clusters O type and 22 Ol-OF type have different part of clusters with peculiarities, BGM role and galaxy content. Comparison both sets of clusters is shown in the Table1. The difference between subsets is significant.

Table 1.

Type	**O**	**OL-OF**
Number	**18**	**22**
BG (BGM role)	1	4
P	2	7
D/E galactic content		
D	3	3
DE	0	4
ED	4	4
E	11	11

Conclusion

We found significant difference between open clusters O type and OL-OF type. The clusters with overdence belts have excess of both peculiarity clusters and dominant bright galaxy clusters. Main type of peculiarity is presence of crossing overdence regions without overdence in the intersection. The part of disk (lenticular + spiral) galaxies bigger in OL-OF type too. We suppose founded peculiarities connected with galaxy clusters evolution: Ol-OF type is the next stage after O type in galaxy cluster evolution.

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