Substructures in Abell clusters of galaxies[★]

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ABSTRACT

Aims. We present the results of substructure detection on a large sample of Abell clusters.

Methods. We apply the wavelet transform to positions of galaxies in 183 Abell clusters. The significance of the substructuring detected was determined using Monte Carlo simulations on sets of 1000 randomly generated distributions of galaxies for each cluster and wavelet scale.

Results. 62 of the investigated clusters are strongly substructured; the frequency of occurrence of substructure is 0.34. The investigated clusters were classified as unimodal, bimodal or complex systems. The clusters were divided into clusters having substructures in the field of the cluster S_f or in the core region S_c . The Kolmogorov-Smirnov test show no significant differences at the level $\alpha = 0.05$ in the distribution of clusters having S_c and S_f substructures with redshift. Using a χ^2 test we found no correlation between the existence of subclustering and the morphological type of galaxy clusters.

Key words. galaxies: clusters: general

1. Introduction

The presence or absence of substructures in galaxy clusters is very important for the study of cluster formation and evolution. Over the past two decades, substructures have been detected in a significant fraction of galaxy clusters. The existence of subclustering suggests that clusters are dynamically young objects. This allows one to test cosmological models (Thomas et al. 1998; Knebe & Muller 2000). The frequency of substructures in clusters was used in the past to evaluate the density parameter Ω_0 (Richstone et al. 1992; Kauffmann & White 1993). Moreover, the properties of galaxies in clusters depend on their environment. In clusters, morphology segregation is found among galaxies both in substructures and outside them (Biviano et al. 2002). Similar results based on the APM cluster sample were obtained by Plionis (2001). He found that in the analyzed sample of data, dynamically young clusters are spatially much more clustered.

Kolokotronis et al. (2002) investigated a sample of 22 rich galaxy clusters, finding a strong correlation between the optical (APM) and X-ray (ROSAT) morphological parameters. Their work led to the conclusion that in both parts of the spectrum it is possible to identify the dynamical state of a cluster correctly. Important results were obtained by Schuecker et al. (2001). Analyzing X-ray surface brightness distribution of 470 clusters they found a substructure-density relation. 52%

of studied clusters had substructures in an aperture radius of 1 Mpc.

The analysis of cluster ellipticity (Plionis 2002) revealed correlation with cluster redshift. Cluster ellipticity increases with redshift for the investigated sample with $z < 0.18$, see however Floor et al. (2003), Flin et al. (2004) and Rahman et al. (2004).

By constructing radial number-density profiles for about 100 clusters, Baier (1979, 1983) and Baier & Mai (1977, 1978) concluded that as many as 80% of the clusters they studied had subclustering. Based on the projected distribution of galaxies, using surface density contour maps for 65 rich galaxy clusters, Geller & Beers (1982) found that substructures are statistically significant in 40% of these cases. The same percentage of subclustering was reported by Dressler & Shectman (1988) from 3D data (radial velocities of galaxies). West et al. (1988) reported a lower percentage of subclustering, finding little significant subclustering in the sample studied. Using both projected distributions and radial velocities of galaxies, West & Bothun (1990) found structures in the outer parts of clusters. Krywult (1997) applied the symmetry and separation tests to positional data of 18 clusters and concluded that 32% of these clusters show substructures. Using a number of statistical tests on 33 clusters, Bird (1993) showed that depending on the method applied, from 10% to 40% have statistically significant substructures. Escalera et al. (1994) applied the wavelet analysis to 16 clusters classified by them as unimodal or bimodal. More recent studies were carried out by Kriessler & Beers (1997),

[★] Tables 1–3 and Figs. 3–17 are only available in electronic form at <http://www.edpsciences.org>

using the adaptive kernel technique for 56 clusters. They concluded that 57% of these clusters show substructures. A wavelet analysis of 18 Abell clusters (Krywult et al. 1999) showed the existence of substructures in 50% of cases. Using four different methods, Krywult & Flin (2000) found that statistically significant subclustering is present in 40% of the investigated clusters.

A comparison of our work with other recent studies indicates a good correspondence between the fraction of substructures detected in 2D and 3D data. Thus, the analysis of substructures in galaxy clusters based on projected, i.e. 2D data, can reveal a statistically correct percentage of subclustering, disregarding some differences for individual objects (Flin & Krywult 2002).

We present the results obtained from a large sample, which can be useful for comparison with other data. Our clusters contain objects within the standard 3 mag range and a visual verification of star/galaxy separation has been performed. We use the parameters $h = 0.75$ and $q = 0.5$.

Observational data are presented in Sect. 2, with the method applied, i.e. the wavelet analysis, given in Sect. 3. Section 4 presents the results. In Sect. 5 we discuss the individual clusters. Section 6 provides a conclusion.

2. Observational data

There are two sources of our data. The first is our previous papers (Trévese et al. 1992, 1997; Flin et al. 1995; Flin et al. 2000) derived from 10-inch photographic plates taken with the 48-inch Palomar Schmidt Telescope (Hickson 1977). The emulsions employed were Kodak 127-02 or Kodak 098-04, both used with a 2 mm Schott RG-1 glass filter, which corresponds to the red photographic F -band of Oemler (1974). The plates were calibrated using the Palomar spot sensitometer.

The fields containing clusters originally selected by Hickson (1977), as well as some additional Abell (1989) clusters clearly visible on the plates, were scanned in the transparency mode using a PDS 1010G micro-densitometer, producing a digital image for each cluster field with a pixel size from 15 to 20 μm , according to the noise level of the plate and the cluster distance. Objects were automatically detected and magnitude values computed in many circular apertures, producing a magnitude profile from which the objects were automatically classified as point-like or diffuse.

Total magnitudes m_T were computed from the flux integrated in an aperture of radius $R_1 = 1.5r_1$, where r_1 is the first momentum of intensity distribution (see Trévese et al. 1992).

With the above definition, total magnitudes correspond on average to the magnitude m_{iso} computed in a circular aperture determined by the isophote $\mu = 24 \text{ mag arcsec}^{-2}$, with the advantage that r_1 is less noisy than the corresponding isophotal radius (see Flin et al. 1995). Magnitude-zero points are taken from the literature (Hoessel et al. 1980; Hoessel & Schneider 1985; Sandage & Perlmutter 1991; Peterson 1970; Gunn & Oke 1975; Bothun et al. 1985; Murphy et al. 1983).

The majority of galaxy catalogues were obtained by applying FOCAS package (Jarvis & Tyson 1981) to the Digitized

Sky Survey, which is the second source of our data. The essential difference between this and other samples is the visual checking of all objects classified as galaxies when automatic procedures were applied.

We take into account only well separated Abell clusters with clearly visible galaxies, which allows us to perform the visual verification of the automatic star/galaxy classification. It was performed for all objects brighter than $m_3 + 3$ classified by the FOCAS package as galaxies, m_3 is the magnitude of the third brightest galaxy.

The sample of galaxy clusters analyzed by us is not statistically uniform. However, we ensure the reliability of star/galaxy separation, which allows us to state that each of our clusters contain galaxies only.

The basic parameters of the clusters included in the present study are given in Table 1. The first column contains the cluster name, Cols. 2 and 3 give the right ascension and declination (1950) of the cluster center, and Col. 3 shows the cluster redshift from Struble & Rood (1987). In our analysis, we took into account all galaxies within the radius of $R = 1.5 \text{ Mpc}$ from the cluster center and with a magnitude range from m_3 to $m_3 + 3$, where m_3 is the magnitude of the third brightest galaxy.

The completeness of each galaxy cluster sample has been checked using the $\log(N) - m$ dependence. In all cases, the completeness covered a range of at least 3 mag. For 29 of these clusters Trévese et al. (1996) studied the luminosity function. As seen from their Table 1 and Fig. 1, the sampling was done for $M^* + 2 \text{ mag}$. For clusters A157, A779, A2028 and A2056 the magnitude limit was brighter than $m_3 + 3$. This can be related to the fact that the automatic star/galaxy classification methods break down for weak images of galaxies on the photographic plates, or to the low population of galaxies in the clusters.

3. Wavelet analysis

The detection of structure in the regions studied was achieved by a wavelet analysis (Escalera et al. 1994). The wavelet technique is a convolution on a grid of $N \times N$ pixels between the signal $s(r)$ (in our case, the angular positions of galaxies) and the analyzing wavelet function $g(r, a)$. Following Escalera & Mazure (1992), we use the two-dimensional radial function called the Mexican Hat, given by the formula:

$$g(r, a) = \left(2 - \frac{r^2}{a^2}\right) \exp\left(-\frac{r^2}{2a^2}\right), \quad (1)$$

where r is the distance between the position of a galaxy and point (x, y) where the wavelet coefficient is calculated, and a is a scale length for the wavelet in order to form the corresponding set of wavelet coefficients. As a result of the convolution, the signal is transformed into a set of wavelet coefficients given by:

$$w(r, a) = g(r, a) \otimes s(r). \quad (2)$$

Each pixel in the grid then has a corresponding wavelet coefficient. Using a set of different scales, a structure is detected only when its characteristic size is of the order of the scale applied. Following Daubechies (1990), the factor of $\sqrt{2}$ from

one scale to another ensures correct sampling in the case of the Mexican Hat. When analyzed with the largest scale, the field will produce a wavelet image showing a single central structure. If the scale decreases, the central structure either remains unchanged or splits into substructures. In this way, we can detect all structures present in the map, irrespective of their location or size. For the analysis presented here, the discrete wavelet was computed on a grid of 256×256 pixels for seven scales increasing from $a = 8$ to 64 (in pixel units), namely 8, 11, 16, 22, 32, 45, 64, corresponding to 94, 129, 188, 258, 375, 527, 750 kpc. In order to avoid any edge effects, areas larger than the cluster itself were analyzed.

We modeled the significance of the substructure detected using Monte Carlo simulations. For each cluster and each scale a , a wavelet analysis was carried out on a set of 1000 randomly generated distributions of galaxies containing the same number of points as in the actual fields.

We assume that a substructure is real if the probability that the detected substructure is due to random fluctuations is less than 1%. Furthermore, for each scale a only substructures with more than 4 galaxy members in a circle of radius a are considered.

In this way, we detected all structures in the field of the galaxy clusters studied here. Following Escalera et al. (1994), we classified the structures morphologically according to three categories: unimodal, bimodal and complex.

Some of the detected substructures are due to projection effects. However, the application of 1000 simulations for each scale a allows one to estimate the probability of the existence of the detected substructure in the random distribution of galaxies, and it is small. Theoretically, subclustering existing in 3D data should be also detected in 2D data. However, it may happen that two subgroups are located along the line-of-sight, thus appearing in projection as one group. The projection effect is of the same importance for clusters with and without 3D substructures. Therefore, for the statistical investigations of the frequency of substructure occurrence this is not a very important factor.

4. Results

The results of our wavelet analysis applied to the present sample of galaxy clusters are given in Table 3. Column 1 gives the cluster name, column 2 identifies the structure (M – main cluster; A – dominant central structure; B, C – substructures), Col. 3 shows the wavelet scales a at which the structures were detected, with values in pixel units for a map of 256×256 pixels, Col. 4 gives the number of galaxies belonging to the relevant structures, and Cols. 5 and 6 show coordinates for the center of the detected structure. Column 7 gives cluster morphology (U – unimodal, S_f – substructures present in the field of cluster, and S_c – substructures in the cluster core).

We assume that a cluster has substructures in the core (S_c) if the distance between the center of the detected substructure and the center of the main cluster is smaller than 375 kpc. If it is located at a greater distance, the cluster has substructures in the field (S_f).

Fig. 1. The distribution of the galaxy clusters with substructures versus redshifts for the morphological type S_c (solid line) and S_f (dotted line).

Using the classification scheme for clusters of galaxies developed by Rood & Sastry (1971) and by Bautz & Morgan (1970) the distribution of the clusters having substructures for different morphological types is presented in Table 2. Excluding results for types L and B, which are poorly populated, the χ^2 test shows no correlation between the existence of subclustering and the type of galaxy cluster at the significance level $\alpha = 0.05$. Also the S_f and S_c substructures do not depend on the BM and RS cluster morphological types.

We tested if the dependence S_c versus redshift and S_f versus redshift is the same (Fig. 1). Using the Kolmogorov-Smirnov test we did not find any statistically significant difference at the level $\alpha = 0.05$ between the distributions. The test carried out for bins of 0.005, 0.010 and 0.015 lead to the same conclusion.

In Figs. 3–18 we show only 62 of the clusters with detected substructures. The plots show the distribution of galaxies and the wavelet images on a grid of 256×256 pixels for six wavelet scales $a = 129, 188, 258, 375, 527, 750$ kpc. From these plots it is possible to identify unimodal or bimodal clusters, and substructures. In general, the central A – structure can still be seen at small scales, although the corresponding physical structure is clearly defined at the largest scales only.

Thus, the wavelet analysis shows statistically significant substructures in 34% of the clusters in our sample. According to the frequency of clusters with statistically significant substructures, the results presented in this paper are consistent with those of other authors, based on 2D or 3D data.

5. Discussion

Below we present some comments on substructures in particular clusters.

A76 – At the scales of $a = 375$ kpc and $a = 258$ kpc, this cluster has two galaxy groups in the cluster field.

A117 – At the scale of $a = 188$ kpc substructures are located in the central region of the cluster.

A121 – Substructures are identified at scales $a = 375$ kpc and $a = 258$ kpc.

A133 – In this bimodal cluster, small subclusters occur at the scale of $a = 188$ kpc.

- A140** – At the scale $a = 188$ kpc, this cluster has one group of galaxies.
- A151** – Two significant substructures at the scale $a = 375$ kpc.
- A261** – This is bimodal cluster at scale of $a = 527$ kpc.
- A358** – Substructures exists in the central region of the cluster at the scale of $a = 129$ kpc.
- A415** – Two significant substructures occur at the scales $a = 188$ kpc and $a = 258$ kpc.
- A426** – The substructures are located in the field of the cluster at the all scales.
- A496** – The significant substructures occur at the all scales in the field of the cluster.
- A514** – This is an elongated cluster with substructures at the scales of $a = 375$ kpc and $a = 188$ kpc.
- A527** – One group of galaxies located at the external part of the cluster.
- A539** – At the scales $a = 258$ kpc and $a = 188$ kpc small groups of galaxies are located at the central part of the cluster.
- A548** – In this bimodal cluster, substructures exists at the scales $a = 188$ kpc and $a = 94$ kpc.
- A671** – This cluster has two significant substructures in the cluster center at the scale of $a = 129$ kpc. Each of them has 8 galaxy members.
- A754** – At the scales of $a = 188$ kpc and $a = 129$ kpc there are three substructures.
- A786** – Only one substructure at the scale of $a = 375$ kpc.
- A924** – Two groups of galaxies in the central region of cluster, at the scale of $a = 375$ kpc.
- A978** – In this symmetrical cluster two substructures exists at the scale of $a = 258$ kpc.
- A1016** – At the scale $a = 188$ kpc, this cluster has significant substructures at the cluster center.
- A1060** – There are six substructures at the scales $a = 375$ kpc and $a = 129$ kpc.
- A1187** – This bimodal cluster has two substructures at the scale of $a = 527$ kpc.
- A1275** – Two significant substructures located symmetrically according cluster center.
- A1292** – One substructure at the outer part of cluster, $a = 258$ kpc.
- A1367** – At the scale of $a = 129$ kpc this cluster has two galaxy groups.
- A1377** – Two significant substructures occur at the scales of $a = 129$ kpc and $a = 94$ kpc.
- A1401** – Bimodal cluster, substructures at the scale of $a = 527$ kpc.
- A1413** – This is an elongated cluster with two close groups of galaxies at the scale of $a = 375$ kpc.
- A1631** – This cluster has substructures at the scale $a = 188$ kpc in the cluster center.
- A1650** – This cluster has substructures in the cluster field.
- A1651** – One group of galaxies at the scale of $a = 375$ kpc in the field of the galaxies.
- A1661** – This elongated cluster has one group of galaxies at the scale of $a = 375$ kpc.
- A1736** – The substructures occur at the scales of $a = 188$ kpc.
- A1809** – In this cluster the substructures are located in the central region at the scale $a = 258$ kpc.
- A1831** – This cluster has two significant substructures in the cluster center at the scale of $a = 188$ kpc.
- A1837** – The substructures are located in the field of the cluster.
- A1904** – This cluster has one substructure in the field at the scale of $a = 129$ kpc.
- A1913** – Statistical significant substructures exists at the scale $a = 188$ kpc.
- A1983** – This is a bimodal cluster.
- A2020** – This is a bimodal cluster.
- A2022** – One group of galaxies at the scale of $a = 129$ kpc.
- A2028** – In this elongated cluster, substructure exists at the scale of $a = 258$ kpc. It is located in the upper region of the field.
- A2052** – The substructures at the scale $a = 375$ kpc exists in the external region of the cluster.
- A2065** – One group of galaxies in the external part of the cluster occurs at the scale of $a = 258$ kpc.
- A2073** – In this almost regular cluster, the wavelet analysis identified one substructure in the core region, at the scale of $a = 188$ kpc.
- A2124** – At the scale of $a = 129$ kpc, two small substructures are located in the central region of the cluster.
- A2147** – In this cluster two groups of galaxies occurs at the scale of $a = 375$ kpc.
- A2151** – This is a bimodal cluster.
- A2152** – This bimodal cluster has substructure at the scale of $a = 258$ kpc.
- A2199** – At the scales of $a = 129$ kpc and $a = 94$ kpc substructures occurs in the field of the cluster.
- A2255** – This cluster has one significant substructure in the cluster center at the scale of $a = 129$ kpc.
- A2312** – One small substructure in the center of the cluster, at the scale $a = 188$ kpc.
- A2457** – This cluster has one group of galaxies in the center, at the scale $a = 129$ kpc.
- A2593** – Only one small group of galaxies is present in the core region of the cluster, at the scale of $a = 188$ kpc.
- A2877** – Only two small substructures occurs at the scale of $a = 94$ kpc.
- A3128** – In this cluster the substructures exists at all the scales smaller than $a = 375$ kpc.
- A3376** – Two groups of galaxies at the scales of $a = 188$ kpc and $a = 129$ kpc.
- A3395** – This is the bimodal cluster.
- A3526** – This bimodal cluster has small substructures at the scales of $a = 375$ kpc, $a = 258$ kpc and $a = 188$ kpc.
- A3562** – In this cluster substructures occurs at the scales of $a = 258$ kpc and $a = 129$ kpc.
- A3667** – This cluster has significant substructures at the scales of $a = 258$ kpc and $a = 94$ kpc.

6. Conclusions

The method based on a wavelet transform has been applied for substructure detection in the projected distributions of galaxies

Fig. 2. Distribution of galaxies in A85 with the wavelet images for scales $a = 527, 375, 258$ kpc presented in the upper right box (galaxies within magnitude range from m_3 to $m_3 + 3$).

in 183 Abell clusters. The significance of substructure detected has been calibrated using simulated distributions by means of Monte Carlo modeling, performing 1000 simulations for each cluster and each scale. Applying the Mexican Hat wavelet analysis to the projected distributions of galaxies in 183 clusters, we conclude that significant structure is present in 62, that is 34% of the cases.

Our results indicate that a large fraction of clusters have substructures in their projected galaxy distributions. A comparison with other investigations based both on the projected and on the 3D data shows that, while in individual cases there are sometimes differences in finding substructures, the percentage of substructure occurrence is not greatly affected. We find no correlation between frequency of the clusters with subclustering and their morphological type.

Our results are in agreement with the Plionis (2001) investigation. He applied two different methods for substructure detection in 309 ACO clusters for which only about 180 have measured redshifts. In our studies all clusters have measured redshifts, so our samples are almost identically numerous.

The influence of magnitude limits on subclustering was examined by Flin & Krywult (2000). This was done using symmetry and separation tests (West et al. 1988). The subclustering depends neither on the magnitude range of considered galaxies, which is $m_3 + 2, m_3 + 3$, and $m_3 + 4$, nor the possible errors in determination of the third brightest galaxy. They checked this for $m_i + 3$, where $i = 3 \dots 10$.

This shows that the search for subclustering does not depend on the magnitude limit, when $m_3 + 3$ or $m_3 + 4$ is considered, but when this magnitude range is significantly enlarged, substructures could be observed.

We applied our method to published optical data (Slezak et al. 1997) of the very rich cluster Abell 85 (Fig. 2). The data were analysed in the same manner as ours. We took into account all galaxies within a radius of $R = 1.5$ Mpc from the cluster centre. To check the influence of the magnitude limit on the detected substructures the analysis was carried out on two sets of catalogues. The first catalogue was magnitude limited at the level $m_3 + 3$, the second one at the level $m_3 + 4$.

The results of a wavelet analysis show no statistically significant substructures in neither case. Due to increases in the number of galaxies in this catalogues from 317 to

587, the wavelet analysis showed some substructures, but they are not statistically significant at our adopted probability level. However, when all Slezak et al. (1997) data covering a magnitude range much larger than $m_3 + 4$ were considered, subclustering was detected.

The influence of the cluster centre chosen has been analyzed for clusters using mean, median and ACO catalogue centres. In some cases were found a differences between subclustering but the difference are not statistically significant.

In some tests to detect substructures in galaxy clusters there is a strong dependence on the cluster centre choice. This is the case of the symmetry test, the Lee test and others. A detailed discussion is given using numerical simulations by Pinkey et al. (1996).

The wavelet analysis performs a convolution of the analysing function (e.g. Mexican Hat) with positions of galaxies in cluster regions. Contrary to previously mentioned tests this method do not use the predetermined cluster centre for calculation. Our earlier studies show that the choice of the cluster centre is an important factor influencing the frequency of substructure occurrence.

Our considerations also show that the percentage of subclustering using a wavelet analysis applied to 2D data is close to that obtained from 3D data.

In A496 the wavelet analysis shows one substructure located in the outer region of this cluster. Durret et al. (2000) find only small groups of galaxies located in the central region of the cluster, but no significant substructures. In Fig. 9 of their paper there is one group of galaxies located in the outer region of A496, which corresponds to substructure detected by us. This comparison shows that different methods of analysis detect different substructures.

The results presented in this paper are in agreement with Burgett et al. (2004). They applied four statistical tests of the substructure analysis to the 25 low-richness clusters from the 2ndFGRS catalogue of galaxy clusters. They conclude that substructures exist in 20% to 44% of clusters, depending on the method applied.

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Fig. 18. Distribution of galaxies in A3562 and A3667 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

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Online Material

Table 1. List of studied clusters.

Cluster	α	δ	z	Cluster	α	δ	z	Cluster	α	δ	z
A14	00 12.7	-24 10	0.0640	A439	03 27.5	+24 37	0.1063	A1146	10 58.9	-22 27	0.141
A21	00 17.9	+28 21	0.0948	A449	03 43.5	+75 02	0.0803	A1185	11 08.1	+28 57	0.0304
A22	00 18.2	-25 59	0.1432	A465	03 48.3	+06 09	0.0855	A1187	11 08.9	+39 51	0.0791
A76	00 37.2	+06 30	0.0416	A496	04 31.3	-13 21	0.0320	A1190	11 09.0	+41 07	0.0794
A85	00 39.1	-09 37	0.0518	A500	04 36.8	-22 12	0.0666	A1213	11 13.8	+29 32	0.0468
A88	00 40.4	-26 19	0.1086	A505	04 51.6	+79 56	0.0543	A1216	11 15.2	-04 12	0.0524
A104	00 47.1	+24 15	0.0822	A514	04 45.5	-20 31	0.0731	A1228	11 18.8	+34 36	0.0350
A114	00 51.2	-21 57	0.0566	A526	04 57.2	+05 22	0.0541	A1275	11 27.3	+36 57	0.0603
A115	00 53.3	+26 03	0.1971	A527	05 04.0	+73 38	0.0794	A1292	11 29.1	+36 06	0.2319
A117	00 53.5	-10 18	0.0535	A537	05 18.3	+73 50	0.168	A1299	11 29.7	+34 15	0.2247
A119	00 53.8	-01 32	0.0440	A539	05 13.9	+06 24	0.2050	A1314	11 32.1	+49 19	0.0341
A121	00 55.0	-07 17	0.1048	A548	05 45.0	-25 38	0.041	A1334	11 36.3	-04 02	0.0555
A133	01 00.2	-22 04	0.0604	A564	06 55.2	+69 53	0.0779	A1346	11 38.6	+05 58	0.0970
A140	01 02.1	-24 14	0.152	A566	06 59.8	+63 22	0.0984	A1364	11 41.1	-01 29	0.1070
A147	01 05.6	+01 54	0.0438	A576	07 17.3	+55 50	0.0381	A1365	11 41.8	+31 11	0.0763
A151	01 06.4	-15 41	0.0526	A592	07 39.9	+09 29	0.0624	A1367	11 41.9	+20 07	0.0215
A157	01 08.6	-14 40	0.119	A637	08 11.4	+48 32	0.168	A1377	11 44.3	+56 01	0.0514
A166	01 12.1	-16 32	0.1156	A644	08 15.0	-07 26	0.0704	A1401	11 49.5	+37 33	0.1648
A168	01 12.6	-00 01	0.0452	A646	08 18.6	+47 16	0.1303	A1412	11 53.1	+73 45	0.0839
A189	01 21.1	+01 23	0.0335	A649	08 20.6	+49 02	0.150	A1413	11 52.8	+23 39	0.1427
A193	01 22.5	+08 26	0.0482	A655	08 21.8	+47 17	0.1245	A1437	11 57.9	+03 37	0.1339
A194	01 23.0	-01 46	0.0178	A671	08 25.4	+30 35	0.0494	A1474	12 05.4	+15 14	0.0791
A195	01 24.2	+18 55	0.0422	A680	08 32.1	+37 02	0.079	A1524	12 19.2	+08 07	0.1369
A260	01 49.0	+32 55	0.0348	A754	09 06.4	-09 26	0.0528	A1541	12 24.9	+09 07	0.0892
A261	01 48.9	-02 29	0.0467	A757	09 09.4	+47 55	0.0515	A1570	12 33.9	+20 05	0.180
A262	01 49.9	+35 54	0.0161	A779	09 16.8	+33 59	0.0226	A1589	12 39.1	+18 52	0.0718
A274	01 52.2	-06 31	0.1289	A786	09 23.7	+75 01	0.1241	A1630	12 49.2	+04 50	0.0649
A277	01 53.3	-07 37	0.0947	A924	10 04.1	+35 54	0.0989	A1631	12 50.2	-15 10	0.0508
A278	01 54.4	+31 59	0.0896	A978	10 18.0	-06 16	0.0527	A1644	12 54.6	-17 05	0.0449
A279	01 53.8	+00 49	0.0797	A979	10 17.9	-07 38	0.055	A1650	12 56.2	-01 29	0.0845
A358	02 27.8	-13 25	0.0576	A1016	10 24.4	+11 14	0.0321	A1651	12 56.8	-03 55	0.0825
A389	02 49.1	-25 07	0.1160	A1035	10 29.2	+40 28	0.0799	A1661	12 59.4	+29 21	0.1671
A399	02 55.2	+12 49	0.0715	A1060	10 34.5	-27 16	0.0114	A1675	13 02.9	+34 49	0.184
A401	02 56.2	+13 23	0.0748	A1081	10 42.0	+35 50	0.1588	A1689	13 09.0	-01 06	0.181
A407	02 58.6	+35 38	0.0470	A1126	10 51.3	+17 07	0.0852	A1691	13 09.1	+39 28	0.0722
A415	03 04.4	-12 14	0.0788	A1132	10 55.3	+57 03	0.1363	A1700	13 12.3	+28 59	0.142
A426	03 15.3	+41 20	0.0183	A1139	10 55.5	+01 46	0.0383	A1736	13 24.1	-26 51	0.035

Table 1. continued.

Cluster	α	δ	z	Cluster	α	δ	z	Cluster	α	δ	z
A1749	13 27.3	+37 53	0.059	A2073	15 23.6	+28 35	0.120	A2457	22 33.2	+01 13	0.0597
A1774	13 39.0	+40 16	0.1691	A2089	15 30.6	+28 11	0.0743	A2593	23 22.0	+14 22	0.0433
A1775	13 39.6	+26 37	0.0696	A2092	15 31.3	+31 19	0.0669	A2597	23 22.7	-12 23	0.0852
A1795	13 46.7	+26 50	0.0616	A2096	15 33.5	+37 30	0.134	A2634	23 35.8	+26 45	0.0312
A1809	13 50.8	+05 24	0.0788	A2107	15 37.6	+21 56	0.0421	A2657	23 42.3	+08 52	0.0414
A1831	13 56.9	+28 14	0.0733	A2124	15 43.1	+36 13	0.0654	A2665	23 48.2	+05 50	0.0556
A1837	13 59.1	-10 55	0.0376	A2142	15 56.2	+27 22	0.0899	A2666	23 48.4	+26 52	0.0265
A1904	14 20.3	+48 47	0.0708	A2147	16 00.0	+16 02	0.0356	A2670	23 51.6	-10 41	0.0745
A1913	14 24.5	+16 54	0.0533	A2151	16 03.0	+17 53	0.0371	A2700	00 01.3	+01 47	0.0978
A1927	14 28.8	+25 53	0.0740	A2152	16 03.1	+16 35	0.0374	A2717	00 00.7	-36 14	0.0498
A1942	14 36.1	+03 53	0.224	A2175	16 18.4	+30 02	0.0978	A2721	00 03.6	-35 00	0.114
A1983	14 50.4	+16 57	0.0441	A2197	16 26.5	+41 01	0.0303	A2877	01 07.6	-46 10	0.0241
A1991	14 52.2	+18 50	0.0586	A2199	16 26.9	+39 38	0.0303	A3128	03 28.8	-52 44	0.0554
A2020	15 01.3	+08 07	0.0578	A2210	16 32.3	+05 35	0.1465	A3266	04 30.5	-61 35	0.0594
A2022	15 02.2	+28 37	0.0564	A2255	17 12.2	+64 09	0.0800	A3376	05 59.1	-40 03	0.0455
A2028	15 07.1	+07 43	0.0772	A2256	17 06.6	+78 47	0.0601	A3391	06 25.2	-53 39	0.0531
A2029	15 08.5	+05 57	0.0767	A2311	18 50.2	+70 19	0.0675	A3395	06 26.5	-54 22	0.0498
A2040	15 10.3	+07 37	0.0456	A2312	18 53.8	+68 18	0.0590	A3526	12 46.1	-41 02	0.0110
A2048	15 12.8	+04 34	0.0945	A2315	19 01.2	+69 53	0.0822	A3558	13 25.1	-31 14	0.0482
A2052	15 14.3	+07 11	0.0348	A2319	19 19.2	+43 52	0.0564	A3562	13 30.7	-31 25	0.0499
A2055	15 16.3	+06 23	0.0530	A2366	21 40.2	-07 06	0.0542	A3667	20 08.5	-56 58	0.0530
A2056	15 17.1	+28 27	0.0763	A2384	21 49.5	-19 47	0.2384	A3716	20 47.9	-52 54	0.0456
A2063	15 20.6	+08 49	0.0337	A2399	21 54.9	-08 02	0.0587	A3888	22 31.5	-37 59	0.1680
A2065	15 20.6	+27 54	0.0721	A2410	21 59.4	-10 08	0.0806	A4038	23 45.1	-28 25	0.0283

Table 2. The frequency of the galaxy clusters with significant substructures versus the morphological type.

Morphology	Total number	Clusters with substructures	Frequency
cD	47	13	28
C	35	12	34
B	12	1	8
I	38	7	18
F	31	14	45
L	12	5	42

Table 3. Results of the wavelet analysis.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A14	A	64	124	138	95	U
A21	A	64	110	126	31	U
A22	A	64	130	106	89	U
A76	A	64	121	134	43	S _f
		45	107	139	24	
	B	32	94	153	14	
			156	120	13	
	C	22	155	120	10	
			95	177	10	
		16	152	118	6	
		11	91	119	5	
A85	A	64	109	117	119	U
A88	A	64	95	129	22	U
A104	A	64	110	109	62	U
A114	A	64	137	106	52	U
A115	A	64	109	184	59	U
A117	A	64	105	154	37	S _c
		45	90	158	21	
		32	79	161	13	
		22	79	162	10	
	B	16	78	162	9	
	C		158	114	6	
		11	78	162	9	
		8	78	163	8	
A119	A	64	129	139	64	U
A121	A	64	127	123	53	S _f
		45	39	194	33	
	B	32	36	197	19	
	C	22	192	131	12	
			33	198	13	
		16	192	131	12	
		11	191	131	8	
		8	190	130	5	
A133	A	64	121	135	81	B, S _c
	A1	45	111	138	55	
	A2		213	39	46	
		32	107	138	42	
			216	36	28	
		22	97	149	25	
			123	123	20	
			223	38	15	
	B1	16	127	121	18	
	B2		95	155	16	
		11	126	122	10	
		8	126	124	7	
A140	A	64	106	109	76	S _c
		45	100	109	47	
		32	92	108	31	
		22	82	100	16	
	B	16	79	97	13	
		11	78	97	9	
		8	79	98	6	
A147	A	64	182	119	43	U
A151	A	64	111	118	48	S _f
		45	110	128	35	
	B	32	122	127	23	
	C		125	26	17	
		22	127	128	14	
			119	29	12	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A157	A	16	130	131	11	U
			119	31	10	
		11	130	131	9	
			119	32	8	
		8	132	132	6	
			122	34	5	
		64	181	112	42	
		64	135	141	27	
		45	128	121	34	
		64	44	191	25	
A166	A	64	129	117	61	U
A168	A	64	117	119	49	U
A189	A	64	162	136	37	U
A193	A	64	134	88	30	U
A194	A	64	133	187	45	B
A195	A	45	132	216	21	S _f
A260	A		127	153	24	
A261	A	32	126	232	15	
	A2	22	126	129	11	
		16	126	127	10	
		11	126	127	9	
		8	126	127	8	
A262	A	64	178	136	26	
A274	A	64	105	130	29	
A277	A	64	133	115	29	
A278	A	64	180	103	60	U
A279	A	64	134	127	69	U
A358	A	64	117	118	50	S _c
		45	123	116	41	U
		32	126	118	27	
		22	131	125	18	
		16	132	128	15	
	B	11	131	130	13	
	C		98	106	8	
		8	131	130	7	
A389	A	64	73	152	34	
A399	A	64	140	151	37	
A401	A	64	130	119	39	U
A407	A	64	108	165	38	U
A415	A	64	95	150	28	S _f
	B	22	69	147	10	S _f
	C	16	166	59	6	
A426	A	64	153	119	330	
		45	154	118	243	
		32	154	119	184	
		22	153	120	138	
	B		143	241	30	
		16	153	121	113	
			143	242	28	
	C		74	62	20	
	D		18	16	13	U
	E		246	188	15	
	F		239	101	10	
	G		56	157	15	
	H		101	178	16	
		11	152	121	93	
			144	242	24	
			247	188	11	
	I		124	65	11	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A439	J		20	14	8	U
			79	64	10	
			61	157	9	
			240	99	7	
			191	112	14	
			77	5	6	
		8	152	121	83	
			143	242	14	
			190	111	9	
			123	65	8	
A449	K		79	6	5	U
			170	183	6	
			248	189	7	
			239	98	7	
			106	149	9	
			165	88	9	
			112	142	50	
			147	109	35	
			134	133	28	
			146	141	178	
A465	A	64	131	124	115	S _f
A496	B	45	201	221	84	U
	C		32	129	124	
			200	228	57	
		22	131	124	53	
			199	234	35	
		16	129	124	32	
			201	240	21	
		11	201	242	18	
			126	127	20	
		8	202	242	13	
			127	127	14	U
A500	A	64	144	125	36	
A505	A	64	108	175	57	
A514	A	64	80	102	50	
		45	53	92	34	
	B	32	46	82	20	
		22	41	74	13	
	C	16	93	120	9	
			42	72	10	
		11	170	159	6	
A526	A	64	97	141	38	U
A527	A	64	172	158	28	S _f
	B	32	63	233	13	U
		22	63	232	11	
		16	63	231	9	
		11	60	229	7	
A537	A	64	125	116	53	
A539	A	64	130	118	96	
	B	22	20	18	10	
	C	16	158	95	10	
	D		107	83	11	
A548	A1	64	64	175	100	B, S _f
	A2		197	107	90	
		45	48	178	57	
			210	96	66	
		32	215	87	34	
			38	182	33	
		22	35	186	26	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
	B	16	214	79	23	
			211	79	17	
			37	185	17	
			184	133	15	
		11	210	80	11	
			184	134	13	
			43	182	13	
			103	227	7	
		8	228	124	7	
			22	189	9	
			209	81	11	
			186	135	7	
	C		95	85	6	
	D		136	146	5	
			79	148	7	
			44	185	6	
			102	225	5	
A564	A	64	132	174	32	U
A566	A	64	123	139	34	U
A576	A	64	135	125	84	U
A592	A	64	86	109	29	U
A637	A	64	52	104	21	U
A644	A	64	136	116	166	U
A646	A	64	122	102	49	U
A649	A	64	46	78	17	U
A655	A	64	103	111	104	U
A671	A	64	125	125	69	S _f
	B1	45	128	124	55	
		32	132	121	33	
		22	143	117	21	
		16	146	118	13	
		11	146	120	8	
		8	110	123	8	
			146	120	7	
			111	123	6	
			99	126	61	
	A	64	108	123	102	
	B2	45	107	127	75	
		32	113	130	54	
		22	118	131	34	
		16	123	130	19	
	C		84	114	17	
		11	128	126	11	
			81	111	9	
			161	169	6	
A680	A	64	128	125	10	
A754	A	64	161	169	5	
	D	211	104	5		
		64	127	135	36	
		64	89	107	28	
		64	167	117	54	
		32	35	103	24	
		22	39	99	15	
		64	142	129	86	
		45	125	130	61	
		32	119	130	41	
		22	119	130	23	
	B1	16	120	139	16	
		B2	117	119	15	
A757	A	64	127	135	36	U
A779	A	64	89	107	28	U
A786	A	64	167	117	54	S _f
	B	32	35	103	24	
		22	39	99	15	
		64	142	129	86	
		45	125	130	61	
	A	32	119	130	41	
		22	119	130	23	
		16	120	139	16	
		B2	117	119	15	
A924	A	64	142	129	86	S _c
	A	45	125	130	61	
		32	119	130	41	
		22	119	130	23	
		16	120	139	16	
	B1	16	120	139	16	
		B2	117	119	15	
		B2	117	119	15	
	B2	16	120	139	16	
		B2	117	119	15	
		B2	117	119	15	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.		
A978	A	11	82	245	7	S _c		
			29	38	6			
			121	143	8			
		64	133	115	126			
		45	130	116	87			
	B1 B2	32	126	110	46			
		22	131	150	28			
			127	86	30			
		16	131	150	20			
			126	82	21			
A979	A	11	131	149	14	U		
		8	132	148	8			
		64	127	163	52			
A1016	A	64	129	96	59		S _c	
		45	125	123	37			
		32	126	128	22			
		22	127	128	14			
			112	19	12			
	B	16	119	137	10			
			115	15	7			
			153	120	10			
		11	155	118	6			
			120	136	6			
A1035	A	8	122	135	5	U		
		64	129	138	77			
		64	135	135	356			
		45	136	137	255			
	B	32	136	138	173			
			61	53	43			
		22	136	136	111			
			76	60	24			
		16	136	135	82			
A1060	B		79	62	19	S _f		
		11	135	134	55			
			81	63	15			
			179	152	18			
			160	85	14			
	C D E F G		102	165	16			
			35	39	9			
			121	95	16			
		8	135	133	31			
			159	85	12			
A1081	A		180	153	11	U		
			83	63	10			
			35	39	9			
			108	167	11			
			91	160	9			
	64	110	155	42				
	A1126	A	64	105	112		31	U
				87	81		26	
				127	121		51	
				120	110		61	
			123	172	34			
A		64	96	136	69	U		
A1132	A	64	92	144	40	B		
			135	123	35			
		32	159	120	19			
			90	168	22			
		22	89	168	17			

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.			
			155	119	15				
		16	87	168	13				
			154	118	11				
		11	85	167	10				
			152	115	8				
		8	84	168	6				
			153	114	6				
		64	134	133	62				
		64	144	100	37				
		64	128	116	41				
A1190	A	64	134	133	62	U			
A1213	A	64	144	100	37	U			
A1216	A	64	128	116	41	U			
A1228	A	64	102	117	54	U			
A1275	A	64	132	128	42	S _c			
		45	140	122	27				
		32	158	118	15				
			109	124	16				
		B	22	103	124		13		
			164	117	11				
		16	106	121	9				
		C		160	119		9		
		11	107	119	8				
			160	119	5				
		8	107	119	6				
A1292	A	64	136	139	58	S _f			
		45	136	131	31				
		B	22	237	203		12		
			127	135	13				
		A1299	A	64	123		112	74	U
		A1314	A	64	147		115	30	U
		A1334	A	64	88		139	31	U
		A1346	A	64	123		170	68	U
		A1364	A	64	144		169	29	U
		A1365	A	64	126		91	32	U
		A1367	A	64	160		117	126	S _c
		45	159	116	86				
		32	159	116	62				
		22	157	111	38				
		B1	16	149	100		20		
		B2		178	133		20		
		11	180	138	14				
			148	97	12				
		8	180	138	8				
			151	96	9				
		64	138	153	33				
A1377	A	45	142	153	24	S _c			
		32	149	154	21				
		22	153	155	15				
		16	158	156	11				
		B	11	162	155		9		
		C		133	152		5		
		8	162	151	6				
		A	64	78	122		73	B	
		A1	45	53	121		44		
		A2		176	115		38		
		32	45	118	25				
			175	117	23				
		22	169	121	14				
			46	114	16				
		16	166	120	13				
		11	166	119	10				

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
		8	166	120	8	
A1412	A	64	108	109	29	U
A1413	A	64	162	131	66	S _c
		45	167	137	37	
	B1	32	169	149	25	
	B2		154	84	23	
		22	173	143	14	
		16	173	131	10	
		11	170	131	5	
A1437	A	64	116	141	109	U
A1474	A	64	102	150	30	U
A1524	A	64	126	110	64	U
A1541	A	64	119	126	28	U
A1570	A	64	124	188	16	U
A1589	A	64	139	145	43	U
A1630	A	64	113	140	41	U
A1631	A	64	146	107	48	S _c
		45	140	100	31	
		32	133	89	18	
	B	16	128	127	7	
	C		163	82	5	
			169	177	6	
			107	81	7	
		11	127	128	6	
			161	83	5	
		8	127	128	5	
A1644	A	64	135	113	51	U
A1650	A	64	121	135	119	S _f
		45	118	129	74	
		32	118	127	57	
		22	120	123	38	
		16	123	124	28	
	B		178	89	10	
	C		97	35	10	
		11	125	126	16	
		8	125	127	12	
A1651	A	64	134	118	168	S _f
		45	135	122	109	
		32	136	124	68	
	B		215	32	38	
		22	129	128	39	
			205	27	25	
		16	126	131	29	
			203	26	20	
		11	128	130	19	
		8	129	129	13	
A1661	A	64	96	208	56	S _c
		45	77	217	31	
	B	32	56	222	18	
		22	51	223	12	
A1675	A	64	113	156	49	U
A1689	A	64	156	162	99	U
A1691	A	64	144	143	31	U
A1700	A	64	74	117	37	U
A1736	A	64	109	99	117	S _c
		45	107	96	89	
		32	103	93	56	
		22	94	90	33	
			117	133	24	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
	B	16	87	92	20	
	C		136	70	13	
	D		121	134	14	
		11	82	92	11	
		8	127	129	9	
			114	149	8	
			79	90	9	
A1749	A	64	127	109	47	U
A1774	A	64	146	116	43	U
A1775	A	64	109	121	34	U
A1795	A	64	118	154	35	U
A1809	A	64	150	134	52	S_c
		45	148	136	36	
		32	146	136	25	
	B1	22	137	140	13	
	B2		169	118	13	
		16	131	139	8	
		11	133	137	6	
			168	110	6	
			152	160	5	
		8	135	135	5	
			168	109	5	
A1831	A	64	134	125	34	S_c
	B	16	105	60	7	
	C		131	107	7	
A1837	A	64	121	184	456	S_f
		45	125	190	253	
		32	132	191	155	
	B	22	135	189	90	
	C		228	68	53	
	D	16	134	189	55	
	E		228	70	40	
			244	142	30	
			129	130	44	
		11	246	142	21	
			229	70	23	
			129	129	28	
		8	247	141	18	
			230	74	16	
			128	128	18	
A1904	A	64	139	89	27	S_f
	B	11	190	30	5	
A1913	A	64	143	139	43	S_f
		45	145	140	28	
		32	150	145	20	
		22	155	157	11	
	B	16	155	162	9	
	C		96	97	7	
		11	98	98	5	
A1927	A	64	150	91	32	U
A1942	A	64	177	147	42	U
A1983	A	64	136	166	52	B, S_f
	A1	45	131	137	31	
	A2		140	193	24	
		32	128	126	21	
		22	126	125	15	
			105	212	10	
		16	125	125	13	
	B		108	207	7	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
		11	126	125	8	
			111	207	5	
		8	127	128	5	
A1991	A	64	125	114	42	U
A2020	A	64	135	124	52	B
	A1	45	134	59	32	
	A2		152	169	26	
		32	139	44	18	
		11	123	41	6	
A2022	A	64	123	141	37	S_f
	B	8	65	94	4	
A2028	A	64	143	174	23	S_f
		45	137	163	15	
		32	135	163	13	
			33	230	7	
			170	224	7	
		22	140	168	10	
			170	229	6	
	B	16	170	227	5	
A2029	A	64	125	135	73	U
A2040	A	64	133	124	40	U
A2048	A	64	132	117	91	U
A2052	A	64	117	157	93	S_f
		45	122	156	66	
		32	125	153	44	
	B		27	19	18	
		22	126	153	24	
			26	18	16	
		16	21	20	10	
		11	16	22	9	
		8	17	22	7	
A2055	A	64	126	143	47	U
A2056	A	64	183	158	44	U
A2063	A	64	145	144	28	U
A2065	A	64	133	111	122	S_f
		45	132	112	91	
		32	130	113	52	
		22	125	113	35	
	B		238	233	12	
		16	121	114	18	
			240	232	9	
		8	116	113	9	
			141	111	8	
A2073	A	64	126	153	23	S_f
		45	116	157	14	
		32	105	155	12	
		22	104	151	7	
	B	16	103	147	6	
		11	103	150	5	
A2089	A	64	115	108	26	U
A2092	A	64	120	135	27	U
A2096	A	64	95	140	33	U
A2107	A	64	139	125	51	U
A2124	A	64	112	71	46	S_c
		45	115	72	34	
		32	120	74	25	
		22	122	72	16	
		16	119	70	10	
			114	99	8	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A2142	B	11	115	70	8	U
	C		112	104	5	
		8	114	70	7	
	A	64	100	123	30	
	A	64	117	166	70	
		45	128	142	44	
	B1	32	135	132	28	
	B2		139	223	22	
			33	233	17	
		22	135	133	20	
A2147			134	226	14	S _f
		16	132	135	15	
		11	131	135	10	
			55	215	5	
		8	132	135	6	
	A	64	114	141	69	
	A1	45	128	128	44	
	A2		89	207	31	
		32	132	127	32	
		22	127	131	21	
A2151		16	124	132	11	B
		11	61	126	7	
		8	60	127	5	
	A	64	148	118	68	
	A1	45	111	106	34	
	A2		151	143	34	
		32	102	98	22	
		22	163	160	15	
	B		207	105	11	
			103	93	13	
A2152		16	206	104	10	B, S _f
			171	173	10	
		11	208	102	6	
			118	121	9	
			172	174	7	
			149	151	4	
	A	64	99	109	66	
	A1	64	91	99	67	
	A	64	137	126	97	
		45	129	130	59	
A2175		32	125	135	42	U
		22	125	133	27	
		16	126	129	20	
		11	127	128	13	
	B		152	85	8	
			161	246	5	
			209	151	5	
			69	181	7	
		8	126	127	8	
			70	181	6	
A2197			150	82	6	S _f
			211	153	5	
	A	64	162	155	64	
	A	64	113	113	42	
	B	16	98	113	9	
	A	64	119	107	61	
	A	64	114	119	32	
	A	64	120	136	26	
	B	11	131	167	4	
A2210	A	64	162	155	64	U
A2255	A	64	113	113	42	S _c
	B	16	98	113	9	
A2256	A	64	119	107	61	U
A2311	A	64	114	119	32	U
A2312	A	64	120	136	26	S _c
	B	11	131	167	4	

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A2315	A	64	80	102	15	U
A2319	A	64	175	155	25	U
A2366	A	64	125	126	30	U
A2384	A	64	126	142	25	U
A2399	A	64	136	117	34	U
A2410	A	64	145	131	29	U
A2457	A	64	130	132	54	S _c
	B	11	141	82	6	
A2593	A	64	144	138	67	S _f
		45	141	140	48	
		32	139	142	39	
		22	137	145	31	
		16	135	145	23	
		11	130	143	13	
	B		150	83	6	
		8	127	142	10	
			150	84	5	
			144	152	6	
A2597	A	64	166	164	27	U
A2634	A	64	111	150	163	U
A2657	A	64	135	134	52	U
A2665	A	64	91	139	25	U
A2666	A	64	66	86	22	U
A2670	A	64	134	140	181	U
A2700	A	64	118	145	30	U
A2717	A	64	136	119	39	U
A2721	A	64	105	142	51	U
A2877	A	64	142	124	83	S _c
		45	141	125	60	
		32	140	125	37	
		22	140	124	25	
		16	140	123	21	
		11	140	124	17	
	B		167	154	7	
		8	140	129	9	
A3128	A	64	133	112	160	S _{c,f}
		45	128	117	117	
		32	128	118	82	
	B		207	18	28	
		22	129	119	61	
			208	17	15	
		16	129	119	38	
	C		210	93	12	
	D	11	140	115	20	
	E		209	92	10	
	F		118	120	16	
		8	141	114	11	
			209	92	10	
			115	120	10	
			118	141	10	
A3266	A	64	102	163	28	U
A3376	A	64	164	119	43	S _c
		45	170	114	27	
		32	182	110	20	
	B	22	188	109	11	
			128	128	8	
		16	125	127	8	
	C	11	126	125	6	
A3391	A	64	127	67	21	U

Table 3. continued.

Cluster	Struct.	a -Scale	X_c	Y_c	N_{gal}	Morph.
A3395	A	64	147	143	24	B
	A1	45	137	124	16	
	A2		191	232	13	
		32	188	237	9	
			140	125	11	
		22	188	240	8	
			139	130	8	
		16	186	241	8	
		11	185	240	6	
A3526	A	64	124	111	40	B
	A1	45	94	116	31	
	A2		202	111	23	
		32	90	117	20	
			199	109	19	
		22	90	115	13	
			196	107	9	
		16	90	113	11	
			211	112	7	
		11	215	114	5	
A3558	A	64	99	101	79	U
A3562	A	64	185	119	108	$S_{c,f}$
		45	198	125	70	
			34	73	44	
		32	204	132	49	
			27	64	28	
		22	205	133	34	
			24	60	17	
		16	202	129	22	
	B		22	62	14	
	C1	11	197	121	14	$S_{c,f}$
	C2		215	141	12	
		8	197	119	8	
	A		214	141	9	
		64	82	90	93	
		45	64	74	58	
		B	59	76	37	
			128	126	36	
		22	60	80	25	
	C		127	123	18	
		16	61	82	19	
		11	60	80	11	
A3667	D1	8	57	76	6	$S_{c,f}$
			66	90	7	
	D2		21	65	6	
A3716	A	64	139	128	73	U
A3888	A	64	133	129	31	U
A4038	A	64	133	129	101	U

Fig. 3. Distribution of galaxies in A76, A117, A121 and A133 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 4. Distribution of galaxies in A140, A151, A261 and A358 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 5. Distribution of galaxies in A415, A426, A496 and A514 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 6. Distribution of galaxies in A527, A539, A548 and A671 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 7. Distribution of galaxies in A754, A786, A924 and A978 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 8. Distribution of galaxies in A1016, A1060, A1187 and A1275 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 9. Distribution of galaxies in A1292, A1367, A1377 and A1401 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 10. Distribution of galaxies in A1413, A1631, A1650 and A1651 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 11. Distribution of galaxies in A1661, A1736, A1809 and A1831 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 12. Distribution of galaxies in A1837, A1904, A1913 and A1983 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 13. Distribution of galaxies in A2020, A2022, A2028 and A2052 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 14. Distribution of galaxies in A2065, A2073, A2124 and A2147 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 15. Distribution of galaxies in A2151, A2152, A2199 and A2255 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 16. Distribution of galaxies in A2312, A2457, A2593 and A2877 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.

Fig. 17. Distribution of galaxies in A3128, A3376, A3395 and A3526 with wavelet images for scales $a = 129, 188, 258, 375, 527, 750$ kpc presented in the upper right box.