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Test membership of Tago groups of galaxies-I

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ABSTRACT

In This paper the cluster analysis technique (The Euclidean Separation Distance Coefficients) is used to test the membership of individuals in groups of galaxies and apply specific criteria to identify the members which should be excluded from these groups. The method is applied to quintet galaxy groups taken from final release of the two degree field galaxy redshift survey (2dFGRS) . The sample included 4739 quintets with total number of 23695 galaxies. The final results indicate that 317 Groups have one galaxy that has attribute discordant and should be discarded from its grou p.

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1. Introduction

Groups of galaxies defined as small aggregates of galaxies, containing up to some tens of galaxies in the hierarchy of galaxies groups. Physical groups usually selected on the basis of close values of redshift and enhanced frequencies of galaxies relative to that of the background.

According to de Vaucoulaurs (1975), groups contain nearly half of the galaxies in the universe, and redshift surveys of the nearby universe indicate that most galaxies occur in small groups (Humason et al. 1956; de Vaucoulaurs 1965; Holmberg 1969; Materne 1979; Huchra and Geller 1982; Geller and Huchra 1983; Nolthenius and White 1987; Tully 1987a, 1987b).

There are many different catalogues of galaxy groups differ from each other by various selection criteria of members in the groups such as position, mean surface brightness, magnitude, and mean separation distance between the center of groups and each members (Shakhbazian 1957, 1973; de Vaucoulaurs 1975; Turner and Gott 1976a, 1976b; Rose 1977; Karachentsev et al. 1979; Huchra and Geller 1982; Hickson 1982; Huchra et al. 1983; Tully 1987a, 1987b; Rubin et al. 1991; Hickson et al. 1992; Prandoni et al. 1994; Barton et al. 1996; Allam and Tucker 2000; Focardi and Kelm 2002; de Carvalho et al. 2005; Deng et al. 2008; Wang et al. 2008; McConnachie et al. 2009; Diaz-Gimenez et al. 2012)

Because most of the selection criteria depend on the member's distance from the center of the groups and the radii of the members too. We can see many problems in groups of galaxies catalogue, one of the most serious troubles is the projection effect, due to the uncertainty in determining the radii of galaxies (R) and distance determination (D). Later studies on some of these catalogs showed that some of the galaxies in the groups don't belong to their groups and were discarded that in turn could lead to removing the group from the catalog (Hickson 1982, 1993; Mendes de Oliveira 1995; Sulentic 1997).

The uncertainties in Velocity (V), Distance and Hubble constant cause serious problems in the Radii of the groups and the individuals which makes a relative uncertainty in R. This can be added to the fact that one cannot assume if these groups are true physical groups or just projection (Sulentic 1983).

The aim of this study is to test the membership of the galaxies in their groups by applying cluster analysis method (the Euclidean separation coefficient) to find the similarity or dissimilarity between members in the same group.

2. Data reduction

Tago et al. (2006) presented a catalogue of galaxy groups and clusters by applying the friends-of-friends (FOF) algorithm in the final release of the Two Degree Field Galaxy Redshift Survey (2dFGRS). The final sample contains 10,750 groups in the Northern part, and 14,465 groups in the Southern part of the 2dF survey with membership number ≥ 2.

Galaxies in the same groups are supposed to have similar properties that connect them together. So the method depends on studying the similarity between some attributes of galaxies which seems to form a group or catalogued as a group. If these attributes are similar or nearly equal, according to the philosophy of the technique then it may form a group and these groups are real.

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By using the Unweight pair Group Method using arithmetic Average (UPGMA) (Sokal and Michener 1958; Day and Edelsbrunner 1984; Murtagh 1984; Romesburg 1984) to measure the similarity or dissimilarity between any two member's astrophysical parameters in each group.

This is most effectively defined by the Euclidean distance (separation) coefficient between two objects has some properties (X) given by the following equation.

$$e_{jk} = \sqrt{\sum_{i-1}^{3} (X_{ij} - X_{ik})^2} \quad (1)$$

Where j, k are two objects, $e_{jk}$is the euclidean coefficients between objects j and k, and X is the attribute (properties) .This means that to compute e_{jk} for two objects J and K, we use the data in the j^{th} and k^{th} columns of the original data matrix. A generalization form of n attribute can take the form

$$e_{jk} = \sqrt{\sum_{i-1}^{n} (X_{ij} - X_{ik})^2} \quad (2)$$

Equation (2) gives the square root of the sum of the squares of the differences of the values of the n attributes.

The average Euclidean distance coefficient $d_{jk}$is defined as the average of the squares of the differences, expressed as,

$$d_{jk} = \sqrt{\sum_{i-1}^{n} \left[\frac{(X_{ij} - X_{ik})]^2}{n}\right]} \quad (3)$$

In all these equations X_{ij}stands for the value of the i^{th} attribute measured on the j^{th} object and X_{ik} is the value of the i^{th} attribute measured for the k^{th} object, Romesburg (1984).

Mohamed et al. (2009) criteria were used along with the method on the quintet groups of galaxies in the Tago catalog (Tago et al. 2006) to test the physical reality of each member in all quintet Tago groups of galaxies (4739 groups which have 23,695 galaxies).

The criteria depend on;

(1) Galaxies of coefficients smaller by any value than $e_{av} - \sigma$ are given the name Twin (T). The twin property is here of a relative sense, because it depends on the attributes of the groups.
(2) Galaxies of coefficients of the order $e_{ij} < e_{av}$are given the name pair (P).
(3) Coefficients ranging between $e_{av} \leq e_{ij} \leq e_{av} + \sigma$ are given the named member (M)
(4) If the coefficients are$e_{ij} > e_{av} + \sigma$, it is called attribute discordant galaxy (AD). It is the galaxy that whenever its attributes enter with attributes of the other galaxies in an assembly falsifies the Euclidean coefficients
(5) To decide the triplet character, the Combined Euclidean Distance Coefficient (CEC) is to be determined. Although triplets can be seen directly from the coefficients, we found it necessary to determine the CEC to assure the results and to isolate them quantitatively.

3. Results and discussion

We applied the UPGAMA method to the 4739 quintet groups of galaxies taken from the Tago catalogue (Tago et al. 2006) and calculated the astrophysical Euclidean separation coefficients of each two members in the same group using the magnitude in b-band and the Color index (bj-br).

The sample of the result from first 10 groups of galaxies (from 4739 groups) listed in Table 1 as follows: Column (1): the number of the Euclidean confidents array,column (2): the b magnitude of the first object, column:3 the b magnitude of the second, column (4): the color index (bj-br) of the first object, column (5): the color index (bj-br) of the second object column (6): the calculated Astrophysical euclidean coefficient, column (7) is the average astrophysical euclidean coefficient, column (8): the standard deviation, column (9): the classification of each two galaxies (T, P, M, AD) according to the value of the similarity.

The results from quintet Tago groups show that most of the members in the groups are real members while some groups have one or more attribute discordant galaxies and some groups contain two sub groups. To inspect the reality of the results the combined Euclidean coefficient was applied

$$e_{m(jk)} = \frac{1}{2}(e_{mj} + e_{mk}) \quad (4)$$

Where m, j and k are galaxy members on the same group

Applying the combined Euclidean coefficient shows that 317 Groups have one or more galaxy that has attribute discordant and should be discarded from its group (Table 2). In Table 2, the list of attribute discordant galaxy (317 AD galaxies) which should be excluded from the Tago groups catalogue. Column1: Group ID. No., column2: galaxy ID. No, column 3 and 4 is the galaxy position

4. Conclusion

In this paper, the UPGAMA method as a cluster analysis technique used to test the membership in quintet Tago groups of galaxies. The complete sample has 4739 quintet groups. The UPGAMA technique used to figure the euclidean coefficients

Table 1. The first 10 quintet groups as a sample of all results.

	$(B)_i$	$(B)_j$	$(B_j - B_r)_i$	$(B_j - B_r)_j$	e_{ij}	e_{av}	σ	classification
Group No.: 34								
e_{12}	17.929	18.079	−18.65	−18.5	0.2121	1.12646	0.75627	T
e_{13}	17.929	16.543	−18.65	−20.036	1.9601			AD
e_{14}	17.929	17.316	−18.65	−19.263	0.86691			P
e_{15}	17.929	18.141	−18.65	−18.415	0.31649			T
e_{23}	18.079	16.543	−18.5	−20.036	2.17223			AD
e_{24}	18.079	17.316	−18.5	−19.263	1.07904			P
e_{25}	18.079	18.141	−18.5	−18.415	0.10521			T
e_{34}	16.543	17.316	−20.036	−19.263	1.09319			P
e_{35}	16.543	18.141	−20.036	−18.415	2.27623			AD
e_{45}	17.316	18.141	−19.263	−18.415	1.1831			M
Group No.: 70								
e_{12}	17.596	18.366	−20.099	−19.193	1.189	1.70155	0.8994	P
e_{13}	17.596	18.7	−20.099	−18.859	1.66025			P
e_{14}	17.596	16.866	−20.099	−20.829	1.03238			P
e_{15}	17.596	19.251	−20.099	−18.375	2.38981			M
e_{23}	18.366	18.7	−19.193	−18.859	0.47235			T
e_{24}	18.366	16.866	−19.193	−20.829	2.21957			M
e_{25}	18.366	19.251	−19.193	−18.375	1.20513			P
e_{34}	18.7	16.866	−18.859	−20.829	2.69155			AD
e_{35}	18.7	19.251	−18.859	−18.375	0.73339			T
e_{45}	16.866	19.251	−20.829	−18.375	3.42204			AD
Group No.: 94								
e_{12}	19.328	17.723	−18.276	−19.828	2.2326	1.28552	0.71364	AD
e_{13}	19.328	19.024	−18.276	−18.616	0.45609			T
e_{14}	19.328	18.376	−18.276	−19.264	1.37202			M
e_{15}	19.328	17.638	−18.276	−19.868	2.32176			AD
e_{23}	17.723	19.024	−19.828	−18.616	1.77807			M
e_{24}	17.723	18.376	−19.828	−19.264	0.86285			P
e_{25}	17.723	17.638	−19.828	−19.868	0.09394			T
e_{34}	19.024	18.376	−18.616	−19.264	0.91641			P
e_{35}	19.024	17.638	−18.616	−19.868	1.86775			M
e_{45}	18.376	17.638	−19.264	−19.868	0.95366			P
Group No.: 107								
e_{12}	18.485	17.396	−19.958	−21.047	1.54	1.41874	0.76853	M
e_{13}	18.485	18.09	−19.958	−20.353	0.55861			T
e_{14}	18.485	19.344	−19.958	−19.099	1.21481			P
e_{15}	18.485	19.21	−19.958	−19.233	1.0253			P
e_{23}	17.396	18.09	−21.047	−20.353	0.98146			P
e_{24}	17.396	19.344	−21.047	−19.099	2.75489			AD
e_{25}	17.396	19.21	−21.047	−19.233	2.56538			AD
e_{34}	18.09	19.344	−20.353	−19.099	1.77342			M
e_{35}	18.09	19.21	−20.353	−19.233	1.58392			M
e_{45}	19.344	19.21	−19.099	−19.233	0.1895			T
Group No.: 128								
e_{12}	18.312	15.4	−17.638	−20.529	4.1033	2.27585	1.49058	AD
e_{13}	18.312	17.637	−17.638	−18.342	0.97532			P
e_{14}	18.312	19.048	−17.638	−16.902	1.04086			P
e_{15}	18.312	17.565	−17.638	−18.432	1.09016			P
e_{23}	15.4	17.637	−20.529	−18.342	3.12844			M
e_{24}	15.4	19.048	−20.529	−16.902	5.14422			AD
e_{25}	15.4	17.565	−20.529	−18.432	3.01407			M
e_{34}	17.637	19.048	−18.342	−16.902	2.01607			P
e_{35}	17.637	17.565	−18.342	−18.432	0.11526			T
e_{45}	19.048	17.565	−16.902	−18.432	2.13077			P
Group No.: 147								
e_{12}	18.956	18.928	−19.982	−20.01	0.0396	0.46391	0.35146	T
e_{13}	18.956	19.034	−19.982	−19.682	0.30997			P
e_{14}	18.956	18.4	−19.982	−20.538	0.7863			M
e_{15}	18.956	19.024	−19.982	−19.914	0.09617			T

(*Continued*)

Table 1. (Continued).

	$(B)_i$	$(B)_j$	$(B_j - B_r)_i$	$(B_j - B_r)_j$	e_{ij}	e_{av}	σ	classification
e_{23}	18.928	19.034	−20.01	−19.682	0.3447			P
e_{24}	18.928	18.4	−20.01	−20.538	0.7467			M
e_{25}	18.928	19.024	−20.01	−19.914	0.13576			P
e_{34}	19.034	18.4	−19.682	−20.538	1.06522			AD
e_{35}	19.034	19.024	−19.682	−19.914	0.23222			P
e_{45}	18.4	19.024	−20.538	−19.914	0.88247			AD
Group No.: 165								
e_{12}	19.158	17.927	−18.727	−19.918	1.7128	0.99862	0.54539	AD
e_{13}	19.158	19.224	−18.727	−18.514	0.22299			T
e_{14}	19.158	18.835	−18.727	−18.953	0.39421			T
e_{15}	19.158	18.271	−18.727	−19.467	1.15515			M
e_{23}	17.927	19.224	−19.918	−18.514	1.91139			AD
e_{24}	17.927	18.835	−19.918	−18.953	1.32502			M
e_{25}	17.927	18.271	−19.918	−19.467	0.56722			P
e_{34}	19.224	18.835	−18.514	−18.953	0.58655			P
e_{35}	19.224	18.271	−18.514	−19.467	1.34775			M
e_{45}	18.835	18.271	−18.953	−19.467	0.76308			P
Group No.: 206								
e_{12}	18.373	18.531	−19.036	−18.846	0.2471	0.53068	0.43519	P
e_{13}	18.373	17.751	−19.036	−19.658	0.87964			M
e_{14}	18.373	18.568	−19.036	−18.778	0.3234			P
e_{15}	18.373	18.45	−19.036	−18.959	0.10889			P
e_{23}	18.531	17.751	−18.846	−19.658	1.12594			AD
e_{24}	18.531	18.568	−18.846	−18.778	0.07741			T
e_{25}	18.531	18.45	−18.846	−18.959	0.13903			P
e_{34}	17.751	18.568	−19.658	−18.778	1.20079			AD
e_{35}	17.751	18.45	−19.658	−18.959	0.98854			AD
e_{45}	18.568	18.45	−18.778	−18.959	0.21607			P
Group No.: 237								
e_{12}	18.582	16.67	−17.81	−19.696	2.6856	1.24371	0.73204	AD
e_{13}	18.582	17.516	−17.81	−18.91	1.53178			M
e_{14}	18.582	17.632	−17.81	−18.794	1.36776			M
e_{15}	18.582	17.046	−17.81	−19.402	2.21218			AD
e_{23}	16.67	17.516	−19.696	−18.91	1.15478			P
e_{24}	16.67	17.632	−19.696	−18.794	1.31873			M
e_{25}	16.67	17.046	−19.696	−19.402	0.4773			T
e_{34}	17.516	17.632	−18.91	−18.794	0.16405			T
e_{35}	17.516	17.046	−18.91	−19.402	0.68041			P
e_{45}	17.632	17.046	−18.794	−19.402	0.84443			P
Group No.: 256								
e_{12}	18.754	17.287	−17.861	−19.292	2.0493	2.16554	1.40206	P
e_{13}	18.754	19.12	−17.861	−17.495	0.5176			T
e_{14}	18.754	18.631	−17.861	−17.948	0.15066			T
e_{15}	18.754	16.029	−17.861	−20.61	3.87074			AD
e_{23}	17.287	19.12	−19.292	−17.495	2.56692			M
e_{24}	17.287	18.631	−19.292	−17.948	1.9007			P
e_{25}	17.287	16.029	−19.292	−20.61	1.822			P
e_{34}	19.12	18.631	−17.495	−17.948	0.66658			T
e_{35}	19.12	16.029	−17.495	−20.61	4.38834			AD
e_{45}	18.631	16.029	−17.948	−20.61	3.72245			AD

between each pair inside same group and apply specific criteria to identify the relation between every pair within same group. The astrophysical parameters b-magnitude and color index are used as attributes to test the similarity or dissimilarity between each pair.

The conclusive outcome shows that, there are 317 Groups have one attribute discordant galaxy which should be excluded from catalogue.

When the AD list exclude from their groups in the original catalogue, all astrophysical parameters in these groups which depends on the group

Table 2. The list of discordant galaxy (317 AD galaxies) which should be excluded from the Tago groups catalogue.

Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$	Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$
52	356	15.55	−20.244	6653	48040	19.018	−18.601
76	505	18.215	−20.095	6697	48350	18.061	−20.448
118	798	16.135	−22.022	6712	48416	19.296	−18.452
128	935	15.4	−20.529	6744	48705	16.965	−21.02
147	1038	18.4	−20.538	6795	49105	17.507	−19.727
147	1067	18.017	−18.423	6806	49216	16.961	−21.65
206	1510	17.751	−19.658	6847	49537	17.38	−20.476
220	1571	17.983	−20.169	6926	49940	19.32	−18.977
237	1726	18.582	−17.81	6971	50192	18.098	−19.699
262	1909	16.719	−21.606	6977	50265	16.277	−20.022
351	2587	17.563	−21.164	6993	50359	16.934	−19.887
397	7650	16.928	−18.524	7013	50935	14.681	−20.146
471	3491	17.751	−20.42	7071	51217	17.892	−20.672
497	34615	19.225	−17.374	7092	51123	16.667	−18.529
498	3732	18.139	−17.764	7093	51395	17.542	−21.104
520	3896	18.366	−20.102	7109	51341	17.782	−21.066
544	4126	16.222	−19.589	7135	51765	18.944	−19.174
577	4382	19.267	−19.473	7160	51757	16.493	−19.131
603	4586	17.066	−19.31	7237	52676	16.02	−18.063
618	4624	17.468	−20.45	7250	52711	16.384	−20.923
691	5367	16.913	−19.701	7253	53625	18.203	−20.836
703	5394	18.349	−20.246	7366	53234	17.01	−21.957
730	5588	19.146	−20.059	7462	54082	18.669	−18.583
834	6252	16.342	−20.837	7483	54102	17.956	−21.233
888	6494	18.359	−20.459	7538	54509	16.781	−20.474
894	6722	16.668	−19.866	7590	54924	16.284	−20.918
933	6874	17.741	−20.78	7617	55169	19.416	−18.448
1053	7649	16.984	−22.132	7706	55807	16.311	−20.986
1070	7951	19.235	−18.575	7736	55967	17.228	−19.758
1084	8008	17.358	−20.908	7810	56585	18.209	−15.95
1093	8131	15.394	−20.131	7860	56998	18.463	−19.783
1108	8159	18.831	−16.715	7955	57906	16.441	−20.342
1137	8345	19.02	−16.486	7991	57697	18.43	−18.839
1191	8720	16.52	−20.927	8027	58352	16.763	−19.995
1214	8867	17.532	−18.823	8047	58169	17.373	−21.68
1265	9466	16.887	−21.133	8086	58741	18.156	−20.566
1268	9271	15.107	−20.384	8103	58543	19.181	−18.163
1282	9533	15.513	−20.507	8172	58920	15.159	−18.562
1294	9656	16.923	−19.882	8192	59760	16.955	−20.972
1349	10031	19.397	−18.198	8221	59972	16.409	−20.135
1350	10024	17.724	−21.621	8288	59808	16.714	−22.109
1352	9991	17.222	−21.07	8327	60061	19.082	−19.589
1398	10318	19.187	−15.376	8371	60339	18.243	−16.116
1410	10427	17.001	−19.825	8421	60722	16.792	−20.557
1495	11054	14.858	−17.644	8449	61002	16.457	−20.82
1633	12087	17.481	−20.79	8470	61153	18.017	−20.019
1672	12361	18.583	−19.634	8472	61151	17.685	−20.505
1736	12776	17.425	−20.191	8513	62031	18.24	−20.336
1758	13064	16.579	−20.732	8573	62496	19.061	−17.978
1865	13896	17.942	−20.618	8631	62266	17.451	−21.211
2014	14901	17.648	−18.752	8676	63311	14.345	−19.248
2023	15108	15.935	−20.126	8851	64571	16.341	−21.407
2027	15013	17.27	−20.57	8852	64564	19.234	−17.783
2071	15360	16.793	−21.731	8861	64055	16.525	−20.821
2120	15602	19.263	−17.356	8871	64031	17.019	−20.341
2144	15801	16.47	−20.675	8914	64448	18.6	−20.487
2350	17512	15.771	−20.911	8921	65169	18.266	−15.941
2360	17312	16.687	−20.104	8972	65557	18.268	−19.241
2461	19306	14.462	−20.091	9041	65322	17.027	−20.143
2487	18238	17.355	−20.553	9067	66197	16.846	−20.564
2505	18370	18.436	−19.519	9072	66707	17.05	−20.666

(*Continued*)

Table 2. (Continued).

Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$	Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$
2512	18760	17.429	−20.762	9136	66718	18.635	−19.997
2558	19130	17.719	−20.986	9214	68663	16.413	−17.92
2571	18880	19.292	−18.925	9220	66606	18.998	−18.423
2670	19535	16.9	−21.5	9259	67647	15.501	−20.665
2740	19940	18.94	−19.317	9263	66969	17.36	−20.631
2777	20933	19.385	−19.009	9263	67696	14.402	−20.267
2860	21416	16.439	−20.35	9284	67079	16.548	−20.517
2897	21009	17.561	−19.681	9345	67467	16.985	−18.099
2948	25215	17.78	−20.69	9391	67882	16.785	−20.751
2993	22400	18.459	−20.304	9408	68805	19.309	−19.985
3008	21753	18.674	−18.487	9424	68107	17.531	−19.73
3090	23188	16.633	−20.36	9482	69442	18.638	−19.024
3157	22876	18.746	−19.007	9517	69653	16.745	−21.1
3186	23178	14.855	−19.502	9583	70101	18.731	−19.909
3191	23208	19.163	−19.272	9614	69503	15.852	−20.198
3196	23258	17.505	−21.813	9683	70845	18.115	−19.967
3257	23618	17.312	−20.829	9694	70969	18.045	−20.275
3273	23719	18.805	−19.301	9726	70386	17.78	−20.003
3294	24601	18.369	−20.37	9749	70532	17.082	−21.729
3342	24880	17.13	−19.677	9758	70583	17.729	−21.066
3361	25024	18.847	−20.264	9836	71918	19.131	−17.909
3376	24465	17.832	−20.252	9841	71122	18.395	−20.459
3405	25344	16.585	−20.911	9858	72081	19.118	−18.874
3491	25582	14.927	−21.223	9859	71330	16.501	−21.412
3601	26741	18.793	−20.219	9899	71624	15.421	−19.157
3672	27296	17.392	−20.776	9913	71715	17.959	−20.232
3734	27742	17.592	−20.354	9917	71905	15.292	−19.242
3748	27856	17.459	−20.949	9931	72604	17.549	−20.309
3751	27561	19.195	−17.963	9982	72148	15.84	−20.386
3811	28022	16.715	−21.4	9989	74068	17.326	−20.223
3827	29732	16.47	−19.754	10057	73490	17.461	−20.933
3831	28352	17.731	−20.283	10060	73504	18.89	−18.111
3845	28436	19.39	−18.883	10091	73687	17.171	−20.963
3855	28417	17.899	−20.494	10226	74059	18.261	−19.941
3856	28525	17.761	−18.375	10274	74410	16.294	−19.982
3917	28960	18.047	−20.055	10274	74981	17.93	−20.368
3956	29167	16.806	−20.832	10294	75165	18.871	−18.418
4089	30171	16.7	−19.305	10419	75535	17.583	−21.199
4116	30353	17.577	−18.816	10461	76431	16.743	−20.576
4169	30682	17.452	−20.212	10467	76484	17.797	−19.393
4186	30836	17.485	−17.145	10475	76557	16.193	−21.038
4293	78872	16.515	−19.786	10581	76725	18.87	−16.836
4384	32281	16.786	−19.864	10613	76971	17.739	−21.123
4436	32749	17.102	−20.528	10721	78392	19.219	−19.493
4461	32801	16.193	−20.74	10896	79692	17.747	−19.24
4591	33683	18.369	−19.954	10957	80111	17.481	−20.459
4610	33887	16.772	−20.728	10965	80231	18.548	−18.772
4691	34354	17.772	−20.131	11083	81069	19.423	−17.148
4742	34714	16.493	−20.469	11145	81456	17.441	−19.883
4746	34801	19.113	−18.515	11369	83016	17.298	−20.807
4766	34871	17.348	−21.018	11384	83115	19.147	−17.725
4787	35009	17.867	−21.558	11523	85059	15.956	−20.968
4812	35199	17.21	−21.082	11579	84671	18.601	−18.745
4866	35749	15.608	−20.323	11600	84796	18.482	−17.72
4874	35789	15.483	−20.397	11774	86126	17.921	−20.479
4874	35592	17.115	−21.134	11832	86557	19.182	−18.97
4894	35693	16.962	−20.706	11847	86683	17.187	−20.811
4932	35990	17.023	−20.048	11915	87218	19.302	−19.077
4937	36394	17.62	−18.917	11930	87330	16.785	−20.63
4941	36426	16.499	−20.46	12036	88195	17.186	−19.296
5029	37170	16.991	−19.092	12051	88341	17.054	−20.09

(*Continued*)

Table 2. (Continued).

Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$	Group ID.	Galaxy ID	$\alpha_{2000}(deg)$	$\alpha_{2000}(deg)$
5053	36703	16.146	−20.436	12139	89034	18.18	−19.584
5118	37837	16.379	−19.003	12173	89295	16.828	−21.092
5135	37276	17.369	−20.584	12190	89421	17.621	−18.915
5164	38087	14.848	−20.68	12281	90139	16.506	−21.608
5179	37556	19.25	−18.555	12316	90361	17.034	−21.276
5229	38496	16.679	−18.887	12351	90619	19.134	−18.623
5413	39678	16.326	−22.254	12366	90730	19.037	−19.391
5435	39341	16.691	−21.306	12375	90851	16.41	−21.376
5445	39416	18.428	−19.491	12410	91087	19.082	−18.709
5465	40003	17.953	−19.71	12422	91189	17.109	−19.234
5513	39740	17.482	−21.501	12446	91364	17.227	−18.92
5535	40471	16.445	−20.569	12562	92233	19.329	−18.656
5581	40769	19.221	−18.343	12668	93093	19.35	−19.38
5709	41129	17.502	−20.794	12802	94046	17.217	−21.731
5748	41846	19.302	−19.427	12853	94394	16.397	−21.383
5752	41874	17.046	−19.677	12970	95914	19.025	−17.261
5772	41647	19.097	−15.81	12975	95275	16.282	−20.929
5799	42204	17.245	−20.604	12979	95300	17.857	−19.102
5869	42316	18.348	−20.202	13121	97186	18.187	−19.292
5896	42969	19.251	−18.762	13133	96585	16.732	−20.34
5896	42505	17.883	−20.614	13136	99888	17.528	−19.613
5937	43265	15.837	−19.918	13167	96824	17.387	−19.762
5988	43587	17.163	−20.258	13249	97491	16.391	−20.835
6033	43473	17.987	−20.926	13265	98843	17.81	−19.647
6078	43754	15.294	−19.678	13349	98109	16.631	−20.018
6096	44354	16.491	−20.893	13431	98599	16.585	−19.786
6100	44384	16.723	−18.833	13491	99043	15.736	−19.722
6187	45057	19.08	−16.898	13554	99570	16.809	−21.289
6268	45441	17.703	−20.598	13666	100377	19.231	−17.846
6290	45565	19.104	−19.399	13734	100863	17.426	−18.734
6319	52028	19.39	−18.189	13833	101748	18.055	−20.536
6358	45814	17.045	−19.38	13858	101978	16.454	−21.511
6442	46415	15.32	−19.568	14238	104738	17.121	−19.862
6506	47046	18.096	−20.661	14299	105160	17.679	−20.776
6509	47077	16.309	−20.524	14313	105277	18.005	−20.52
6546	47301	16.42	−17.96	14435	106172	17.433	−19.848
6619	47775	17.49	−21.379				

astrophysical parameters will be changed such as centroid of the group, mean redshift, radial velocity, distance and combined magnitude.

Disclosure statement

No potential conflict of interest was reported by the author.

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