International Journal of Scientific & Engineering Research, Volume 5, Issue 1, January-2014
ISSN 2229-5518

Study of 338 galaxies of Virgo Cluster

Varsha Gupta, Gopal Upadhyaya

Abstract— The Virgo cluster is the nearest and best studied rich cluster of galaxies. Owing to its proximity, it provides great opportunity towards its detailed study. The present paper is based on the first exhaustive study on Virgo by Bruno Binggeli, Allan Sandage and G.A. Tammann (1985) that encompasses 2096 galaxies (including all member, possible member and background galaxies). This paper is an attempt to understand the true morphological structure and kinematics of the cluster by including new available data (velocity and distances) of 338 galaxies to VCC, mainly the dwarf Ellipticals (163) galaxies which in fact, dominate (in number) the cluster .The sample contains many fainter galaxies up to BT ~ 20 mag. The study reveals the complexity of its structure which certainly provides the evidence for un-relaxed dynamics and the evolutionary state of Virgo cluster.

Key words — Virgo cluster, structure, morphology, heliocentric velocity.

INTRODUCTION

Study of cluster of galaxies has been pouring in valuable information about their formation and evolution. Virgo cluster, the nearest and largest rich cluster of galaxies in Northern Hemisphere is an important cluster for extra-galactic astronomy. Cosmographically, it lies at the center of Local Super cluster (also called Virgo super cluster) in whose outskirts Milky Way is situated in the Local group (G. de Vaucouleurs, 1956) [1].

The discovery of cluster itself dates back to 1784, when Charles Meissier and collaborators noted the unusual concentrations of nebulae in Virgo and listed them as Meissier objects, which were later identified as member galaxies of the Virgo cluster. Studies by Shapley & Ames (1926, 1932) [2], [3]; Hubble & Humason (1931) [4]; Smith (1936) [5]; de Vaucauleurs (1956, 1961) [1], [6]; Reaves (1956) [7]; Zwicky (1959) [8]; de Vaucouleurs & de Vaucouleurs (1973) [9] and many more have revealed much about the cluster.

Bruno Binggeli, Allan Sandage and G.A. Tammann in 1985 provided a solid platform for exhaustive studies on 'Virgo' by compiling a catalog, called Virgo Cluster Catalog or VCC which they further modified in 1987 and 1993 [10], [11], [12]. Followed by, the studies of Yasuda et al. 1997 [13]; Gavazzi et al., 1999 [14]; Schindler, Binggeli and Bohringer, 1999 [15] and many other workers further refined and redefined the Virgo structure. Moreover, Gavazzi and collaborators in 1999 presented an extended 3 D structure of Virgo cluster, showing elaborated subdivision of different cluster regions and estimated their distance by using Fundamental plane (FP) and Tully Fisher relations (TF) relations.

There appears unanimous consensus that Virgo cluster is an irregular cluster, lying at a distance of ~ 17 Mpc (Gavazzi et al., 1999 and references therein) with mean velocity of ~ 1094 kms^{-1} [12]. It is made up of several clouds or groups of galaxies with two main components, cluster A associated with M87 and cluster B associated with M49 (whereas Gavazzi et al., 1999 placed M49 closer than cluster B, based on TF distance estimate). The galaxies in Virgo region are not at unique distance and evidence of infall has been reported [11], [14]. However, the idea of infall is still not settled. Authors keep on reporting diverse views on this issue (BST 1993 [12]; Mei et al., 2007 [16]; Chernin et al., 2010 [17]). The subclustering in the cluster provides the evidence of lack of dynamical equilibrium.

Virgo cluster is a home of ~ 2096 optically catalogued galaxies of all known Hubble types and diverse luminosities, ranging (in absolute magnitude) from the bright giant elliptical and spirals to faint dwarf and irregular galaxies, with dwarf Ellipticals in particular numerically dominating the cluster population .

Owing to its proximity, it could be mapped to an unsurpassed level of depth and morphological detail, rendering it presently the most studied richest cluster of galaxies in terms of number of known galaxies. In particular, this cluster is an important stepping stone towards determination of the distance scale of the universe.

However even today, the criteria set by BST, still serve as an important standard for many studies on 'Virgo'. Therefore in order to understand the real structure and kinematics of galaxies of Virgo cluster, the present paper is divided into two sections-

Section 1: Study of structure and kinematics of Virgo cluster as explained by BST 85, BST 87 and the revised structure presented by BST 93.

Section 2: Reanalysis of morphological and Kinematic structure by updating the velocity and distance values of 338 galaxies of VCC.

Section 1:

Earlier studies showed that the structure of Virgo cluster is quite complex. It is an irregular cluster with significant sub structures. It mainly consists of two significant sub clusters (cluster A and cluster B) and few clouds (termed as W, W', M and an elongated Southern extension or SE). Main cluster A containing M87/NGC4486 (considered as heart of the Virgo cluster) is separated from cluster B containing M49/NGC4472. The clouds are considered as the separate entities, with distinct structural and kinematical properties. It is also noticed that the Virgo cluster is a home of all known morphological

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

types of galaxies.

Bruno Binggeli, Allan Sandage, G. A. Tammann in 1985 carried out the most exhaustive high quality optical survey of Virgo cluster and compiled a catalog called 'Virgo Cluster Catalog' or 'VCC' that encompasses 2096 galaxies . By covering the area of around 140 deg^2, it roughly centered on Virgo cluster at α ~ 12h25m and δ ~ 13° and includes all galaxies down to BT ~ 18 mag. Few fainter members up to BT ~ 20 mag were also included in it. However, the surface brightness limit for studying extended galaxies is BT ~ 25 mag/arcsec^2.

Table 1 shows the morphological distribution of all the 2096 galaxies supported by histogram (figure 1), which clearly shows that dwarf Elliptical galaxies, in particular, dominate the cluster population.

Table 1:

Type	No. of Galaxies
E (Elliptical)	48
dE (Dwarf Elliptical)	1144
S0+dS0	35+98 = 133
Others(pec,?,Amorphous type)	40
S0/a	11
Spirals[Sa+Sab+Sb+Sbc+Sc+Sc(I-IV) +Sd+Sdm]	185
Sm+Im	160
Im/BCD	16
BCD	62
Total	**2096**

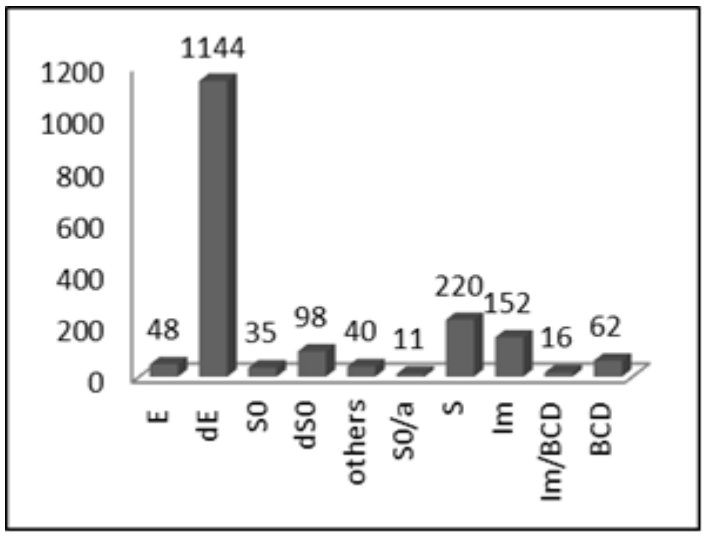

Fig.1 Morphological distribution of all galaxies of VCC

They divided all the galaxies of VCC into three categories: Certain cluster member (which belong to Virgo cluster) designated as 'M', Possible cluster member (may or may not belong to the Virgo cluster) marked as '(-)', and Background galaxy (outside the Virgo cluster or Zwicky galaxy) designated as 'B'. According to surface brightness, resolution into knots, luminosity class, and radial velocity; the criterion is set for cluster membership (Binggeli et al. 1984 and 85) [18], [10]. Whereas in some cases, where the cluster membership is uncertain the galaxy was included as Possible member. Figure 2 shows the distribution of galaxies as per VCC.

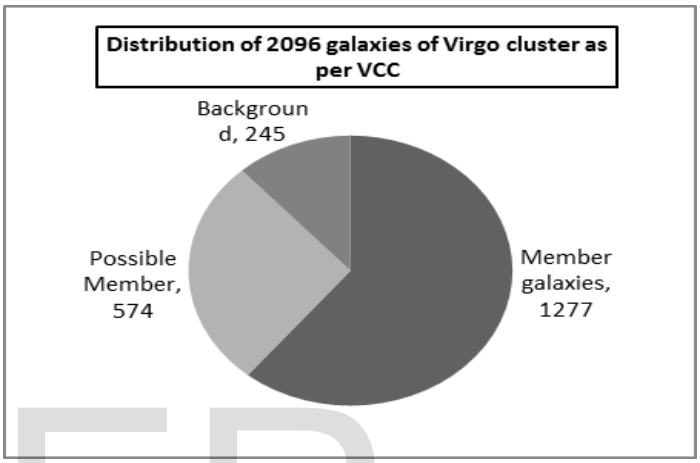

Fig. 2 Distribution of 2096 galaxies of Virgo cluster as per VCC

They separated cluster members from background galaxies by considering the following criterion:

a. dE (dwarf elliptical) and I (Irregular) have low surface brightness.
b. Star forming member galaxies have well resolved stellar associations and HII regions.
c. Spiral members could be identified on the basis of luminosi -ty class.
d. The heliocentric radial velocity ($v_\odot$) ranges from -700 kms^{-1} to 2700 kms^{-1}, applied to all types (for cluster membership).

BST concluded that the radial velocities serve in general, as a confirmation of morphological membership.

Extending their previous work Bingelli, Sandage and Tammann in 1987 (hereafter BST87) carried out the kinematic analysis of VCC and brought in few modifications:

They separated the member and background galaxies of VCC on the basis of velocity data by considering that those galaxies having velocity (heliocentric) $v_\odot$ < 500 kms^{-1} must be a cluster member whereas galaxies with $v_\odot$ > 3000 kms^{-1} are certainly in background. They observed that in many cases, the change in membership status is often followed by a change in Hubble type.

Besides, few regions in the surveyed area were found where it was difficult to distinguish between members and non- mem-

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

bers, neither from the morphological criteria nor from velocities. Those areas were marked as 'cloud regions' (namely; 'W cloud', 'W' cloud', 'M cloud', and the 'Southern Extension'). They also observed that early type galaxies (E, S0, dE, dS0) were much more concentrated towards the cluster center(s) than late type galaxies (spirals and Irregulars).

The real structure and kinematics of Virgo cluster became clearer when Bruno Binggeli, C.C. Popsecu and G. A. Tammmann in 1993 (hereafter BTS93) supplemented the VCC and the study of BST1987. They increased the kinematic size of Virgo Cluster to total 708 galaxies (out of 2096 galaxies listed in VCC) by adding 144 new velocity data to the previous known for 564 galaxies. With this new (enlarged) kinematic sample of VCC and by using the same criteria, earlier set by BTS87 (for certain cluster member and background galaxy), they once again analyzed the kinematics of Virgo cluster.

BST93 plotted the velocity histogram (shown in figure 3) and found that the new velocity data were fully consistent with their previous morphological work (except for few cases).

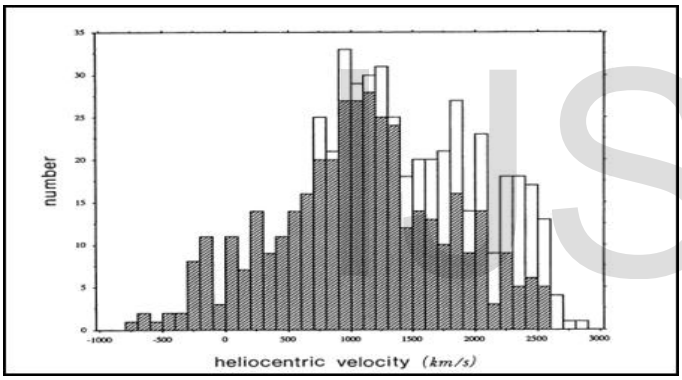

Fig. 3 Velocity distribution of all members and possible members of VCC (courtesy: BST93)

By analyzing the velocity histogram they confirmed that those galaxies having $v_\odot$ < 500 kms^{-1} are bonafide cluster member. Whereas, spoiled velocity range between 700 kms^{-1} < $v_\odot$ < 3000 kms^{-1} was obtained which clearly indicate that not every galaxy with $v_\odot$ < 3000 kms^{-1} is automatically a cluster member and therefore they are included as possible member.

BST93 were of the view that there must be number of well-known clouds of galaxies in the near background which overlap with the broad velocity distribution of the Virgo cluster and due to their proximity these cloud galaxies (which were earlier considered as separate entities) are not sufficiently distinct from the cluster member by morphology. Therefore these galaxies entered the VCC as 'possible members'. The revised structure of Virgo cluster by BST93 showing the cleansed sample containing main cluster A and cluster B is shown in figure 4 and different cloud regions along with Southern Extension (SE) are shown in figure 5. They also proposed the mean heliocentric velocity of Virgo cluster to be $<v_\odot>_{VC}$ = 1050 ± 35 kms^{-1} and found that it is nearly 5 % lower than $<v_\odot>_{VC}$ = 1094 ± 35 kms^{-1}, as recommended by BTS87.

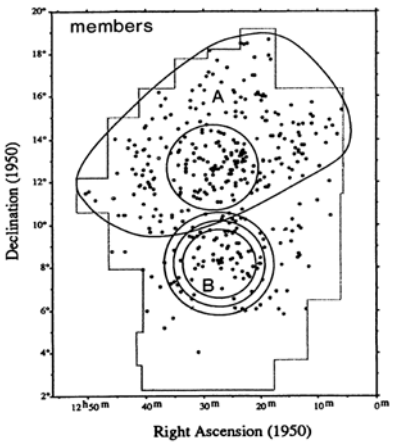

Fig.4 Cleansed sample of Virgo cluster containing cluster A and cluster B (courtesy: BTS93)

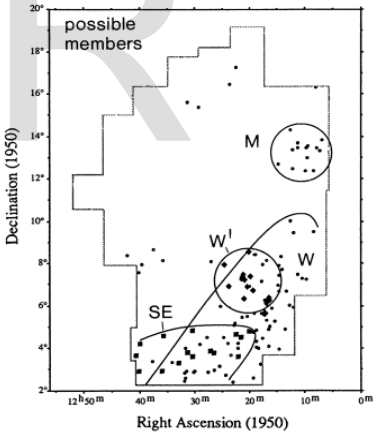

Fig.5 Different cloud regions & along with SE identified by BTS (courtesy: BTS93)

Because of relative proximity, the Virgo cluster has been studied in detail at many wavelengths (Hα, HI, CO, near IR, radio continumm and X-ray) by many astronomers. As a result, enormous data is now available. In the next section we pickup updated velocity and distance data from GOLD Mine database (as of Sep. 2008 it contains the data of total 3649 galaxies in the Coma supercluster, Virgo cluster, Cancer and Abell cluster) and NASA/IPAC Extragalactic Database (NED), with a view to analyse the effect of inclusion of this recent data in VCC.

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

Section 2:

From section 1, it is clear that for any irregular cluster with complex substructure like Virgo, inclusion of every new velocity data is an important gain that helps in putting the morphological judgment on the test where (and only where) a decision for M (Member) or B (Background) is to be made. Where the membership is left open (Possible members/Cloud member), the new kinematic information could be used to decide between 'M' or 'B'. Therefore in the present paper, the galactic position, distance and velocity data of 338 galaxies (by including the member, possible member and background galaxies of VCC) are updated by lifting the data as available worldwide on Goldmine site (can be referred on http://goldmine.mib.infn.it/), described by Gavazzi et al., 2003) [19] and NASA/IPAC Extragalactic Database (ref. on http://ned.ipac.caltech.edu/forms/gmd.html) [20].
Considering distance to Virgo cluster, D ≈ 17 Mpc and those galaxies belonging to cluster A (as assigned by Gavazzi et al., 1993) are certain members of the cluster while all those galaxies that belong to different clouds having < 3000 kms^{-1} are excluded from the present study. However we do not deny the fact that many of cloud galaxies (with heliocentric velocity $v_{\odot}$ < 3000 kms^{-1}) could also be the cluster member.

Fig. 6 shows the distribution of galaxies of VCC (including member, cloud member, and background galaxies) with their modified galactic positions (from epoch 1950 to J2000). The kinematic structure of Virgo cluster is reanalyzed on the basis of new (previously unknown) and updated velocity data of the sample galaxies (including background galaxies for which no velocity and distance values available in BST85 or in BST93) by plotting a scatter diagram (Velocity vs. Declination), shown in fig 7.

It is observed that all member galaxies in our sample (between 8°<δ<17°) have velocity $v_{\odot}$< 3000 kms^{-1}, a well-defined gap is observed near $v_{\odot}$= 3000 kms^{-1}, beyond which there are no cluster members. All the background galaxies are found to have $v_{\odot}$> 3000 kms^{-1}, (i.e. beyond the velocity gap). Whereas in VCC, Binggeli et al. considered some background galaxies having $v_{\odot}$< 3000 kms^{-1} , and classified these low velocity galaxies as possible members but Gavazzi and collaborators placed them into different clouds (these galaxies are not considered in our sample of 338 galaxies). The observations once again confirm the previous findings of BST93.

To find the morphological distribution of sample galaxies in the cluster, we have plotted velocity histograms (figure 8 & 9), showing distribution of different morphological types of 338 galaxies. It is once again clear from their distribution that the cluster is a blend of all known morphological types of galaxies with dEs (dwarf Ellipticals) in particular dominating (in number) the cluster population.

Table 2 shows the updated positions (in J2000) and velocity data and distances of 338 galaxies.

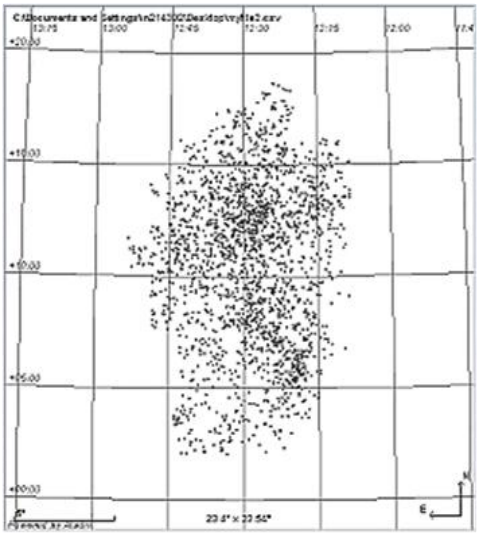

Fig. 6 Distribution of all galaxies of VCC as per their updated galactic positions in J2000

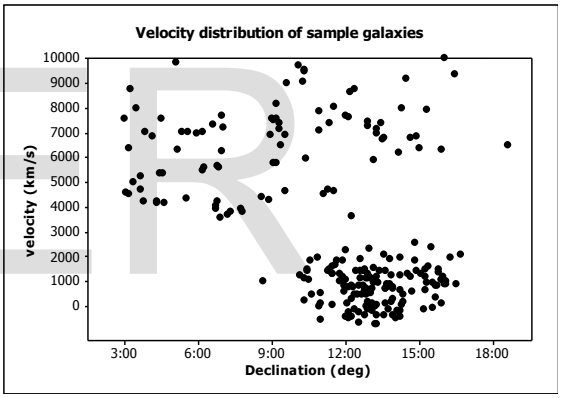

Fig. 7 Velocity distribution of 338 galaxies (including member, possible member and background galaxies of VCC)

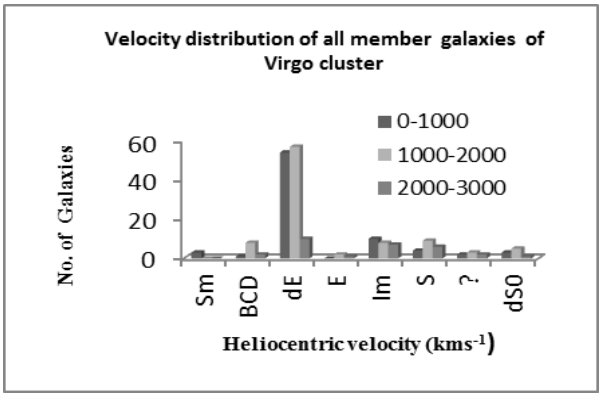

Fig.8 Velocity distribution of 338 galaxies

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

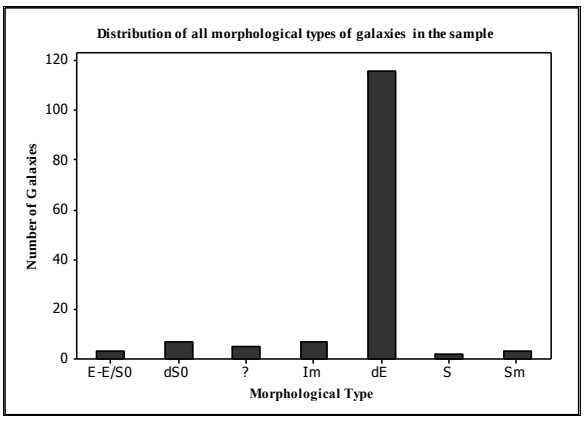

Fig. 9 Morphological distribution of 338 galaxies

Conclusion:

After analyzing the updated velocity data, supported by distance values of 338 galaxies (from GoldMine & NED/IPAC database), it is finally concluded that:

In 282 of the 338 cases listed in table 2, it is observed that the updated velocity data are consistent with the previous morphological studies. In all these cases, the membership status is either confirmed or in case of Possible Member, a definitive solution could be found.

It is in contrast to the remaining 56 cases (or we can say failures) where we found that the 'Member galaxies' with the inclusion of new velocity data, turned out to be in 'Background'. It is also observed that in 16 of 56 cases (tabulated in table 3), the Member galaxy became the Background galaxy, followed by the change in Hubble type. Whereas, for the remaining 40 cases (as tabulated in table 4) only change in membership from Member to Background is found but not in Hubble type. Among these, six galaxies changed their Hubble type from Im to Sm with the inclusion of new velocity data and distance values. For the rest (mainly dEs) it comes with change in membership only but not in Hubble type.

There appears many fainter galaxies as shown in table 4, which were earlier included as 'certain Member' of particular morphological type in VCC (owing to the unavailability of velocity and distance data). These turned out to be in 'Background' with the inclusion of new velocity and distance values followed by change in morphological type.

It is also observed that there is very little or no variation in the velocity values picked up from two different database (GOLDMine and NASA/IPAC Extra galactic or NED database) The worst case happened to be with VCC 773, earlier considered as Possible Member by BST85. Its membership status, still remain uncertain as: it becomes background galaxy with the inclusion of new velocity data collected GOLDMine. Whereas with NED data it is either Member or Possible Member.

Besides, asymmetric velocity distribution of dwarf elliptical galaxies is observed (high, low and also blue shifted velocities, Table 2) which gives the clear indication that the cluster is not yet relaxed. It is still in the process of evolution as predicted earlier by BST 93, Gavazzi et al. 93 and many more.

The present study clearly brings out that the inclusion of new velocity and distance data has changed the membership status of many galaxies of Virgo cluster. However there still remain many galaxies whose velocity data are not yet found. Therefore it is believed that as and when these data are made available, a clearer picture of structure of Virgo cluster will emerge.

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

Table 2:

VCC No. (1)	RA (J2000) (2)	Dec. (J2000) (3)	BT (4)	Mem (old) (5)	Type (old) (6)	Vhelio BST (kms^{-1}) (7)	Mem. (new) (8)	Type (new) (9)	Vhelio (new) (10)	D Mpc (11)	Vhelio (kms^{-1}) NED (12)	Source (13)
3	12:08:26.940	13:31:26.04	17.5	_	BCD?	_	B	?	6801	90.7	6801	25
6	12:08:51.6 31	9:07:53.90	15.1	B	SBa	_	B	Sa	8175	109	8175	3
7	12:09:18.540	11:25:48.79	15	B	SBc(s)I	_	B	Sc (dSc)	18887	251.8	18887	11
12	12:09:44.364	12:07:32.74	15.3	B	SBa(s)	_	B	Sa	8660	115.5	8660	24
14	12:09:51.175	11:15:24.08	16.5	_	BCD?	_	B	BCD	17918	238.9	17918	11
16	12:10:01.099	14:36:55.91	16.5	_	ImIII	_	B	Sd	6770	90.3	6770	25
18	12:10:11.933	12:19:32.38	15	_	Sc(s)II	2300	B	Sc (dSc)	8749	116.7	8753	25
19	12:10:13.800	13:11:17	16.5	_	BCD?	_	B	BCD	6948	90.7	6803	16
28	12:10:45.518	15:51:54.54	15.4	B	SBc	_	B	Sc (dSc)	6325	84.3	6325	24
43	12:12:05.455	13:12:20.30	15.3	_	E3	_	B	E-E/S0	17500	233.3	17500	25
45	12:12:07.572	15:06:33.98	16	_	BCD?	_	B	BCD	15246	203.3	15246	8
53	12:12:22.649	8:46:36.12	15.2	B	Sa:	_	B	Sa	10329	137.7	10329	3
57	12:12:32.609	11:21:10.19	15.1	B	SbI	_	B	Sb	20241	269.9	20241	11
60	12:12:34.531	11:04:30.14	15	M	SmIII-IV	_	B	Sm	4528	60.4	4528	3
62	12:12:38.4	10:01:47.46	15.2	B	S0	_	B	S0	9702	129.4	9702	12
64	12:12:41.5 63	11:33:14.65	15	B	Sab	_	B	Sab	18005	240.1	18005	11
72	12:13:01.999	14:55:57.65	16	M	ImIII /BCD	90	B	Sd	6348	84.7	6351	28
78	12:13:17.491	11:08:21.70	18	_	Im?	_	B	Im	14240	189.9	14240	12
79	12:13:20.791	14:48:17.4	17.2	_	Im?	_	B	Im	6872	91.6	6872	8
88	12:13:43.738	13:23:43.62	18.2	_	dE0?,N	_	B	dE	47430	632.4	47399	8
102	12:14:07.361	13:35:14.32	15	_	BCD	_	B	?	12815	170.9	12815	25
116	12:14:35.654	07:15:19.48	17.2	_	BCD?	_	B	Im	3830	51.1	3830	25
123	12:14:44.880	13:19:22.80	15.2	B	Sa	_	B	Sa	19707	262.8	19737	1
124	12:14:47.294	13:05:06.40	16	_	SmIV	_	B	Sm	5900	77.9	5845	11
125	12:14:55.169	13:12:01.12	18.2	_	?	_	B	?	7145	95.3	7145	7
128	12:14:59.513	09:33:55.01	15.6	M	dE0	_	B	dE	9000	120	_	_
141	12:15:12.883	04:33:52.99	14.9	B	Sbc	_	B	Sbc	12649	168.7	12649	13
148	12:15:26.364	15:14:49.30	15.3	_	BCD	_	B	S (dS)	7913	105.8	7934	28
154	12:15:34.109	13:56:34.30	16.5	_	E/S0	_	B	E-E/S0	23000	306.7	23000	25
174	12:16:00.043	12:41:14.32	14.7	B	Sb	_	B	Sb	19831	264.4	19831	11
184	12:16:18.746	09:44:49.31	16.2	_	dE0?,N	_	B	dE	14184	189.1	14184	3
196	12:16:32.818	09:29:37.32	16.5	_	BCD?	_	B	BCD	12973	173	12973	12
198	12:16:33.794	06:50:06.86	18	_	ImIV?	_	B	Im	3576	47.7	3576	25
202	12:16:35.520	09:40:42.89	16	_	BCD?	_	B	?	14072	187.6	14072	8
208	12:16:53.100	06:54:42.30	17.8	_	dE2	_	B	dE	7696	102.6	7696	11
225	12:17:11.566	08:19:31.15	17	_	BCD?	_	B	BCD	21434	285.8	21434	11
233	12:17:25.279	13:26:14.10	17.7	_	?	_	B	?	6733	89.8	6733	8
246	12:17:41.047	07:09:11.74	19	_	?	_	B	?	3706	49.4	3706	11
248	12:17:41.609	08:49:04.40	17.2	_	ImIV-V?	_	B	Im	4296	57.3	4296	28
249	12:17:42.701	13:22:47.71	14.6	B	Sa	_	B	Sa	7408	98.8	7408	11
251	12:17:44.110	13:10:15.74	14.7	B	Sc(s)I	_	B	Sc (dSc)	12873	171.6	12873	11
262	12:17:55.814	05:52:11.21	15.1	B	Sc(dSc)	_	B	Sc (dSc)	6991	93.2	6991	24
271	12:18:08.093	06:08:22.38	14.4	B	SBb(S)	_	B	Sb	5477	73	5477	27
272	12:18:06.862	10:53:46.46	15.2	B	S01(9)	_	B	S0	7096	94.6	7129	1

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

277	12:18:11.990	07:39:36.22	15.2	_	ImIII/ Spec	_	B	S (dS)	3953	52.8	3953	24
279	12:18:14.630	10:21:14.29	16.3	_	Sc?	_	B	Sc (dSc)	5938	79.2	5938	3
280	12:18:14.690	11:28:51.71	17.7	M	Im IV-V	_	B	Im	8014	106.9	8014	8
284	12:18:21.600	12:51:50.76	18.3	_	?	_	B	?	7424	99	7424	8
288	12:18:30.890	15:33:34.09	17.7	_	dE4?,N	_	B	dE	13165	175.5	13165	8
300	12:18:42.173	05:39:55.51	18.1	_	dE5	_	B	dE	98541	1314	98541	15
301	12:18:42.206	07:27:54.97	18.5	_	dE0?, N?	_	B	dE	39030	520.4	39013	11
314	12:18:57.365	06:11:03.77	14.9	_	Sc(s)II	_	B	Sc (dSc)	5594	74.6	5594	25
325	12:19:09.614	11:42:36.04	15.8	_	S0:	_	B	S0	16560	220.8	16560	11
347	12:19:22.846	12:02:29.83	15.2	B	S0/a	_	B	S0a-S0/Sa	7623	101.6	7623	11
354	12:19:30.089	13:59:26.48	16.6	M	dE0	_	B	dE	99000	1320	112740	6
359	12:19:36.840	05:23:52.15	14.8	B	ScI-II	_	B	Sc (dSc)	11646	155.3	11646	19
361	12:19:37.061	15:09:43.88	17.4	M	dE1	_	M	dE	1215	17	1215	8
377	12:19:50.969	06:59:33.43	14.7	B	SBc(s)II	_	B	Sc (dSc)	7196	95.9	7196	19
380	12:19:52.519	07:43:52.28	15.3	M	BCD	_	B	BCD	3779	50.4	3779	25
396	12:20:12.286	04:16:11.57	17	_	dE4?,N	_	B	dE	23361	311.5	23361	13
398	12:20:12.742	12:40:26.58	18.3	_	dE0?,N	_	B	dE	41550	554	41513	11
401	12:20:14.590	12:51:54.79	17.7	M	dE1:	_	B	dE	7232	94	7048	11
406	12:20:18.754	08:31:58.91	15	B	SBbc	_	B	Sbc	4424	59	4424	24
413	12:20:23.266	13:53:51.32	18	_	ImIII?	_	M	Im	272	17	272	25
419	12:20:29.530	10:14:42.61	15	B	SbI	_	B	Sb	9518	126.9	9518	3
420	12:20:30.180	11:20:27.38	15	B	Sa	_	B	Sa	12925	172.3	12925	11
421	12:20:30.710	13:31:09.08	17	M	dE2	_	M	dE	2098	17	2098	5
426	12:20:36.319	12:53:05.10	18.2	M	dE0,N	_	M	dE	1182	17	1182	11
429	12:20:43.980	14:37:52.28	17.2	_	?	_	M	?	587	17	600	9
443	12:20:54.679	11:09:42.52	15.2	B	ScI	_	B	Sc (dSc)	20649	275.3	20649	12
448	12:21:00.209	12:43:32.77	16.8	_	ImIII?	_	M	Im	672	17	672	25
461	12:21:15.034	13:20:47.54	16.5	M	dE4	_	M	dE	1397	17	1397	11
473	12:21:27.413	06:40:15.74	15.2	B	S0(7)	_	B	S0	4031	53.7	4031	10
485	12:21:35.280	15:58:59.95	15.4	B	S	_	B	S (dS)	9984	133.1	9984	8
493	12:21:45.041	13:11:35.41	19	M	dE	_	B	dE	27632	368.4	27632	11
501	12:21:48.000	12:49:35.62	17	M	dE5?	_	M	dE	-105	17	-105	11
510	12:21:53.698	15:38:45.24	15.1	M	dE3,N	_	M	dE	838	17	838	8
528	12:22:07.858	06:06:12.06	15.2	B	Sab	_	B	Sab	7046	93.6	7019	19
539	12:22:14.801	14:08:32.21	16.8	M	dE3,N	_	M	dE	1222	17	1222	8
541	12:22:18.351	04:17:06.70	16	_	BCD	_	B	BCD	23511	313.5	23511	16
544	12:22:20.688	09:01:51.96	17	M	ImIII	_	B	Sm	5796	77.3	5796	25
550	12:22:24.720	09:29:18.17	16.5	_	ImIII?	_	B	Sm	4658	61.9	4646	3
554	12:22:24.302	15:28:15.74	17.1	M	dE2,N:	_	M	dE	921	17	921	8
573	12:22:42.401	05:38:10.72	15.2	B	Sc	_	B	Sc (dSc)	23083	307.8	23083	19
574	12:22:42.281	08:49:46.20	17	M	dE3	_	B	dIm/dE	23050	307.3	23050	12
578	12:22:43.879	18:32:54.71	17.6	_	?	_	B	?	6490	86.5	6490	9
580	12:22:45.182	12:17:37.61	17.2	_	BCD?	_	B	BCD	27605	368.1	27605	11
583	12:22:45.007	15:30:07.81	15.8	M	Im IV-V	_	M	Im	-72	17	-72	16
586	12:22:46.982	11:26:42.43	18.5	M	dE4	_	B	dE	4636	61.8	4636	11
588	12:22:49.601	03:06:14.51	14.6	B	Sb	_	B	Sb	6339	84.5	6339	19
602	12:23:01.330	08:11:47.04	18.3	M	dE0	_	B	dE	14734	196.5	14734	11
618	12:23:07.406	13:44:40.02	16.5	_	Im?	_	M	Im	1888	17	1890	25
636	12:23:21.202	15:52:06.13	16.4	_	dE0,N	_	M	dE/dS0	105	17	105	14
652	12:23:36.948	08:43:48.58	17.8	M	dE0	_	B	dE	21213	282.8	21213	8

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

662	12:23:41.582	02:57:40.57	14.8	B	Sc(s)	_	B	Sc (dSc)	7546	100.6	7546	24
670	12:23:50.729	04:05:13.74	15.1	B	Sbab(s)	_	B	Sab	6866	91.5	6866	19
674	12:23:52.625	13:52:57.04	18	M	dE0,N	_	M	dE	707	17	707	8
684	12:23:57.708	12:53:13.63	16	M	dE0,N	_	M	dE	552	17	552	11
687	12:23:57.732	11:53:32.37	18.3	M	dE3	_	M	dE	580	17	580	4
690	12:24:02.186	05:18:45.63	15.2	B	S	_	B	S (dS)	7017	93.6	7017	24
703	12:24:10.430	09:14:10.36	17.5	M	ImV	_	B	Im	7125	95	7125	3
706	12:24:12.480	11:31:45.97	17.3	M	dE0,N	_	M	dE	1640	17	1640	11
719	12:24:19.008	12:54:47.16	18.5	M	dE2	_	B	dE	32738	436.5	32738	15
720	12:24:19.495	09:29:30.12	15.3	B	S01	_	B	S0	6923	92.3	6923	12
734	12:24:33.624	06:42:44.60	15.1	B	SBbc(s)	_	B	Sbc	5631	75.1	5631	24
736	12:24:37.560	10:50:20.54	15	B	Sba	_	B	Sa	7839	104.5	7839	12
748	12:24:47.577	14:34:35.09	17.3	M	dE4	_	M	dE	1205	17	1205	4
753	12:24:51.626	13:06:40.20	16.4	M	dE	_	M	dE	955	17	955	11
760	12:24:56.904	11:50:04.92	17.6	M	dE0 pec?	_	M	dE	1833	17	1833	11
761	12:25:00.600	15:36:05.04	17.3	M	dE4	_	B	dE	99000	1320	_	_
765	12:25:03.482	13:14:40.92	16.5	M	dE1,N	_	M	dE	968	17	968	11
770	12:25:08.172	04:28:24.42	15.2	B	Sc	_	B	Sc (dSc)	7573	101	7573	20
773	***12:25:08.239***	***06:53:25.84***	***18.2***	***_***	***dE4?***	***_***	***B***	***dE***	***6223***	***19.1***	***1433***	***11***
779	12:25:13.109	13:01:31.51	17.7	M	dE0,N	_	M	dE	-181	17	-181	4
790	12:25:17.539	14:10:21.22	16.4	M	dE1,N	_	M	dE	638	17	638	8
794	12:25:21.600	16:25:45.98	15.5	M	dS0	_	M	dS0	918	17	918	16
795	12:25:23.160	14:48:12.49	18	M	dE7,N	_	M	dE	1401	17	1401	8
805	12:25:31.992	03:26:16.40	14.9	B	Sbc	_	B	Sbc	7966	106.2	7966	19
808	12:25:31.565	14:09:09.40	17.7	M	dE5,N	_	B	dE	11330	151.1	11317.1	6
810	12:25:33.535	13:13:37.99	17	M	dE0,N	_	M	dE	-340	17	-340	25
812	12:25:34.836	15:11:39.80	17	M	dE1,N	_	M	M	1494	17	1494	8
815	12:25:37.212	13:08:37.39	16.1	M	dE2,N	_	M	dE	-700	17	-700	25
816	12:25:35.981	15:50:52.12	15.3	M	dE5,N	_	M	dE	1087	17	1087	8
817	12:25:36.437	15:49:47.42	15	M	dE1	_	M	dE	1073	17	1073	8
822	12:25:39.408	08:54:43.78	15	B	SBc	_	B	Sc (dSc)	6902	92	6898	24
831	12:25:42.979	09:01:35.29	15	B	Sc	_	B	Sc (dSc)	7507	100.1	7507	25
833	12:25:44.640	13:01:19.56	17.5	M	dE0,N	_	M	dE	720	17	720	11
834	12:25:46.716	04:30:35.53	14.6	_	Sc(s)II	_	B	Sc (dSc)	5381	71.7	5381	28
838	12:25:47.081	12:45:37.44	17.5	M	dE2	_	B	dE	88564	1181	88564	15
846	12:25:50.517	13:11:51.51	16.2	M	dE1,N	_	M	dE	-730	17	-730	25
847	12:25:50.808	08:55:14.16	14.9	B	SBc	_	B	Sc (dSc)	7583	101.1	7583	3
854	12:25:55.697	12:46:10.99	17.7	M	dE8,N	_	M	dE	701	17	701	11
861	12:25:58.930	15:16:38.03	17.9	M	dE4:	_	M	dE	943	17	943	8
870	12:26:05.318	11:48:43.99	15.5	M	dS0(5),N	_	M	dS0	1186	17	1186	11
871	12:26:05.640	12:33:34.70	15.8	M	dE4,N	_	M	dE	1427	17	1427	11
872	12:26:06.689	12:51:39.53	17	M	dE0,N	_	M	dE	1316	17	1316	11
877	12:26:09.521	13:40:23.02	17.6	M	dE0,N	_	M	dE	-98	17	-98	4
882	12:26:15.065	12:57:50.80	16.7	M	dE3,N	_	M	dE	1101	17	1101	27
885	12:26:15.720	05:28:35.00	14.7	B	S01(4)	_	B	S0	4367	58.2	4367	19
892	12:26:20.045	12:30:36.40	18.3	M	dE:	_	M	dE	-666	17	-666	4
899	12:26:26.710	06:42:30.20	16.6	M	ImIV	_	B	Sm	4198	56	4198	25
928	12:26:39.814	12:30:48.72	16.1	M	dE6,N	_	M	dE	-254	17	-254	15
931	12:26:44.009	10:54:17.28	16.4	M	dE2,N	_	M	dE	559	17	559	12
936	12:26:44.429	11:22:46.99	15.8	M	dE1,N	_	M	dE	1291	17	1291	11

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

945	12:26:51.137	13:10:32.59	15.3	M	SBmIII	80	M	Sm	-17	17	162	28
963	12:26:59.158	14:46:56.46	17.2	M	Im:	_	M	Im	1860	17	1866	25
967	12:27:03.826	12:51:54.18	18.7	M	dE4	_	M	dE	1135	17	1135	15
972	12:27:08.422	13:20:08.77	16.9	M	dE3,N	_	B	dE	99000	1320	_	_
977	12:27:11.230	12:02:17.23	17.9	M	dE4,N	_	M	dE	102	17	102	15
991	12:27:17.731	14:08:48.34	14.7	M	dE6	_	M	dE	-406	17	-406	Nil
996	12:27:21.060	13:06:41.51	18.4	M	dE5	_	M	dE	-28	17	-28	15
997	12:27:22.171	12:04:07.28	17.7	M	dE3,N	_	M	dE	-240	17	-240	4
998	12:27:23.489	12:19:53.51	18.2	M	dE4,N	_	M	dE	-109	17	-109	4
1007	12:27:27.614	03:18:07.67	15.2	B	Sbc(s)I	_	B	Sbc	14665	195.5	14665	19
1016	12:27:31.231	03:15:35.06	14.9	B	Sb	_	B	Sb	14625	195	14625	19
1019	12:27:32.189	07:57:47.77	15	B	Sa	_	B	Sa	10022	133.6	10022	19
1024	12:27:34.781	15:44:22.16	18.3	_	dE?,N	_	M	dE	1368	17	1368	8
1027	12:27:37.985	12:52:48.47	18.1	M	dE0,N	_	M	dE	77	17	77	15
1028	12:27:37.560	14:27:20.09	15.7	_	dSo?	_	M	dS0	1301	17	1301	8
1033	12:27:40.723	15:56:41.89	18.4	M	dE0,N	_	M	dE	868	17	868	8
1035	12:27:42.106	12:05:22.81	16	_	E4	_	M	E-E/S0	-500	17	-500	25
1039	12:27:44.285	11:12:52.49	17.1	M	dE3,N	_	M	dE	1441	17	1441	12
1040	12:27:44.563	12:58:54.52	17.5	M	dE3,N	_	M	dE	-143	17	-143	15
1042	12:27:45.307	12:52:19.60	18.6	M	dE	_	M	dE	-62	17	-62	15
1043	12:27:45.593	13:00:31.79	10.9	M	Sb	30	M	Sb	104	17	71	22
1044	12:27:46.267	11:26:06.40	17	M	dE5,N	_	M	dE	1313	17	1313	4
1058	12:28:01.399	04:17:29.00	15.3	B	S	_	B	S (dS)	4190	55.9	4194	27
1059	12:28:00.449	11:56:59.21	18	M	dE6,N	_	M	dE	2248	17	2248	11
1061	12:28:02.035	15:26:40.52	18.2	_	dE3?	_	M	dE	2397	17	2397	8
1064	12:28:04.930	13:36:43.31	17.3	M	dE3,N	_	M	dE	865	17	865	11
1065	12:28:04.970	13:34:41.23	16.4	M	dE0,N	_	M	dE	142	17	142	4
1068	12:28:05.662	12:04:48.25	15.9	_	E2	_	B	E-E/S0	25400	338.7	25400	25
1069	12:28:06.530	12:53:53.38	16.4	M	dE6,N	_	M	dE	2308	17	2308	11
1076	12:28:12.828	10:31:33.74	17.4	M	dE0,N	_	M	dE	1828	17	1828	12
1080	12:28:12.713	06:49:01.45	15.3	B	Spec	_	B	S (dS)	25246	336.6	25246	19
1099	12:28:23.974	11:25:13.58	17.7	M	dE3:	_	M	dE	1625	17	1625	11
1106	12:28:29.268	10:31:12.86	17.5	M	ImV:	_	B	Im	99000	1320	_	_
1111	12:28:30.571	11:56:52.91	17.7	M	dE4,N	_	B	dE	7701	102.7	7701	11
1119	12:28:41.496	09:43:54.44	17.4	M	dE4:,N:	_	B	dE	99000	1320	_	_
1123	12:28:42.655	12:32:59.24	16.7	M	dE2,N	_	M	dE	1874	17	1874	11
1129	12:28:44.918	12:48:35.14	17.7	M	dE3	_	M	dE	12	17	12	11
1130	12:28:46.810	06:30:43.20	15.7	B	Sc pec	_	B	Sc (dSc)	11633	155.1	11633	19
1132	12:28:46.330	16:13:27.30	17.2	M	dE2?	_	M	dE	1978	17	1978	8
1134	12:28:49.730	06:08:52.01	15.2	B	pre merger ?	_	B	?	14591	194.5	14591	19
1138	12:28:52.289	04:17:35.41	15.2	_	Sd	_	B	Sd	4226	56.5	4240	20
1148	12:28:58.140	12:39:42.30	16	_	E0	_	M	E-E/S0	1417	17	1417	11
1153	12:28:59.815	12:38:54.28	17.8	M	dE5	_	M	dE	844	17	844	4
1163	12:29:06.458	14:00:17.75	16.4	M	dE3:	_	M	dE	-454	17	-454	4
1168	12:29:11.779	09:09:26.89	17.7	_	ImIII?	_	B	Im	5797	77.3	5797	3
1174	12:29:18.154	09:56:11.62	15.5	_	BCD?	_	B	BCD	11971	159.6	11971	12
1185	12:29:23.536	12:27:02.02	15.7	M	dE1,N	_	M	dE	500	17	500	25
1198	12:29:32.032	13:30:37.68	17.7	_	dE6?	_	M	dE	-356	17	-356	4
1202	12:29:35.405	13:12:31.50	20	_	dE?,N	_	M	dE	1215	17	1215	5
1209	12:29:40.610	10:23:05.78	17.8	M	dE1:	_	M	dE	1454	17	1454	12

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

1210	12:29:38.501	11:17:56.29	17.7	M	dE0,N	_	M	dE	1485	17	1485	11
1213	12:29:39.247	12:32:53.66	16.4	M	dE0,N	_	M	dE	1099	17	1099	11
1217	12:29:43.922	11:24:16.88	14.6	M	SBmIV	_	M	Sm	38	17	38	2
1219	12:29:44.081	12:48:19.69	18.2	M	dE4,N	_	M	dE	484	17	484	4
1222	12:29:44.585	15:01:29.10	16.4	M	dE4,N/dS0,N	_	M	dE/dS0	1318	17	1318	8
1227	12:29:46.500	11:09:55.58	17.9	M	dE0/ImV	_	B	dIm/dE	18069	240.9	18069	-
1233	12:29:51.130	04:26:54.46	16.8	_	?	_	B	?	21039	280.5	21039	13
1237	12:29:51.216	13:52:04.62	15.5	_	?	_	M	?	-335	17	-335	17
1239	12:29:52.994	11:57:44.32	17.8	M	dE5,N	_	M	dE	-400	17	-400	4
1258	12:30:05.126	16:22:17.22	15.3	_	BCD	_	B	?	9332	124.4	9332	25
1262	12:30:12.108	03:34:39.86	15.1	_	BCD?	_	B	Sm/BCD	5248	70	5248	25
1264	12:30:10.886	12:11:43.80	17.3	M	dE0,N	_	M	dE	-420	17	-420	4
1284	12:30:20.691	03:44:24.95	14.4	_	Sc	_	B	Sc (dSc)	4222	56.3	4222	28
1288	12:30:23.407	15:41:59.46	17.9	M	dE4:	_	B	dE	99000	1320	–	–
1295	12:30:32.299	10:15:39.20	18.3	_	?	_	M	?	1101	17	1101	3
1298	12:30:33.463	12:54:03.24	17.9	M	dE3	_	B	dE	99000	1320	_	_
1302	12:30:38.628	15:36:29.12	18	M	dE1:,N	_	M	dE	826	17	826	4
1304	12:30:39.876	15:07:46.88	15.5	M	dS0,N	_	M	dS0	-108	17	-108	16
1307	12:30:44.621	13:47:57.98	18	M	dE3,N	_	M	dE	1241	17	1241	8
1314	12:30:49.013	13:13:25.82	17.2	M	dE4	_	M	dE	77	17	77	4
1323	12:30:55.740	14:46:26.11	16.2	M	dE2:	_	M	dE	2537	17	2537	8
1334	12:31:00.264	15:43:50.81	16	M	dS03?	_	M	dS0	1496	17	1496	8
1339	12:31:06.499	04:35:17.74	14.9	B	S01pec	_	B	S0	4140	55.2	4140	18
1340	12:31:10.418	13:05:50.42	18.3	M	dE0,N	_	M	dE	1540	17	1540	11
1347	12:31:17.009	05:04:29.35	15	B	S	_	B	S (dS)	9830	131.1	9830	13
1351	12:31:18.408	13:49:44.04	16	M	dE4	_	M	dE	187	17	187	15
1353	12:31:19.428	12:44:16.80	16.6	M	dE2,N	_	M	dE	-353	17	-353	4
1355	12:31:20.194	14:06:54.72	14.3	M	dE2,N	_	B	dE	6210	82.8	6210	28
1362	12:31:30.089	03:07:58.91	17.2	_	BCD?	_	B	BCD	4533	60.4	4533	13
1366	12:31:31.692	11:36:10.91	17.6	M	dE0,N	_	M	dE	1838	17	1838	11
1369	12:31:33.351	12:03:49.58	17.3	M	dE6,N	_	M	dE	777	17	777	11
1389	12:31:52.006	12:28:54.52	15.9	M	dE2,N	_	M	dE	858	17	858	11
1392	12:31:55.915	12:10:26.54	14.9	M	dSB0,N/dE6pec,N	_	M	dE/dS0	278	17	278	28
1395	12:31:55.759	08:36:08.06	16.2	_	dE4?,N	_	M	dE	1036	17	1036	8
1396	12:31:56.381	11:58:21.58	17.2	M	dE0:,N	_	M	dE	1095	17	1095	4
1399	12:32:00.761	12:37:13.12	16.5	M	dE5,N	_	M	dE	471	17	471	11
1400	12:31:53.856	14:18:23.40	16.2	M	dE5,N	_	M	dE	470	17	470	8
1414	12:32:09.311	12:50:20.14	17	_	dE4?,N	_	M	dE	201	17	201	4
1417	12:32:09.583	15:18:03.38	15.8	M	dE5:	_	M	dE	1604	17	1604	8
1423	12:32:15.926	02:59:58.52	16	_	BCD?	_	B	BCD	13079	174.4	13079	16
1426	12:32:23.494	11:53:35.77	15.6	M	ImIV?	_	M	Im	833	17	833	11
1445	12:32:36.742	11:00:58.10	18.4	_	dE?,N	_	B	dE	30000	400	66853	12
1446	12:32:39.012	10:05:31.49	16	M	dE0,N	_	M	dE	1224	17	1224	12
1451	12:32:41.904	15:54:51.12	16.5	M	dE5:,N	_	M	dE	1171	17	1171	8
1453	12:32:44.216	14:11:45.81	14.3	M	dE2,N	_	M	dE	1949	17	1949	25
1456	12:32:49.776	03:17:59.64	14.7	_	SbcII	_	B	Sbc	4985	66.5	4985	25
1458	12:32:50.292	05:47:53.27	15.3	B	SBbcI	_	B	Sbc	11818	157.6	11818	19
1460	12:32:52.632	03:10:59.05	16.5	_	BCD?	_	B	?	8728	116.4	8728	25
1471	12:33:01.255	11:09:07.27	16.5	_	BCD/mer	_	B	?	18268	243.6	18268	12
1473	12:33:07.956	13:32:14.42	18.3	M	dE1:	_	B	dE	24966	332.9	24966	11

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

1481	12:33:08.969	10:50:10.28	17.4	M	dE4,N	_	M	dE	1956	17	1956	12
1483	12:33:09.665	09:15:11.74	16.5	_	ImIV	_	B	Sd	7377	98.4	7380	3
1495	12:33:17.786	13:56:06.14	17.6	M	dE0,N	_	B	dE	99000	1320	_	_
1517	12:33:40.843	12:34:16.46	17.3	M	dE3,N	_	B	dE	10188	135.8	10188	11
1523	12:33:48.677	12:46:48.14	17.6	M	dE0,N	_	M	dE	1127	17	1127	11
1531	12:33:56.052	10:34:41.12	17.4	M	dE0,N	_	M	dE	458	17	458	4
1539	12:34:06.739	12:44:29.76	15.7	M	dE0,N	_	M	dE	1491	17	1491	11
1544	12:34:12.242	11:48:40.97	17	_	BCD	_	B	BCD	16314	217.5	16314	11
1563	**12:34:26.047**	**11:55:01.13**	**16.1**	**M**	**dE3,N**	**_**	**B**	**dE**	**99000**	**1320**	**_**	**_**
1565	12:34:30.434	11:44:03.77	16.9	M	dE0,N	_	M	dE	986	17	986	11
1568	12:34:33.120	06:00:25.20	15	B	Sb	_	B	Sb	11827	157.7	11827	19
1570	12:34:32.164	16:01:57.21	16	_	E3	_	M	E-E/S0	1014	17	1014	8
1574	12:34:32.098	15:10:48.36	17.3	_	?	_	M	?	639	17	639	9
1577	12:34:38.405	15:36:09.68	16.1	M	dE4	_	M	dE	361	17	361	29
1583	12:34:46.810	03:00:36.50	16.5	_	BCD?	_	B	?	4605	61.4	4605	25
1584	12:34:45.146	16:01:27.41	18.5	M	dE0,N	_	M	dE	885	17	885	8
1598	12:35:05.393	05:52:31.69	15.1	B	SBbI-II	_	B	Sb	12086	161.1	12086	19
1603	12:35:07.771	13:33:51.88	18	M	dE4,N	_	M	dE	735	17	735	11
1604	12:35:10.416	13:59:10.43	16.7	M	dE6,N	_	B	dE	10160	135.5	_	_
1605	12:35:13.922	10:25:54.19	17	_	S:	_	M	Sd	1072	17	1072	3
1606	12:35:14.690	12:14:14.71	17.5	M	dE3,N	_	M	dE	748	17	748	11
1607	12:35:17.971	06:32:35.99	14.9	B	S0	_	B	S0	7331	97.7	7331	18
1616	12:35:28.030	14:15:40.72	16.2	M	dE5,N	_	M	dE	184	17	184	4
1623	12:35:32.002	16:36:43.85	16.7	_	?	_	M	?	2108	17	2108	9
1633	12:35:41.189	11:40:01.81	15.6	B	SBbI	_	B	Sb	16214	216.2	16214	11
1636	12:35:43.784	14:24:42.43	15.1	B	SbII	_	B	Sb	9172	122.3	9172	24
1637	12:35:45.521	12:10:53.01	18.5	M	dE0,N	_	M	dE	800	17	800	11
1638	12:35:48.041	03:12:06.52	15.2	B	ScI	_	B	Sc (dSc)	22110	294.8	2211	19
1642	12:35:53.131	11:40:54.91	17.8	M	dE2,N	_	M	dE	1330	17	1330	11
1643	12:35:53.796	05:45:39.82	15.2	_	dE4,N	_	B	S0	12563	167.5	12563	19
1644	12:35:51.833	13:51:32.94	17.5	M	SmIV	_	M	Sm	756	17	756	25
1647	12:35:56.628	10:56:10.67	16	M	dE4	_	M	dE	86	17	86	4
1653	12:36:10.111	05:05:09.64	15.3	B	S0	_	B	S0	6298	84	6298	19
1658	12:36:17.760	13:34:32.30	17	M	dE4	_	B	dE	99000	1320	_	_
1661	12:36:24.785	10:23:04.78	16	M	dE0,N	_	M	dE	1457	17	1457	12
1665	12:36:27.830	12:24:18.65	15.2	_	E4	_	B	E-E/S0	20000	266.7	13241	1
1667	12:36:27.543	16:32:19.15	17.3	_	dE3pec?	_	B	dE	20506	273.4	20506	23
1668	12:36:30.101	13:32:33.11	18	_	dS0:	_	M	dS0	1414	17	1414	11
1669	12:36:30.619	13:38:17.81	16.2	M	dE6,N	_	M	dE	774	17	774	11
1671	12:36:32.880	06:10:22.80	14.8	_	d:S01/2	_	B	dS0	11846	157.9	11846	19
1674	12:36:32.378	13:44:54.31	16.3	M	dE3,N	_	M	dE	868	17	868	8
1677	12:36:34.770	13:35:57.56	16.8	M	dE1,N	_	B	dE	99000	1320	_	_
1682	12:36:36.734	14:13:33.18	17.8	M	dE4:	_	M	dE	41	17	41	4
1683	12:36:37.730	10:56:18.60	17	M	dE2,N	_	M	dE	-558	17	-558	14
1691	12:36:51.114	12:57:31.66	18	M	dS0	_	M	dS0	559	17	559	11
1697	12:37:00.984	06:06:34.34	18.2	_	?	_	B	?	11886	158.5	11886	13
1704	12:37:09.701	10:16:20.32	15.8	M	dE6	_	M	dE	263	17	263	4
1710	12:37:17.220	10:53:16.80	17.8	_	dE2?	_	M	dE	-15	17	-15	4
1711	12:37:22.150	12:17:13.31	16.5	M	dE3,N	_	M	dE	458	17	458	11
1717	12:37:28.956	12:21:11.38	16.5	M	dE7	_	M	dE	1454	17	1454	11

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

1721	12:37:33.578	04:22:03.48	14.2	_	Sb	_	B	Sb	5364	71.5	5364	25
1740	12:38:00.370	14:10:43.68	18	M	dE0:	_	M	dE	-161	17	-161	4
1747	12:38:09.653	13:34:50.92	18.2	M	dE5:	_	M	dE	690	17	690	11
1752	12:38:15.761	07:49:13.37	15.6	B	SBb	_	B	Sb	11299	150.7	11299	8
1761	12:38:27.739	14:04:37.81	16.8	_	dE5?	_	M	dE	-162	17	-162	4
1772	12:38:45.432	06:46:05.34	14.8	B	ScI-II	_	B	Sc (dSc)	5610	74.8	5610	24
1790	12:39:21.994	12:11:45.74	19	_	?	_	B	?	3604	48.1	3604	21
1793	12:39:28.193	04:16:04.30	15.2	B	S	_	B	S (dS)	14616	194.9	14616	19
1810	12:39:50.211	03:47:49.12	15.2	B	S	_	B	S (dS)	12003	160	12003	19
1824	12:40:11.460	05:22:42.02	15.3	B	Sba	_	B	Sa	14072	187.6	14072	13
1842	12:40:29.148	05:01:50.92	15.3	B	Sc	_	B	Sc (dSc)	14571	194.3	14571	19
1845	12:40:32.497	05:21:20.67	15.3	B	S0	_	B	S0	14010	186.8	14010	19
1847	12:40:35.023	02:28:05.30	14.9	B	S0/a	_	B	S0a-S0/Sa	13773	183.6	13773	19
1849	12:40:35.489	09:33:17.78	16.2	_	BCD?	_	B	BCD	15707	209.4	15707	12
1863	12:41:08.045	12:15:44.82	19	M	dE	_	B	dE	22201	296	22201	11
1864	12:41:07.200	03:36:38.88	16.8	_	Im?	_	B	?	4727	63	4727	25
1865	12:41:08.088	03:45:20.88	19.2	_	dE:	_	B	dE	7047	94	7047	13
1874	12:41:19.013	13:10:03.11	17.7	M	dE	_	B	dE	50320	670.9	50285	8
1875	12:41:23.566	06:40:41.12	14.8	B	S01	_	B	S0	3948	52.6	3948	6
1889	12:41:46.070	11:15:01.51	16	M	ImIV:	_	B	Sd	4725	63	4725	25
1893	12:41:51.463	02:44:19.90	16.5	_	dE2,N	_	B	dE	31830	424.4	31803	13
1908	12:42:07.339	05:30:26.32	15.2	B	Spec	_	B	S (dS)	7048	94	7048	24
1915	12:42:13.570	12:32:42.22	17.1	M	dE3	_	B	dE	21330	284.4	–	–
1916	12:42:14.398	14:12:15.78	17	_	Im?	_	B	?	7952	106.1	7954	25
1922	12:42:26.868	14:22:29.42	17.5	_	E0?	_	B	S (dS)	20150	268.7	20150	8
1927	12:42:36.000	10:33:55.12	14.9	B	ScII	_	B	Sc (dSc)	20199	269.3	20199	15
1956	12:43:09.365	03:34:52.39	15.1	_	S	_	B	S (dS)	14659	195.5	14659	19
1959	12:43:14.969	04:05:02.04	15.2	B	S0	_	B	S0	14512	193.5	14512	19
1960	12:43:16.562	13:14:38.36	17	_	ImIII/BCD?	_	B	Im/BCD	20348	271.3	–	–
1962	12:43:18.732	03:33:00.65	15.1	B	S0	_	B	S0	14292	190.6	14292	19
1967	12:43:24.451	03:39:32.11	17.7	_	dE4?	_	B	dE	99000	1320	108204	13
1984	12:43:58.080	03:37:01.20	15.1	B	Sa	_	B	Sa	14472	193	14472	19
1997	12:44:23.083	10:11:19.79	15.1	B	SBbI	_	B	Sb	9040	120.5	9040	3
1998	12:44:23.527	13:00:34.85	18.2	M	dE2	_	B	dE	19409	258.8	19409	8
2005	12:44:45.602	09:45:26.32	14.9	B	ScII-III	_	B	Sc (dSc)	13967	186.2	13967	3
2009	12:44:53.762	10:16:56.46	15.1	B	ScI-II	_	B	Sc (dSc)	9444	187.8	14085	3
2069	12:48:21.631	07:49:49.19	19.5	_	dE?,N	_	B	dE	30000	400	68692	6
2071	12:48:24.581	09:19:00.44	17.8	_	?	_	B	?	6484	86.5	6486	3
2076	12:48:34.022	09:07:47.24	15.3	B	SBbc	_	B	Sbc	7554	100.8	7558	3
2077	12:48:35.623	10:52:30.36	15.2	B	Sab:	_	B	Sab	12185	162.5	12185	3
2082	12:49:58.250	11:15:50.00	15.3	B	S	_	B	S (dS)	7403	98.7	7403	3
2089	12:51:12.324	10:34:12.18	17.5	_	BCD?	_	B	BCD	24093	321.2	–	–
2096	12:53:24.679	11:42:40.57	15.8	_	BCD/meger	_	B	?	19697	262.6	19697	8

Column 1-VCC number from BST85.
Column 2 & 3- Galactic positions; Right Ascension (RA) and Declination (Dec.) in J2000 (hh:mm:ss.s, dd:mm:ss.s) from Hubble Legacy Archieve .
Column 4 - Blue apparent total magnitude of the galaxy from BTS85.
Columns 5, 6 & 7- Membership, Galaxy type and heliocentric velocity in km/s directly lifted from VCC (BTS85).
Columns 8, 9 & 10- New Membership, Galaxy type and heliocentric velocity (km/s) directly picked up from GOLDMine site (collected from literature), source : http://goldmine.mib.infn.it & references therein.
Column 11- Distance of galaxies in Mpc source: GOLDMine database, http://goldmine.mib.infn.it
Distance, D (Mpc): for cluster member derived from the average redshift of the cluster, otherwise from the individual redshift assuming Ho =75 km/sec/Mpc by using Fundamental Plane & Tully-Fisher distance relations (ref. : Gavazzi G.,et al., 1999, MNRAS, 304, 595).

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

Column 12 - Heliocentric velocity in km/s lifted from NASA/IPAC Extragalactic Database (http://ned.ipac.caltech.edu/forms/gmd.html).
Colmn 13 - NED/IPAC data source (collected from different sources) mentioned below:
Sources:

1. Huchra et al. (2012)[21]
2. Chung et al. (2009) [22]
3. Kent et al. (2008)[23]
4. Rines & Margaret (2008)[24]
5. Alighieri et al. (2007)[25]
6. SDSS-DR6 (2007)[26]
7. Giovanelli et al. (2007)[27]
8. SDSS-DR5 (2006)[28]
9. Gavazzi et al. (2006)[29]
10. Woods (2006)[30]
11. SDSS-DR4 (2005)[31]
12. SDSS-DR3 (2004)[32]
13. SDSS-DR2 (2004)[33]
14. Gavazzi et al. (2004)[34]
15. Conselice et al. (2001)[35]
16. Gavazzi et al. (2000)[36]
17. Van Driel et al. (2000)[37]
18. Falco et al. (1999)[38]
19. Grogin et al. (1998)[39]
20. Giovanelli et al. (1997)[40]
21. Drinkwater et al. (1996)[41]
22. Kenney et al. (1995)[42]
23. Owen et al. (1995)[43]
24. Hoffman et al. (1995)[44]
25. Binggeli et al. (1993)[12]
26. LU et al. (1993)[45]
27. Strauss et al. (1992)[46]
28. de Vaucouleurs et al.(1991)[47]
29. Geha et al. (2003)[48]

In columns 5 and 8, M= Certain cluster member, B = Background and '-' or blank = Possible member.

Table3:

VCC No.	BT	Membership. (old)	Type (old)	Vhelio(old) (kms^{-1})	Membership. (New)	Type (new)	Vhelio (new)	Distance (Mpc)	Vhelio NED
1916	17	_	Im?	_	B	?	7952	106.1	7954
1922	17.5	_	E0?	_	B	S (dS)	20150	268.7	20150
1889	16	M	ImIV:	_	B	Sd	4725	63	4725
1864	16.8	_	Im?	_	B	?	4727	63	4727
1643	15.2	_	dE4,N	_	B	S0	12563	167.5	12563
1583	16.5	_	BCD?	_	B	?	4605	61.4	4605
1483	16.5	_	ImIV	_	B	Sd	7377	98.4	7380
1471	16.5	_	BCD/merger	_	B	?	18268	243.6	18268
1460	16.5	_	BCD?	_	B	?	8728	116.4	8728
1258	15.3	_	BCD	_	B	?	9332	124.4	9332
899	16.6	M	ImIV	_	B	Sm	4198	56	4198
544	17	M	ImIII	_	B	Sm	5796	77.3	5796
550	16.5	_	ImIII?	_	B	Sm	4658	61.9	4646
148	15.3	_	BCD	_	B	S (dS)	7913	105.8	7934
116	17.2		BCD?	_	B	Im	3830	51.1	3830
102	15	_	BCD	_	B	?	12815	170.9	12815
16	16.5	_	ImIII	_	B	Sd	6770	90.3	6770

Table 4:

VCC No.	BT	Membership (old)	Type (old)	Vhlio(old) (kms^{-1})	Membership (new)	Type (new)	Vhelio (new)	Distance (Mpc)	Vhelio NED
60	15	M	SmIII-IV	_	B	Sm	4528	60.4	4528
72	16	M	ImIII/BCD	90	B	Sd	6348	84.7	6351
128	15.6	M	dE0	_	B	dE	9000	120	_
280	17.7	M	Im IV-V	_	B	Im	8014	106.9	8014
354	16.6	M	dE0	_	B	dE	99000	1320	112740
719	18.5	M	dE2	_	B	dE	32738	436.5	-
380	15.3	M	BCD	_	B	BCD	3779	50.4	3779
401	17.7	M	dE1:	_	B	dE	7232	94	7048
493	19	M	dE	_	B	dE	27632	368.4	27632
544	17	M	ImIII	_	B	Sm	5796	77.3	5796
574	17	M	dE3	_	B	dIm/dE	23050	307.3	23050
586	18.5	M	dE4	_	B	dE	4636	61.8	4636
602	18.3	M	dE0	_	B	dE	14734	196.5	14734

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

652	17.8	M	dE0	_	B	dE	21213	282.8	21213
703	17.5	M	ImV	_	B	Im	7125	95	7125
719	18.5	M	dE2	_	B	dE	32738	436.5	32738
761	17.3	M	dE4	_	B	dE	99000	1320	_
808	17.7	M	dE5,N	_	B	dE	11330	151.1	11317.1
838	17.5	M	dE2	_	B	dE	88564	1181	88564
899	16.6	M	ImIV	_	B	Sm	4198	56	4198
972	16.9	M	dE3,N	_	B	dE	99000	1320	_
1106	17.5	M	ImV:	_	B	Im	99000	1320	_
1111	17.7	M	dE4,N	_	B	dE	7701	102.7	7701
1119	17.4	M	dE4:,N:	_	B	dE	99000	1320	_
1227	17.9	M	dE0/ImV	_	B	dIm/dE	18069	240.9	_
1288	17.9	M	dE4:	_	B	dE	9900	1320	_
1298	17.9	M	dE3	_	B	dE	99000	1320	_
1355	14.3	M	dE2,N	_	B	dE	6210	82.8	6210
1473	18.3	M	dE1:	_	B	dE	24966	332.9	24966
1495	17.6	M	dE0,N	_	B	dE	99000	1320	_
1517	17.3	M	dE3,N	_	B	dE	10188	135.8	10188
1563	16.1	M	dE3,N	_	B	dE	99000	1320	_
1604	16.7	M	dE6,N	_	B	dE	10160	135.5	_
1658	17	M	dE4	_	B	dE	99000	1320	_
1677	16.8	M	dE1,N	_	B	dE	99000	1320	_
1863	19	M	dE	_	B	dE	22201	296	22201
1874	17.7	M	dE	_	B	dE	50320	670.9	50285
1889	16	M	ImIV:	_	B	Sd	4725	63	4725
1915	17.1	M	dE3	_	B	dE	21330	284.4	_
1998	18.2	M	dE2	_	B	dE	19409	258.8	19409

References:

[1] G. de Vaucauleurs, 1956, Vistas in Astronomy, 2, 1584- 1606.
[2] H. Shapley and A. Ames, 1926, Harvard Circ., 294.
[3] H. Shapley and A. Ames, 1932, Annals of Astron. Obs. of Har. Coll., Vol. 88, No. 2.
[4] E. Hubble and M. L. Humason, 1931, ApJ, 74, 43H.
[5] S. Smith, 1936, ApJ, 83, 23S.
[6] G. de Vaucauleurs, 1961,ApJS, 6, 213D.
[7] G. Reaves, 1956, AJ, 61, 69R.
[8] F. Zwicky, 1959, Handb. Phys., 53, 390.
[9] G. de Vaucouleurs and A. de Vaucouleurs,1973, A&A, 28, 109.
[10] B. Binggeli, A. Sandage and G.A. Tammann, 1985, A J, 90, 1681B.
[11] B. Binggeli, G., A. Tammann and A. Sandage, 1987, A J, 94, 251B.
[12] B. Binggeli, C. C. Popescu, and G.A. Tammann, 1993, A&AS, 98, 275 – 296.
[13] N. Yasuda, M. Fukugita and S. Okamura, 1997, ApJS, 108, 417- 448.
[14] G. Gavazzi, A. Boselli, M. Scodeggio, D. Pierini and E. Belsole, 1999, MNRAS, 304, 595-610.
[15] S. Schindler, B. Binggeli, and H. Bohringer,1999,A&A,343.
[16] Mei et al., 2007, ApJ, 655, 144-162.
[17] A.D. Chernin, I. D. Karachentsev, O. G. Nasonova, P. Teerikorpi, M. J. Valtonen,V. P. Dolgachev, L. M. Domozhilova and G. Byrd,. 2010, arXiv:1006.0555v1[astrp-ph.CO].
[18] B. Binggeli, A. Sandage, and G. A. Tammmann, 1984, AJ, 89, 64.
[19] Galaxy online database Milano Network (GOLD Mine), ref.: http://goldmine.mib.infn.it/ref.: G. Gavazzi, A. Boselli, A. Donati, P. Franzetti and M. Scodeggio, 2003, A&A, 400, 451-455.
[20] NASA/IPAC Extragalactic Database (ref.: http://ned.ipac.caltech.edu/forms/gmd.html).
[21] J. Huchra, P. Macri, M. Lucas et al., 2012, ApJS, 199, 26H.

International Journal of Scientific & Engineering Research Volume 5, Issue 1, January-2014
ISSN 2229-5518

[22] A. Chung, Van Gorkom, J. H. Kenney et al., 2009, AJ, 138, 1741C.
[23] B. R. Kent, R. Giovanelli, M. P. Haynes et al., 2008, AJ, 136, 713K.
[24] K. Rines and J. Geller Margaret, 2008, AJ, 135, 1837R.
[25] S. di Serego Alighieri, G. Gavazzi, C. Giovanardi et al., 2007, A&A., 474, 851D.
[26] Sloan Digital Sky Survey, DR6, 2007, (http://www.sdss.org/dr6/products/catalogs/index.html).
[27] R. Giovanelli, M.P.Haynes, B. R. Kent et al., 2007, AJ, 133, 2569G.
[28] Sloan Digital Sky Survey, DR5, 2006, (http://www.sdss.org/dr5/products/catalogs/index.html).
[29] G. Gavazzi, K. O'Neil, A. Boselli et al., 2006, A&A, 449, 929G.
[30] D. F. Woods, 2006, AJ, 132, 197W.
[31] Sloan Digital Sky Survey, DR4, 2005, (http://www.sdss.org/dr4/products/catalogs/index.html).
[32] Sloan Digital Sky Survey, DR3, 2004, (http://www.sdss.org/dr3/products/catalogs/index.html).
[33] Sloan Digital Sky Survey, DR2, 2004, (http://www.sdss.org/dr2/products/catalogs/index.html).
[34] G. Gavazzi, A. Zaccardo, G. Sanvito, A. Boselli and C. Bonfanti, 2004, A&A, 417, 499G.
[35] Christopher J. Conselice, John S. Gallagher III and Rosemary F. G. Wyse, 2001, ApJ, 559, 791C.
[36] G. Gavazzi, C. Bonfanti, P. Pedotti, A. Boselli, et al., 2000, A&AS, 146, 259G.
[37] W. Van Driel, D. Ragaigne, A. Boselli, A. Donas, and G. Gavazzi, 2000, A&AS, 144, 463V.
[38] E. E. Falco, M. J. Kurtz, M. J. Geller et al., 1999, PASP, 111, 438, (arXiv:astro-ph/9904265).
[39] N. A. Grogin, M. J. Geller and J. P. Huchra, 1998, ApJS, 119, 277.
[40] R. Giovanelli, A. Avera, and I. D. Karachentsev, 1997, AJ, 114, 122G.
[41] M. J. Drinkwater, M. J. Currie, C. K. Young et al., 1996, MNRAS, 279, 595D.
[42] Kenney, D. P. Jeffrey, Vera C. Rubin, P. Planesas, and J. S. Young, 1995, ApJ, 438, 135K.
[43] F. N. Owen, M. J. Ledlow and W. C. Keel, 1995, AJ, 109, 14O.
[44] G. Hoffman, Lyle, B. M. Lewis, E. E. Salpeter, et al., 1995, ApJ, 441, 28H.
[45] N. Y. LU, G. L. Hoffman, T. Groff, T. Roos and C. Lamphier, 1993, ApJS, 88, 383L.
[46] M. A. Strauss, J. P. Huchra, M. Davis, et al., 1992, ApJS, 83, 29S.
[47] G. de Vaucouleurs, A. de Vaucouleurs, Jr. Corwin, et al., 1991, Third Reference Catalogue of Bright Galaxies, Version 3.9.
[48] M. Geha, P. Guhathakurta and R. P. Van der Marel, 2003, AJ, 126, 1794G.