Chapter 2

The Eridanus group

Abstract:

The Eridanus group at a distance of $\sim$ 23 Mpc is a loose group of galaxies in the southern hemisphere. Using the redhsifts from the *NASA Extra-galactic Database (NED)*, $\sim$ 200 galaxies can be associated with the group which extends to $\sim$ 10 Mpc over a velocity range $\sim 1000 - 2200$ km s^{-1}. The velocity dispersion of the group is $\sim$ 240 km s^{-1}. The Eridanus group is a part of the filamentry structure joining several small and large groups including the Fornax cluster and the Dorado group of galaxies. The structure of the Eridanus group is complex with several sub-groups. These sub-groups often have their brightest members as an elliptical or an S0. These sub-groups have appreciably different morphological mix of galaxies. The NGC 1407 sub-group has a morphological mix (70% (E+S0) & 30% (Sp +Irr)) similar to that seen in virialised clusters. The overall population mix in the Eridanus group is 30% (E+S0) & 70% (Sp +Irr). There is no appreciable difference in the velocity range over which the early type and the late type galaxies are distributed in the group. Diffuse X-ray emission is detected around NGC 1407 which is an elliptical galaxy and the brightest member of the Eridanus group, and NGC 1395, another bright elliptical galaxy in the group. Most of the early type galaxies are in the NGC 1407 sub-group. The dynamical studies of Willmer et al. (1989) predicted that the different sub-groups of Eridanus are merging together to form a massive cluster. A sample of 57 galaxies of different morphological types is drawn from different regions of the group to study the H I and the radio continuum properties of galaxies, and the Tully-Fisher relations.

Keywords: Groups/Clusters - Eridanus, Fornax, Dorado, Coma, Virgo, Ursa-Major, sub-clustering, morphological mix, X-ray emission, intra group medium (IGM).

2.1 The Eridanus group: historical perspective

The concentration of galaxies in the Eridanus region is known for many years (Baker 1933, 1936). The complexity of this region was discussed by de Vaucouleurs (1975), who called galaxies associated with NGC 1332 and NGC 1209 as the "Eridanus Cloud". The Eridanus group was identified as a moderate size cluster in a large scale filamentary structure near $cz \sim 1500$ km s^{-1} in the Southern Sky Redshift Survey (SSRS; da Costa et al. 1988). This filamentary structure, which is the most prominent in the southern sky, extends for more than 20 Mpc. The Fornax cluster and the Dorado group of galaxies are parts of this filamentary structure. The dynamical parameters of a few galaxies in the Eridanus group were first published by Rood et al. (1970). With the increased number of identifications in this region by Sandage & Tammann (1975), and Welch et al. (1975), latter authors speculated a dynamical connection between the Fornax cluster and the Eridanus group. Using the data from the Southern Galactic Cap sample (SGC; Pellegrini et al. 1990), Willmer et al. (1989) grouped the galaxies of the Eridanus region into different sub-groups and studied their dynamics. They concluded that each sub-group is a bound structure, and, the entire group is also gravitationally bound with a dynamical mass greater than $\sim 10^{13}$ M$_\odot$. They further pointed out that the Fornax and the Eridanus together constitute a bound system.

The sub-group containing NGC 1407 in the Eridanus is a well studied system (de Vaucouleurs 1975, Huchra & Geller 1982, Maia et al. 1988, Ferguson & Sandage 1990). This region, the most compact among all the sub-groups, has a regular appearance. This sub-group has been known as NGC 1407 or NGC 1400 group in the literature. Willmer et al. (1989) pointed out that most of the early type galaxies are concentrated in this region. One of the early type system NGC 1400 (S0, 558 km s^{-1}) in this region has drawn the attention of several co-workers for its large peculiar velocity. Whereas all identified members in this sub-group are at Helio-centric velocities in the range $\sim 1000-2200$ km s^{-1} , NGC 1400, the second brightest galaxy in this region, is at a Helio-centric velocity of $\sim$ 558 km s^{-1}. Based on the distance measurements from the surface brightness fluctuations, Tonry (1991) showed that NGC 1400 and NGC 1407 are equidistant. These observations, therefore, placed the projected separation between these two galaxies as $\sim 80kpc$. Thereafter, Gould (1993) pointed out that NGC 1400 is bound to the sub-group associated with NGC 1407, and, concluded that NGC 1407/NGC 1400 group is extremely dark with a M/L value exceeding 3000. In the same paper, Gould also pointed out that the true internal dispersion of galaxies in the Eridanus region is $\sim$192 km s^{-1} after taking out the gradient in velocity which he referred to as due to the Hubble flow in the Eridanus-Fornax-Dorado filament (cf. da Costa et al. 1988). Further studies also tried to establish that NGC 1400 and NGC 1407 are equidistant. Quintana et al. (1994) estimated a high value of M/L from identifying more members in this direction to explain the peculiar velocity of NGC 1400.

2.2 Group properties

2.2.1 Structure of the group and members

In Fig. 2.1, the velocity-cone diagrams are plotted in the Super-galactic coordinates. The Helio-centric velocities are from the *NASA Extra-galactic database (NED).* The clustering of galaxies near $l = 283°$ and $b = -43°$ is the Eridanus group. Most of the Eridanus galaxies are concentrated in the velocity range $cz = 1000 - 2200$ km s^{-1} (Fig. 2.3). The group appears to be loose and irregular and it is difficult to apply a strict boundary in the sky. However, a circle in Fig. 2.1 is chosen in such a way to exclude other prominent sub structures in the similar velocity range, e.g., one near $cz \sim 1500$ km s^{-1} and at the Supergalactic latitude of $-25°$. The clustering of galaxies near the apex ($cz = 0$) is due to the galaxies in the local group. In Fig. 2.2, the positions of galaxies within the velocity range $1000 - 2200$ km s^{-1} are plotted including NGC 1400 ($cz = 558$ km s^{-1}) which is the confirmed member of the Eridanus group. There are a total of 181 galaxies in this plot.

The approximate boundaries of different sub-groups identified by Willmer et al. (1989) are overlaid in this figure. The sub-clustering of galaxies is quite prominent in the inner region (*core*) inside the circle marked in Fig. 2.2.

The distances of a few early type galaxies from the Eridanus group have been determined using the surface brightness fluctuations in the I-band and in the K-band. The mean distance modulus $(m-M)$ of NGC 1400 (S0, 558 km s^{-1}), NGC 1407 (E, 1779 km s^{-1}), NGC 1395 (E, 1717 km s^{-1}), NGC 1332 (S0, 1524 km s^{-1}), and NGC 1426 (E, 1443 km s^{-1}) is 31.8 ± 0.2 mag. This implies a distance of $\sim 23 \pm 2$ Mpc (Jensen et al. 1998, Tonry et al. 1997, Tonry et al. 2001).

2.2.2 Morphological distribution

It can be seen in Fig. 2.2 that most of the early type galaxies are in the inner regions (*core*) inside the circle. In the outer regions, population is dominated by spirals. It can be seen in Fig. 2.2 that the sub-clustering is quite prominent in the inner region. The morphological mix is appreciably different in each sub-group. The three sub-groups, *viz.*, NGC 1407, NGC 1332, and NGC 1395 have their brightest members as an elliptical or an S0. The NGC 1407 sub-group is the richest in early types, most of them being S0s. The population mix of (E+S0) and (Spirals+Irr) in the NGC 1407 sub-group is 70% & 30% respectively, while that in most of the other sub-groups is 40% & 60% respectively. The overall population mix in the Eridanus group is 30% (E+S0) & 70% (Sp +Irr). In Fig. 2.3, the velocity-histograms of early and late type galaxies are plotted for the inner region (*core*), and the entire (inner and outer) region shown in Fig. 2.2. There is no appreciable difference in the velocity range over which the early type and the late type galaxies are distributed. On the other hand, in massive cluster galaxies like Virgo and Coma, the Spiral/Irr galaxies usually have a much flatter distribution than that of the E/S0 galaxies. It is interesting to note that the population mix in the NGC 1407 sub-group is similar to that seen in evolved clusters like Coma, whereas the velocity dispersion ($\sim$ 250 km s^{-1}) is much smaller than that in Coma ($\sim$ 1000 km s^{-1}). S0's in clusters are believed as swept up spirals as a result of ram-pressure stripping or as transformed spirals as a result of tidal interactions with galaxies and cluster potential. We will see in the next section that the intra-group medium density and velocity dispersion of the group is not sufficient to strip gas from galaxies via ram-pressure stripping. Given the sizes ($\sim$ 1 Mpc) of the sub-groups, the crossing times of galaxies in the sub-groups are about 4 Gyr which is shorter as compared to the

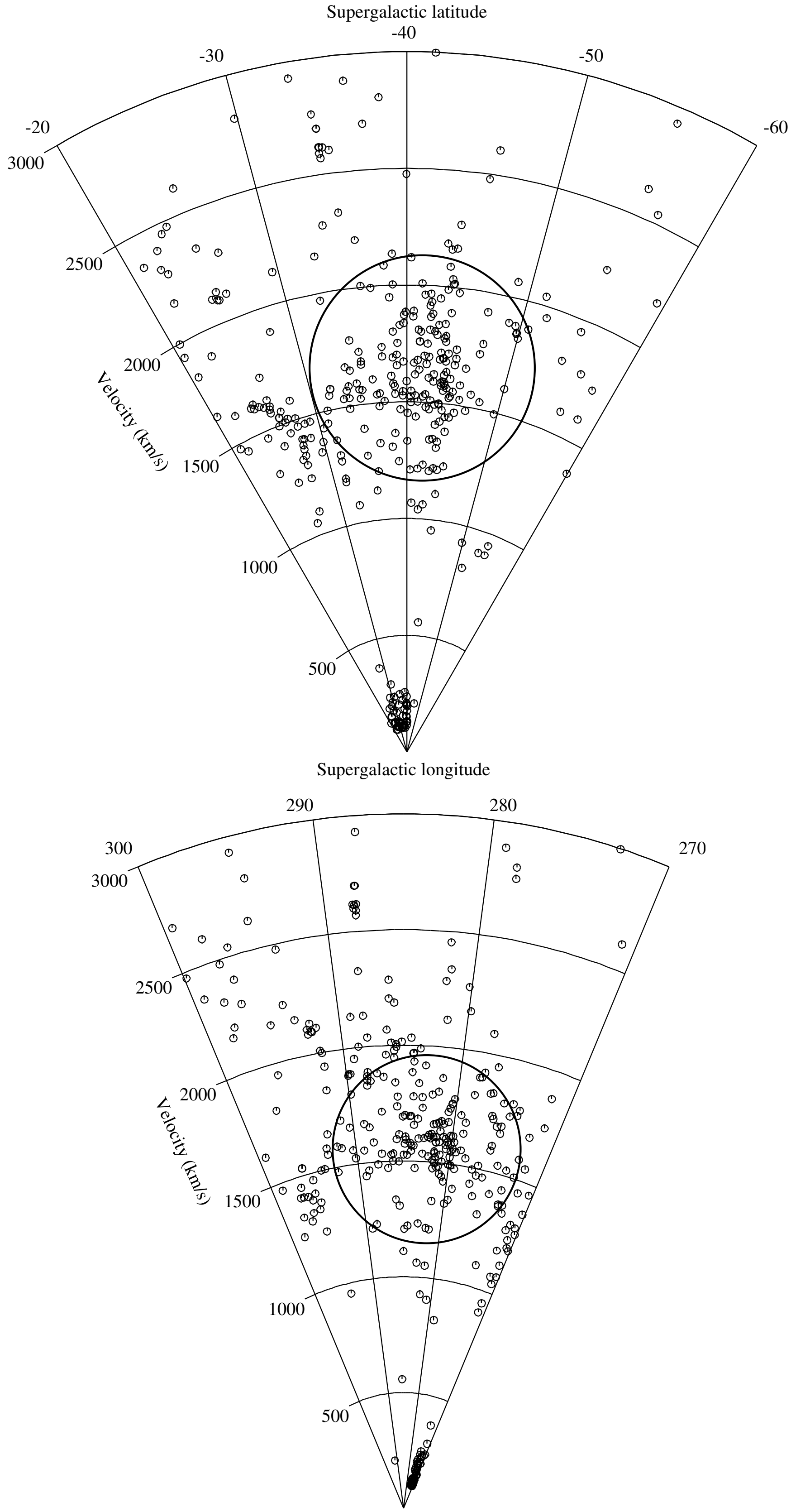

Figure 2.1: Optical positions of galaxies plotted in the velocity-cone diagrams. The positions are in the Super-galactic coordinates. The velocities are Helio-centric, and, are obtained from the *NASA Extra-galactic Database (NED)*. The circle marks the Eridanus group.

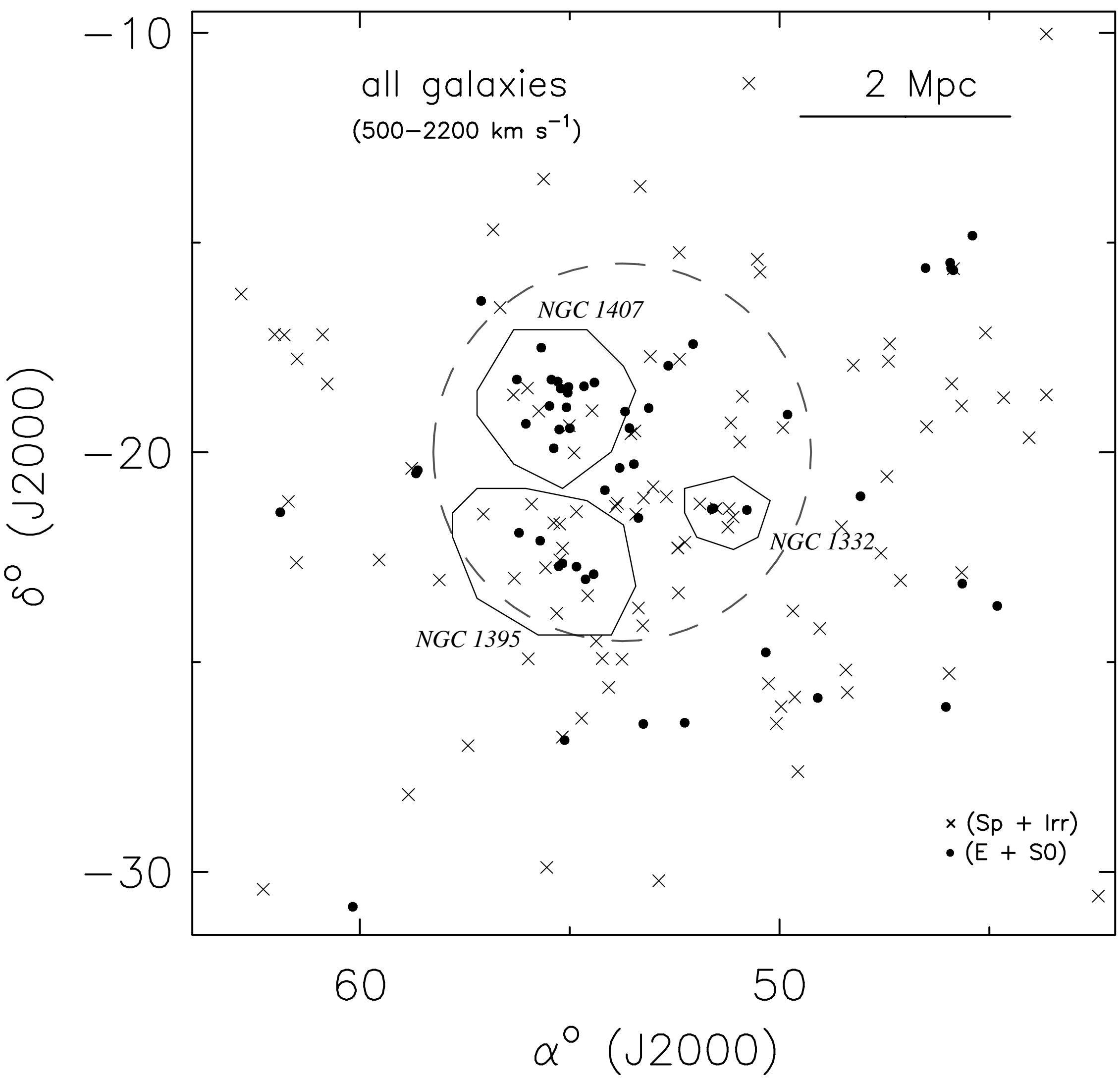

Figure 2.2: Optical positions of galaxies in the Eridanus group. The early type (E+S0) galaxies are marked as filled circles, and late type (Sp + Irr) galaxies are marked as crosses. The sub-grouping in the inner region is quite prominent. A few sub-groups with their identifications (cf. Willmer et al. 1989) are marked by enclosed boundaries . The dotted circle is identified as the *core* of the group.

typical ages of galaxies. It implies that interactions between galaxies are possible in the sub-groups. However, it is unclear if most of galaxies have already interacted in the sub-groups.

2.2.3 X-ray properties

The optically bright early type galaxies NGC 1400, NGC 1407, NGC 1395, and NGC 1332 are known X-ray sources in this group. Trinchieri et al. (2000) reported the presence of diffuse X-ray emission around NGC 1407. The processed and calibrated X-ray images (0.1 keV - 2.0 keV) centered at NGC 1407, NGC 1395, and NGC 1332 were obtained from the *ROSAT PSPC (Roentgen Satellite Position Sensitive Proportional Counter)* archival data. The total observation time in these fields were $\sim$ 6 hrs. The images were convolved with a circular Gaussian beam of $FWHM$ 90″ to enhance the diffuse emission. Apart from X-ray emission associated with NGC 1400, NGC 1407, and a few other unresolved sources in the field, diffuse emission up to an extent of $\sim 30'$ ($\sim$ 200 kpc) centered at NGC 1407 can be seen in Fig. 2.4. The diffuse X-ray emission can also be seen near NGC 1395 in Fig. 2.4, however, no such diffuse emission is seen around NGC 1332 (not shown here). Using the *PIMMS (Portable, Interactive Multi-Mission Simulator*; Mukai 1993) tool, the diffuse emission is modeled as thermal free-free emission from a Raymond-Smith plasma of energy $\sim$ 1.0 keV and metallicity 0.2–solar. The choice of the temperature and the metallicity is in accordance with typical values found in X-ray groups (Mulchaey 2000).

The total X-ray luminosities of the diffuse emission in the energy range 0.1-2.0 keV is 1.6×10^{41}erg s^{-1} for the NGC 1407 sub-group, and 6.8×10^{40}erg s^{-1} for the NGC 1395 sub-group. The Intra Group Medium (IGM) density is estimated as $\sim 2.0 \times 10^{-4}$ cm^{-3} in the X-ray emitting regions. The X-ray luminosity is about three orders of magnitude lower, and IGM density is about an order of magnitude lower than that observed in virialised clusters (e.g. Coma), but, consistent with that seen in groups (Mulchaey 2000).

Ram-pressure varies as $\rho_{IGM} V^2$ with the IGM density ρ_{IGM} and relative velocity V of a galaxy in the IGM. For the Eridanus group, it can be shown (see Sect. 5.3 for details) that for typical sizes of galaxies, ram-pressure can affect H I at column densities below 3×10^{19} cm^{-2} while bulk of H I mass in galaxies is at column densities above this value. Therefore, ram-pressure is ineffective in removing gas from galaxies in the Eridanus group. Since the gas loss via transport processes have a strong dependence on the temperature as $T^{2.5}$ (see Sect. 5.3 for details), an order of magnitude lower temperatures in groups as compared to clusters render these processes also ineffective in groups.

2.3 Eridanus and other groups/clusters

In Tab. 2.1, the properties of the Eridanus group are compared with the two clusters Virgo and Fornax, and one group Ursa-Major. These groups/clusters are at more or less similar distances as that of the Eridanus group. The Fornax cluster and the Eridanus group are parts of a filamentary structure described by da Costa et al. (1988), and the Ursa-Major group is considered as a loose group associated with the Virgo cluster (Tully et al. 1996). All the four systems have different properties. The Fornax having the highest galaxy density among all the systems has lowest spiral fraction consistent with the density-morphology relation. The Eridanus group forms an intermediate sample between a cluster like Virgo, and a loose group like Ursa Major in terms of morphological mix. The mean projected galaxy density in Eridanus (inner 9° or 3.5 Mpc) is intermediate between those in Ursa-Major and Virgo. The galaxies in Virgo are H I deficient, but, Ursa-major group has normal H I content. The X-ray luminosity in the Eridanus group is at the lower end of the X-ray luminosities observed in groups (Mulchaey 2001). The velocity dispersion in Eridanus is intermediate between that in Fornax and Ursa-Major. The Eridanus group is a dynamically young system as the velocity dispersion of the group is $\sim$240 km s^{-1} , which is much smaller than that found in clusters like Virgo ($\sim$ 800 km s^{-1}).

From this comparison, it appears that the Eridanus group forms a system which is intermediate between a loose group (Ursa-Major) and a rich cluster (Virgo). The high fraction of S0's in the Eridanus group can not be explained by either ram-pressure or the transport processes. If S0's are believed as a result of evolution of galaxies, the Eridanus group may be able to provide clues to the evolutionary processes other than those active in clusters of galaxies.

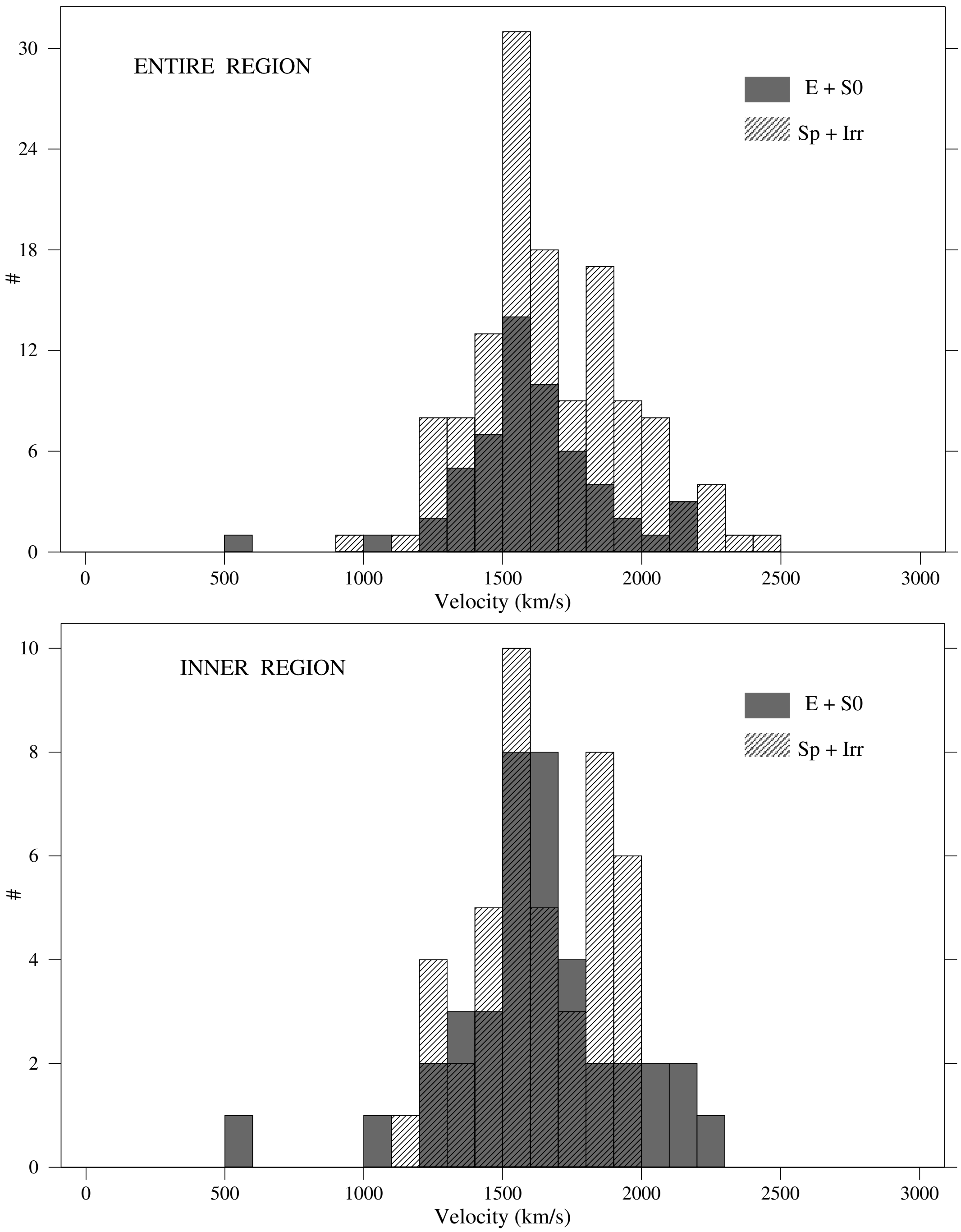

Figure 2.3: The velocity-histograms of galaxies in the inner regions (*core*), and the entire group (Fig. 2.2) are shown. There is no appreciable difference in the velocity range over which the early type and the late type galaxies are distributed.

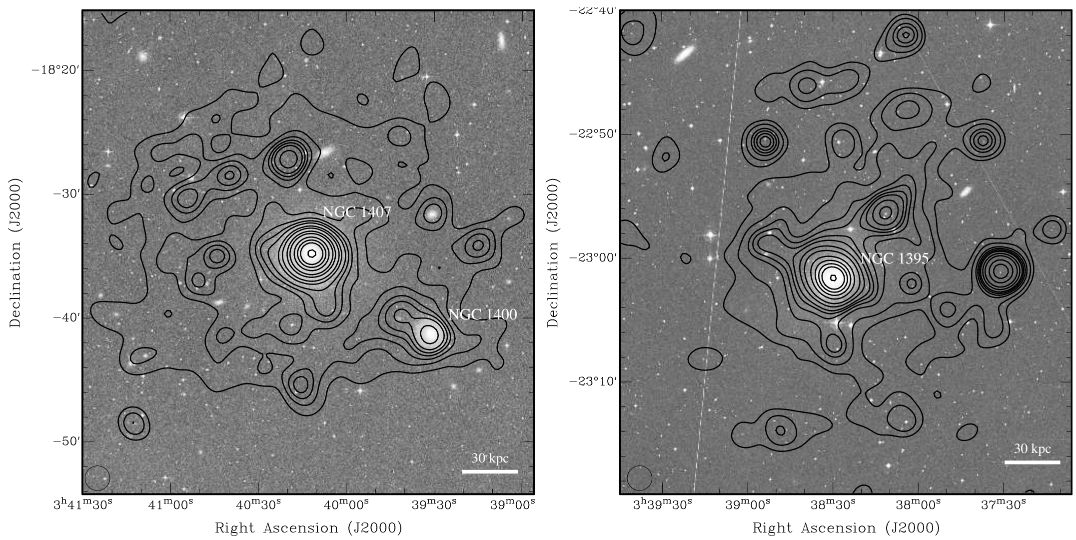

Figure 2.4: X-ray emission around NGC 1407 and NGC 1395 overlaid upon the optical images from the *DSS*. The X-ray images are retrieved from the *ROSAT PSPC* archival data and smoothed with a circular Gaussian beam of 90". The diffuse X-ray emission is believed to be thermal. The total X-ray luminosity (0.2–2.0 keV) of the diffuse emission is estimated as 1.6×10^{41}erg s^{-1} for the NGC 1407 sub-group, and 6.8×10^{40}erg s^{-1} for the NGC 1395 sub-group.

Table 2.1: Comparison of four nearby galaxy groups/clusters

Name/Properties	**Virgo**[a]	**Fornax**[b]	**Eridanus**[c]	**Ursa-Major**[d]
Distance (Mpc)	21	20	23	21
No. of E+S0	71	23	36	9
No. of S + Irr	123	17	42	53
(S+Irr) fraction	0.6	0.4	0.5	0.9
Vel. dispersion (km s^{-1})	760	350	240	150
log X-ray luminosity (erg s^{-1})	43.5	41.7	41.4	–
Proj. galaxy density (Mpc^{-2})	50	70	8	3
Mean H I deficiency	2.5	2.5	–	0
References	1,2,3,4,5	2,6,7,8,9	10	11,12,13

Notes - (a): Inner 6° region, (b): Inner 2°.4 region, (c): Inner 9° region, (d): Inner 15° region. References - (1) Federspiel et al.(1998), (2) Ferguson (1989), (3) Binggeli et al. (1987), (4) Mushotzky & Smith (1980), (5) Haynes & Giovanelli (1986), (6)Mould et al. (2000), (7) Richter & Sadler (1985), (8) Paolillo et al. (2001), (9) Schroder et al. (2001), (10) this chapter, (11) Sakai et al. (2000), (12) Tully et al. (1996), (13) Verheijen (2001)

2.4 Conclusions

Several conclusions can be drawn from the properties of the Eridanus group described in the previous sections. Some of the important conclusions relevant to this thesis are the following:

- The complex structure of the group suggests that it is not virialised, and could be in its early stages of evolution.
- The low velocity dispersion ($\sigma \sim 240$ km s^{-1}), the long crossing time and the significant amount of substructures in the group suggests that the group is dynamically young.
- The association of diffuse X-ray emission with the two elliptical galaxies which also happen to be the brightest galaxies in the two sub-groups respectively suggests that the group is perhaps evolving into a cluster, where similar associations are detected, but, with higher optical and X-ray luminosities.
- The low IGM density ($\rho_{IGM} \sim 10^{-4}$ cm^{-3}) in Eridanus and low temperatures in groups (typically $T_{IGM} \sim 10^7$ K) relative to that in clusters (typically $\rho_{ICM} \sim 10^{-3}$ cm^{-3}, and $T_{ICM} \sim 10^8$ K) , make ram-pressure stripping ($\sim \rho\sigma^2$) and transport processes ($\sim T^{2.5}$) ineffective in removing gas from galaxies in groups than in clusters.
- The high fraction of S0's in the Eridanus group is surprising. It indicates that significant evolution of galaxies has taken place in the group if we believe that S0's are formed as a result of galaxy evolution (*nurture*).

2.5 Sample of galaxies

A sample of galaxies was constructed for the H I 21cm-line observations with the GMRT, and with the 1-m optical reflector at State Observatory, Nainital to get the R-band CCD photometry. The *Two Micron All Sky Survey* (2MASS) photometric data in the J, H, and K bands were also used. The selection of galaxies were made keeping in mind the objectives of the thesis. The galaxies were not selected based on their H I content. The galaxies were selected from the inner 9° region of the Eridanus group where galaxy density is higher and most of the S0's are found. Both early type and late type galaxies were included in the sample. The early type (E+S0's) galaxies usually have a little or no H I , but, it was important to observe them in a group as some gas might still be left in some of these galaxies if the morphological transformation (as it is expected in the *nurture* scenario) has taken place recently. The late type galaxies which are expected to be rich in H I might be loosing gas as a result of evolution processes, if any. Therefore, it was important to select galaxies of different morphological types. Since the present study was carried out with a limited telescope time of $\sim$ 200 hour, the pointing centres of the observations were adjusted in a way to include two or more galaxies within the *FWHM* of the primary beam. Unfortunately, one complete run of observations on 15 galaxies, mostly early types, was badly affected in November, 2001 due to ionospheric scintillations caused perhaps due to solar maximum in that year. The data collected during this period could not be used to obtain images. In Tabs 2.2 & 6.1, the complete observed sample of galaxies is listed with some of their previously known optical and radio properties. Most of the data presented in Tabs. 2.2 & 6.1 are from NED. The description of the table columns of Tab. 2.2 are as follows:

Column 1 : Serial number.
Column 2 : Name of the galaxy.
Columns 3&4 : Equatorial coordinates (Right Ascension & declination) in the J2000 epoch.
Column 5 : Coordinates (longitude & latitude) in the Super Galactic (SG) reference frame.
Column 6 : Helio-centric velocity (optical definition).

The descriptions of the table columns of Tab. 6.1 are as follows:

Column 1 : Serial number.
Column 2 : Name of the galaxy.
Column 3 : Morphological type.
Column 4 : Hubble type.
Column 5 : Apparent total photographic B-band magnitude corrected for the inclination.
Column 6 : Apparent total K-band magnitude from 2MASS.
Column 7 : B–K color.

Columns 8&9 : Single dish H I flux integral (Jy km s^{-1}) and velocity width at 20% of the peak flux in the global H I profile (km s^{-1}).

Table 2.2: Sample of galaxies for H I observations

#	Name	α(J2000) h m s	δ(J2000) ° ′ ″	l_{SG} °	b_{SG} °	cz (km/s)
1	NGC 1297	03 19 14.2	–19 06 00	284.30	–38.61	1579
2	NGC 1309	03 22 06.5	–15 24 00	289.12	–38.86	2135
3	NGC 1315	03 23 06.6	–21 22 31	281.46	–39.68	1673
4	SGC 0321.2-1929	03 23 25.1	–19 17 00	284.18	–39.61	1545
5	UGCA 068	03 23 47.2	–19 45 15	283.58	–39.73	1838
6	NGC 1325	03 24 25.4	–21 32 36	281.26	–39.99	1589
7	ESO 548- G 016	03 26 02.4	–21 20 26	281.55	–40.36	2119
8	NGC 1332	03 26 17.3	–21 20 07	281.56	–40.41	1524
9	NGC 1331	03 26 28.3	–21 21 20	281.54	–40.46	1210
10	APMBGC 548+070+070	03 26 31.3	–21 13 01	281.72	–40.46	1548
11	ESO 548- G 021	03 27 35.3	–21 13 42	281.72	–40.71	1668
12	ESO 548- G 025	03 29 00.7	–22 08 45	280.53	–41.08	1680
13	NGC 1345	03 29 31.7	–17 46 40	286.32	–40.91	1529
14	NGC 1347	03 29 41.8	–22 16 45	280.35	–41.24	1759
15	NGC 1353	03 32 03.0	–20 49 09	282.34	–41.73	1525
16	UGCA 077	03 32 19.2	–17 43 05	286.48	–41.57	1961
17	ESO 482- G 005	03 33 02.2	–24 07 58	277.89	–42.03	1915
18	IC 1952	03 33 26.7	–23 42 46	278.46	–42.13	1812
19	ESO 548- G 036	03 33 27.6	–21 33 53	281.35	–42.09	1480
20	IC 1953	03 33 41.9	–21 28 43	281.47	–42.14	1867
21	NGC 1359	03 33 47.7	–19 29 31	284.15	–42.06	1966
22	ESO 548- G 043	03 34 10.5	–19 33 30	284.07	–42.16	1931
23	ESO 548- G 044	03 34 19.2	–19 25 28	284.25	–42.18	1696
24	NGC 1371	03 35 02.0	–24 55 59	276.80	–42.48	1471
25	NGC 1370	03 35 14.6	–20 22 25	282.99	–42.46	1063
26	ESO 548- G 049	03 35 28.1	–21 13 01	281.85	–42.55	1510
27	IC 1962	03 35 37.5	–21 17 39	281.74	–42.58	1806
28	NGC 1377	03 36 39.1	–20 54 08	282.29	–42.81	1792
29	ESO 482- G 013	03 36 53.9	–24 54 46	276.82	–42.90	1835
30	NGC 1385	03 37 28.3	–24 30 05	277.38	–43.04	1493
31	NGC 1383	03 37 39.2	–18 20 22	285.80	–42.89	1948
32	NGC 1390	03 37 52.2	–19 00 30	284.89	–42.99	1207
33	NGC 1393	03 38 38.6	–18 25 41	285.70	–43.13	2185
34	NGC 1401	03 39 21.8	–22 43 29	279.81	–43.48	1495
35	ESO 548- G 064	03 40 00.0	–19 25 35	284.36	–43.52	1694
36	ESO 548- G 065	03 40 02.7	–19 22 00	284.45	–43.53	1221
37	IC 0343	03 40 07.1	–18 26 36	285.72	–43.48	1841
38	NGC 1407	03 40 11.9	–18 34 49	285.53	–43.51	1779
39	ESO 482- G 031	03 40 41.5	–22 39 04	279.92	–43.79	1621
40	APMBGC 548-110-078	03 40 52.5	–18 28 29	285.69	–43.66	1595
41	NGC 1415	03 40 56.7	–22 33 47	280.04	–43.85	1585
42	NGC 1414	03 40 57.0	–21 42 47	281.22	–43.84	1681
43	ESO 548- G 072	03 41 00.3	–19 27 19	284.34	–43.76	2034
44	NGC 1416	03 41 02.9	–22 43 09	279.82	–43.87	2167
45	IC 0345	03 41 09.1	–18 18 51	285.92	–43.71	1335
46	ESO 482- G 035	03 41 15.0	–23 50 10	278.27	–43.91	1890

#	Name	α(J2000) h m s	δ(J2000) ° ′ ″	l_{SG} °	b_{SG} °	cz (km/s)
47	NGC 1422	03 41 31.1	–21 40 54	281.27	–43.97	1637
48	IC 0346	03 41 44.6	–18 16 01	286.00	–43.85	2013
49	ESO 549- G 002	03 42 57.3	–19 01 12	284.99	–44.19	1111
50	MCG -03-10-041	03 43 35.5	–16 00 52	289.18	–44.07	1215
51	NGC 1440	03 45 02.9	–18 15 58	286.09	–44.63	1534
52	NGC 1438	03 45 17.2	–23 00 09	279.43	–44.85	1555
53	NGC 1452	03 45 22.3	–18 38 01	285.58	–44.73	1737
54	ESO 549- G 018	03 48 14.1	–21 28 28	281.60	–45.52	1587
55	NGC 1481	03 54 28.9	–20 25 38	283.15	–46.96	1733
56	NGC 1482	03 54 39.3	–20 30 09	283.04	–47.00	1916
57	ESO 549- G 035	03 55 04.0	–20 23 01	283.22	–47.10	1778

Note: The positions and velocities are from the *NASA Extra-galactic Database (NED)*

Table 2.3: Optical properties of galaxies in the Eridanus group

#	Name	Morph.	H.T.	B_0^T (mag)	K^T (mag)	B – K (mag)	H I Flux (Jy km/s)	W_{20} (km/s)
1	NGC 1297	S0a	–2.3	12.65	8.93	3.72		
2	NGC 1309	Sbc	4.0	11.83	9.10	2.73	18.7	171
3	NGC 1315	S0	–1.0	13.38	9.73	3.65		
4	SGC 0321.2-1929	Im	10.0				3.1	79
5	UGCA 068	Scdm	8.7	13.56			5.9	131
6	NGC 1325	Sbc	4.0	11.51	8.63	2.88	24.4	348
7	ESO 548- G 016	S?		14.61				
8	NGC 1332	S0	–3.0	11.21	7.05	4.16		
9	NGC 1331	E/S0	–5.0	14.22	10.76	3.46		
10	APMBGC 548+070+070	S0			11.23			
11	ESO 548- G 021	Sdm						
12	ESO 548- G 025	Sa	0.7	14.47				
13	NGC 1345	Sc	4.5	13.80			12.0	138
14	NGC 1347	Scd	5.3	13.55			0.6	105
15	NGC 1353	Sbc	3.0	11.73	8.11	3.62		
16	UGCA 077	Sdm	9.0	14.36			5.3	158
17	ESO 482- G 005	Sdm	8.0	14.33			5.4	184
18	IC 1952	Sbc	4.0	12.59	9.87	2.72	5.1	263
19	ESO 548- G 036	S?			10.43		4.1	
20	IC 1953	Sd	7.0	12.10	9.65	2.45	8.1	197
21	NGC 1359	Scm	9.0	12.37	11.17	1.20	25.7	223
22	ESO 548- G 043	Sa		15.55	11.46	4.09		
23	ESO 548- G 044	S0/a	–1.3	14.11	10.37	3.74		
24	NGC 1371	Sa	1.0	11.36	7.63	3.73	53.7	427
25	NGC 1370	E/S0	–3.5	13.36	9.87	3.49		
26	ESO 548- G 049	S?		14.92				
27	IC 1962	Sdm	8.0	13.74			5.5	171
28	NGC 1377	S0	–2.0	13.29	9.72	3.57		
29	ESO 482- G 013	Sb					2.0	99
30	NGC 1385	Scd	6.0	11.14	8.57	2.57	22.6	204
31	NGC 1383	S0	–2.0	13.25	9.44	3.81		
32	NGC 1390	S0/a	1.0	14.01	11.54	2.47	2.4	191
33	NGC 1393	S0	–1.9	12.78	9.18	3.60		
34	NGC 1401	S0	–2.0	13.11	9.35	3.76		
35	ESO 548- G 064	S0		14.52	10.73	3.79		
36	ESO 548- G 065	Sa	0.7	14.56	12.90	1.66	2.0	145
37	IC 0343	S0	–1.0	13.91	10.50	3.41		
38	NGC 1407	E0	–5.0	10.71	6.70	4.01		
39	ESO 482- G 031	dS0			12.37			
40	APMBGC 548-110-078	dS0						
41	NGC 1415	S0/a	0.0	12.41	8.73	3.68		
42	NGC 1414	Sbc	3.8	13.59			2.1	
43	ESO 548- G 072	S?						
44	NGC 1416	E/S0	–5.0	13.88	10.54	3.34		
45	IC 0345	S0/a		14.64	10.05	4.59		
46	ESO 482- G 035	Sab	2.1	13.42			4.2	177

#	Name	M.T.	H.T.	B_0^T (mag)	K^T (mag)	B − K (mag)	H I Flux (Jy km/s)	W_{20} (km/s)
47	NGC 1422	Sab	2.4	13.16	10.73	2.43		
48	IC 0346	S0	−0.8	13.37	9.78	3.59		
49	ESO 549- G 002	Im	10.0	14.53				
50	MCG -03-10-041	Sdm	8.0		11.91		3.7	184
51	NGC 1440	S0	−1.9	12.35	8.20	4.15		
52	NGC 1438	S0/a	0.0	12.94	9.62	3.32		
53	NGC 1452	Sa	0.4	12.56	8.67	3.89		
54	ESO 549- G 018	Sc	5.0	13.13	10.64	2.49		
55	NGC 1481	S0	−3.3	14.40	11.18	3.22		
56	NGC 1482	S0/a	−0.8	13.01	8.48	4.53	5.5	131
57	ESO 549- G 035	Sc					6.0	145

1) The morphological types, Hubble types, and photographic B-band magnitudes are from RC3 (Third reference catalog of galaxies; de Vaucouleurs et al. 1991) provided by NED. The K-band magnitudes are from the *Two Micron All Sky Survey* (2MASS; Jarrett et al. 2000). The single dish H I flux integrals and H I widths are from NED.

Bibliography

[1] Baker, R.H. 1933, *Ann. Harv. Coll. Obs.*, **88**, 79

[2] Baker, R.H. 1936, *Ann. Harv. Coll. Obs.*, **88**, No. 6

[3] Binggeli, B., Tammann, G.A., & Sandage, A. 1987, *AJ*, **94**, 251

[4] da Costa, L.N., Pellegrini, P.S., Sargent, W.L. et al. 1988, *ApJ*, **327**, 544

[5] de Vaucouleurs, G. *In Galaxies and the Universe, ed. Sandage, A., Sandage, M., Kristian, J., Univ. of Chicago, Chicago*, p. 557

[6] Federspiel, M., Tammann, G. A., & Sandage, A. 1998, *ApJ*, **495**, 115

[7] Ferguson, H.C. 1989, *Ap&SS*, **157**, 227

[8] Ferguson, H.C. & Sandage, A. 1990, *AJ*, **100**, 1

[9] Gooch, R., 1996 *In Astronomical Data Analysis Software and Systems - V, A.S.P. Conference Series, Ed. by Jacoby, G.H.& Barnes, J.*, **101**, 80

[10] Gould, A. 1993, *ApJ*, **403**, 37

[11] Haynes, M. P., & Giovanelli, R. 1986, *ApJ*, **306**, 466

[12] Huchra, J.P. & Geller, M.J. 1982, *ApJ Suppl.*, **257**, 423

[13] Jarrett, T.H., Chester, T., Cutri, R., Schneider, S., Skrutskie, M., & Huchra, J.P. 2000, *AJ*, **119**, 2498

[14] Jensen, J.B., Tonry, J.L., & Luppino, G.A. 1998, *ApJ*, **505**, 111

[15] Maia, M.A.G., da Costa, L.N., & Latham, D.W. 1988, *ApJ Suppl.*, **69**, 809

[16] Mould J.R., Hughes, S. M. G., Stetson, P. B. et al. 2000, *ApJ*, **528**, 655

[17] Mushotzky, R.F., & Smith, B.W. 1980, *In Highlights of astronomy, IAU Proceedings*, **5**, 735

[18] Mukai, K. 1993, *Legacy 3 (HEASARC Journal), p. 21-31 (*http://heasarc.gsfc.nasa.gov/docs/software/tools/pimms.html*)*

[19] Mulchaey, J.S. 2000, *ARA&A*, **38**, 289

[20] Paolillo, M., Andreon, S., Longo, G. et al. 2001, *A&A*, **367**, 59

[21] Pellegrini, P.S., da Costa, L.N., Huchra, J.P., Latham, D.W., & Willmer, C.N.A. 1989, *AJ*, **99**, 751

[22] Perrett, K.M. et al. 1997, *AJ*, **113**, 895

[23] Richter, O.G., Sadler, E.M. 1985, *A&AS*, **59**, 433

[24] Sakai, S., Mould, J. R., Hughes, S. M. G. et al. 2000, *ApJ*, **529**, 698

[25] Quintana, H., Fouqué, P., & Way, M.J. 1993, *A&A*, **283**, 722

[26] Rood, H.J., Rothman, V.C.A., & Turnrose, B.E. 1970, *ApJ*, **162**, 411

[27] Sandage, A. & Tammann, G.A. 1975, *ApJ*, **196**, 313

[28] Schroder, A., Drinkwater, M. J., & Richter, O.-G. 2001, *A&A*, **376**, 98

[29] Tonry, J.L. 1991, *ApJ*, **371**, 1

[30] Tonry, J.L., Blakeslee, J.P., Ajhar, E.A., & Dressler, A. 1997, *ApJ*, **475**, 399

[31] Tonry, J.L. et al. 2001, *ApJ*, **546**, 681

[32] Trinchieri, G., Pellegrini, S., Wolter, A., Fabbiano, G., & Fiore, F. 2000, *A&A*, **364**, 53

[33] Tully, R. B., Verheijen, M. A. W., Pierce, M. J., Huang, J., & Wainscoat, R. J. 1996, *AJ*, **112**, 2471

[34] Verheijen, M.A.W., & Sancisi, R. 2001, *A&A*, **370**, 765

[35] Welch, G.A., Chincarini, G., & Rood, H.J. 1975, *AJ*, **80**, 77

[36] Willmer, C.N.A., Focardi, P., da Costa, L.N., & Pellegrini, P.S. 1989, *AJ*, **98**, 1531