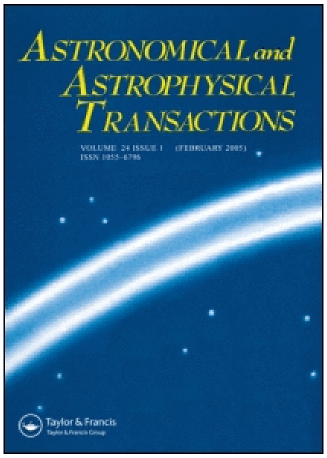

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

"Diskoteka" - a new catalog of thin edge-on galaxies

I. D. Karachentsev [a]; V. E. Karachentseva [b]; S. L. Parnovsky [b]; Yu. N. Kudrya [b]
[a] Special Astrophysical Observatory, Russian Academy of Sciences, Stavropol Territory, Russia
[b] Astronomical Observatory, Kiev University, Kiev, Ukraina

Online Publication Date: 01 August 1993
To cite this Article: Karachentsev, I. D., Karachentseva, V. E., Parnovsky, S. L. and Kudrya, Yu. N. (1993) '"Diskoteka" - a new catalog of thin edge-on galaxies', Astronomical & Astrophysical Transactions, 4:2, 143 - 151
To link to this article: DOI: 10.1080/10556799308205371
URL: http://dx.doi.org/10.1080/10556799308205371

Astronomical and Astrophysical Transactions, 1993,
Vol. 4, pp. 143–151
Reprints available directly from the publisher.
Photocopying permitted by license only

"DISKOTEKA"—A NEW CATALOG OF THIN EDGE-ON GALAXIES

I. D. KARACHENTSEV,[1] V. E. KARACHENTSEVA,[2]
S. L. PARNOVSKY[2] and YU. N. KUDRYA[2]

[1] *Special Astrophysical Observatory, Russian Academy of Sciences, Stavropol Territory, Russia, 357147*
[2] *Astronomical Observatory, Kiev University, Observatornaja 3, Kiev, 252053, Ukraina*

(29 May 1992)

We give a brief description of a new catalog of disklike edge-on galaxies, which is devised to study large-scale cosmic streamings. The Catalog covers the whole northern and southern sky, and contains 4463 galaxies with angular diameters $a > 40$ arcseconds and apparent axial ratio $a/b > 7$.

KEY WORDS Spiral galaxies, catalog, cosmic streamings.

1. THE AIM AND APPROACH

One of unexpected results in modern observational cosmology was the discovery of regular (non-Hubble) motions of galaxies on a scale of about 50 Mpc. Such anisotropic streaming in the Hydra–Centaurus direction with an amplitude of ~500 km/s is probably caused by the existence of the "Great Attractor," i.e. a mass concentration at 60 Mpc distance in the sky region mentioned above (Rubin *et al.*, 1976, Aaronson *et al.*, 1986, Dressler *et al.*, 1987). It is not yet clear what is the size of the volume affected by this cosmic streaming, there are no clear evidences for the existence of other regions involved in large-scale coherent motions.

Such cosmic "Gulfstreams" could be studied because the distance estimates independent of the redshift are available (Tully and Fisher, 1977, Faber and Jakson, 1976). With increasing number of known redshifts for the galaxies from existing catalogs, e.g. MCG (Vorontsov-Velyaminov *et al.*, 1962–1974), CGCG (Zwicky *et al.*, 1961–1968), UGC (Nilson, 1973), and ESO (Lauberts, 1982), a necessity to compile a new special catalog for the study of large-scale motions has become evident. Recently Karachentsev (1989) noted that a rich sample of "thin" edge-on spirals would be an appropriate tool for this purpose. Thin buldgeless galaxies show a tight correlation between their linear diameters and the 21 cm line widths, that allows to measure their distances without detailed photometry. The new catalog should comply with the following requirements:

—to cover the whole northern and southern sky;

—to achieve the characteristic depth of $D = (100\text{–}200)$ Mpc, i.e. larger than the present catalogs, MGC, UGC, CGCG, and ESO;

Table 1 The first page of the Flat Galaxies Catalog

FGC N	PGC #	R.A. (1950.0) h m s	DEC. (1950.0) ° ′ ″	l^{II} b^{II} °	°	a_0	b_0 (arc min)	a_E	b_E	PA (deg)	T	As	SB	N	Notes
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		00 01 29.4	−07 15 21	91.61	−66.92	0.78	0.11	0.75	0.11	80	m	2	III	1	*
2		00 01 46.5	−06 28 21	92.67	−66.26	0.90	0.10	0.78	0.12	120	bc	1	II	0	
3		00 01 47.4	+51 22 12	115.54	−10.55	1.10	0.10	1.01	0.11	48	c	1	II	2	*
4		00 02 26.1	+04 13 40	101.66	−56.44	0.69	0.08	0.57	0.11	122	cd	1	IV	3	
5	496	00 04 05.1	+17 00 28	107.93	−44.28	1.14	0.15	1.16	0.20	66	dm	0	III	1	*
6	527	00 04 18.3	+41 27 37	114.09	−20.37	1.49	0.15	1.32	0.13	28	cd	2	II	3	
7	566	00 04 40.3	+33 38 11	112.55	−28.06	1.18	0.10	0.92	0.12	178	c	1	III	1	
8		00 05 49.1	+32 44 47	112.62	−28.98	1.14	0.11	1.01	0.11	14	cd	1	III	4	
9		00 06 11.8	−04 54 35	96.71	−65.31	0.72	0.09	0.67	0.10	108	cd	1	II	0	
10		00 06 14.8	+04 10 33	103.27	−56.78	0.78	0.11	0.67	0.11	127	d	2	III	2	
11	670	00 06 46.0	+00 19 12	101.17	−60.48	1.01	0.12	0.90	0.15	40	b	0	II	1	
12		00 06 46.7	+30 23 09	112.34	−31.34	0.80	0.10	0.96	0.11	50	cd	2	III	0	*
13		00 06 50.8	−02 01 52	99.52	−62.70	0.90	0.10	0.71	0.11	42	bc	1	III	1	*
14		00 07 13.0	+38 51 10	114.17	−23.03	0.72	0.09	0.69	0.10	22	cd	0	II	0	
15		00 07 16.7	+28 16 02	111.98	−33.44	0.87	0.12	0.87	0.16	43	bc	0	III	3	
16	731	00 07 50.0	+28 42 30	112.23	−33.03	1.98	0.16	1.79	0.21	6	c	0	III	4	*
17		00 08 13.2	−01 10 16	100.85	−62.01	0.73	0.06	0.62	0.07	61	d	0	III	1	*
18		00 08 32.9	+33 37 56	113.45	−28.22	1.12	0.11	0.90	0.12	109	c	1	III	0	

19		00 08 47.4	−14 14 54	85.53	−73.85	0.74	0.10	0.67	0.11	49	bc	0	II	1	
20		00 09 36.1	+86 40 20	122.38	+24.12	0.66	0.08	0.75	0.09	56	cd	1	II	1	*
21	889	00 10 42.2	+16 45 18	110.01	−44.88	2.40	0.31	2.02	0.26	106	dm	2	II	0	*
22		00 11 07.2	+05 41 58	106.13	−55.66	1.01	0.10	1.03	0.12	54	c	0	II	1	*
23		00 11 13.0	+43 02 31	115.71	−19.02	1.51	0.17	1.32	0.16	97	dm	1	II	1	*
24	937	00 11 39.0	+07 08 03	106.98	−54.30	1.01	0.11	0.95	0.12	24	cd	2	II	1	
25		00 11 41.6	+01 39 01	104.33	−59.59	0.87	0.11	0.78	0.13	128	bc	1	III	1	
26		00 11 52.5	+07 01 19	107.03	−54.43	0.64	0.09	0.58	0.10	108	d	1	IV	0	
27		00 13 21.1	+15 43 18	110.60	−46.02	0.95	0.12	0.99	0.12	56	c	0	II	2	*
28		00 13 23.9	+03 12 41	105.95	−58.21	0.78	0.11	0.78	0.12	18	bc	1	II	0	
29	1195	00 15 49.1	+17 33 26	111.91	−44.33	0.95	0.12	0.97	0.14	110	c	1	II	0	
30		00 16 28.2	+26 21 09	114.02	−35.68	1.01	0.11	1.21	0.12	177	d	0	II	1	
31		00 17 00.2	+18 22 53	112.50	−43.57	1.12	0.09	0.99	0.10	34	dm	2	II	1	*
32	1269	00 17 07.5	+00 05 58	106.13	−61.46	1.06	0.12	0.95	0.12	146	c	1	II	0	*
33		00 18 16.1	+26 42 11	114.58	−35.39	0.90	0.11	0.84	0.11	150	dm	1	I	0	
34	1346	00 18 24.9	+07 20 45	109.87	−54.47	1.23	0.11	1.16	0.13	18	c	0	III	2	
35	1368	00 18 53.7	−04 30 32	104.27	−66.01	1.90	0.15	1.66	0.20	37	bc	0	III	2	*
36		00 19 34.1	+10 06 15	111.23	−51.82	0.90	0.11	0.91	0.11	149	d	0	II	1	
37	1422	00 19 39.0	+20 20 03	113.76	−41.74	1.04	0.14	1.01	0.16	161	c	1	II	1	
38		00 19 56.2	−10 58 25	99.02	−72.21	0.76	0.08	1.01	0.08	105	d	0	III	0	
39	1498	00 20 28.8	+34 52 12	116.42	−27.37	0.76	0.10	0.69	0.10	140	cd	0	III	2	
40		00 20 30.2	+20 41 43	114.10	−41.41	0.71	0.10	0.56	0.10	138	dm	2	IV	1	*
41		00 20 40.5	+41 42 25	117.36	−20.58	0.81	0.10	0.69	0.11	47	c	1	II	1	
42	1525	00 21 27.9	+16 12 56	113.49	−45.88	6.16	0.64	5.60	0.60	55	c	0	II	0	*
43		00 22 37.2	+13 15 29	113.22	−48.84	0.80	0.09	0.74	0.10	83	cd	1	IV	3	
44	1609	00 23 14.0	−02 33 40	107.96	−64.41	2.46	0.22	2.24	0.22	14	c	0	II	0	*

—to have a morphological homogeneity irrespective of the distance of galaxies;

—to contain preferably objects of late structural types, Sc–Sd, which are easily detectable in 21-cm surveys, and whose radial velocities are weakly affected by the virialization effect.

Preparation of such a catalog was started in 1988 by joint efforts of the Special Astrophysical Observatory and the Astronomical Observatory of Kiev University. By the present moment this project, named DISKOTEKA, has been completed, and we describe some of its general properties.

2. CATALOG DESCRIPTION

Selection of objects for the Catalog of Flat Galaxies (hereafter FGC) was carried out by systematic visual inspection of all the prints of both the Palomar Observatory Sky Survey (POSS) and the ESO/SERC Sky Survey in the blue and red colors. The Catalog includes the galaxies satisfying two simple conditions:

—the ratio of major-to-minor axes for the blue image is $a/b > 7$;

—the angular diameter of the blue major axis corresponds to $a > 40$ arc seconds;

In accordance with the original observational material, the Catalog consists of two parts: FGC and FGCE. The first part is based on the POSS, and covers the sky region with declination $+90° > \mathrm{DEC} > -17.5°$. The second one is based on the ESO/SERC films, and covers the rest of the sky area up to the southern pole. Altogether, FGC and FGCE comprise 2573 and 1890 galaxies, respectively. One can see the structure of the Catalog in Table 1, which reproduces the first page of FGC. The content of Table 1 is:

column 1—the FGC number;

column 2—the PGC number (Paturel *et al.*, 1989);

columns 3 and 4—Right Ascension and Declination for the 1950.0 equinox given in hours, minutes and seconds, and degrees, arcminutes and arcseconds, respectively, measured with a typical error of about 10 arcseconds;
columns 5 and 6—galactic longitude and latitude in degrees;
columns 7 and 8—major and minor angular diameters in arcminutes, measured on the blue POSS print;

columns 9 and 10—major and minor diameters, measured on the red print;

column 11—the positional angle of the major axis, measured in the anti-clockwise direction from the North;

column 12—the morphological type of a spiral according to the Hubble classification; as expected, Sc and Sd-types are most frequent ones in the Catalog;

column 13—index of apparent asymmetry (0—feebly marked, 2—pronounced);

column 14—index of the mean surface brightness (I—high, IV—very low);

column 15—the number of "significant" neighbours with an angular diameter a in the range $2a_0 > a > a_0/2$, which are located in the circle of 10 a_0 radius, where a_0 is the major axis of the galaxy considered;

column 16—reference to the Catalog notes that contain data on the morphologic peculiarity of the flat galaxy and its environment.

The Catalog Appendix includes the list of notes, cross-identifications with other known catalogs, and also data on radial velocities for the flat galaxies.

3. SELECTION EFFECTS

The simple geometric conditions used for including a galaxy in the Catalog make easy the analysis of different selection effects that are inevitable in any sample. Figure 1 shows the integral number of galaxies as a function of their blue angular diameters. Here filled circles correspond to the FGC data, and crosses, to the southern extension, FGCE. Two dashed lines indicate a homogeneous distribution $N \propto a^{-3}$. As one can see, the $\lg N(a)$ distribution has more or less the same shape for both samples. An additional analysis yields the completeness of the Catalog of about 90 per cent for $a_0 = 1.0$ arcminute, and 65 per cent for 0.7 arcminute.

In Figure 2 the number of flat galaxies is plotted versus their blue axial ratio a/b. The catalogic distribution, $n(a/b)$, is rather steep and can be well fitted by

$$n(a/b) \propto \exp[-(a/b)/2].$$

The shape of the distribution depends on both the true axial ratio distribution and projection (and selection) effects. The thinnest catalogic objects have apparent axial ratio $(a/b)_{\max} = 22$. This parameter must reflect, obviously, the conditions of formation and evolution of spiral disks. A steep decrease of the $n(a/b)$ distribution, together with axial ratio errors, are, probably, the main reason for the Catalog incompleteness at small diameters a and b.

4. THE DISTRIBUTION OVER THE SKY

The distribution of the Catalog objects over the whole sky is presented in Figure 3 in equatorial coordinates. Here we took into account a systematic difference in diameters of galaxies, measured on the POSS and ESO/SERC surveys. For objects in the common sky region we obtained the mean ratio $\langle a_{ESO}/a_{POSS} \rangle = 1.26 \pm 0.04$, which is due to a better quality of photographic emulsions used for the southern sky survey. The same ratio has been obtained earlier by Paturel *et al.* (1987). In accordance with this circumstance we omitted FGCE-galaxies with $a < 50''$ in Figure 3.

Besides the zone of extinction in the Milky Way the distribution of flat galaxies over the whole sky looks rather homogeneous. Dense concentrations of galaxies in the known supercluster regions, Virgo, Coma, Perseus, and Hercules, are practically absent in Figure 3. The region of the "Great Attractor" (13^h, $-30°$) also cannot be distinguished by its number density of galaxies. The distribution of the DISKOTEKA-galaxies shows no clear signs of the presence of some filamentary structures. However, the eye can find a number of empty regions at high galactic latitudes, which may be caused by real cosmic voids like the known Bootes void.

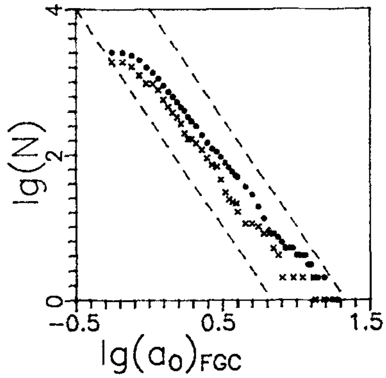

Figure 1 The integral distribution of the number of flat galaxies over their blue angular diameter. Filled circles: FGC, crosses: FGCE. Dashed lines correspond to a homogeneous distribution.

In general the low-contrast pattern of the distribution of the DISKOTEKA objects resembles the distribution of extragalactic IRAS-sources, identified with dust-rich spiral galaxies (Gezari *et al.*, 1987). The absence of prominent details in the flat galaxy distribution is in accordance with the conclusion of Giovanelli *et al.* (1986) that the correlation function amplitude decreases along the Hubble morphologic sequence from the early types to the later ones. Note also that the smoothest over-sky distribution is characteristic of the flattest galaxies, having $a/b > 10$.

5. INDICATIONS OF ANISOTROPY

Unlike galaxies with a small axial ratio a/b, the positional angle of edge-on galaxies can be measured with high accuracy. Comparing the FGC and FGCE

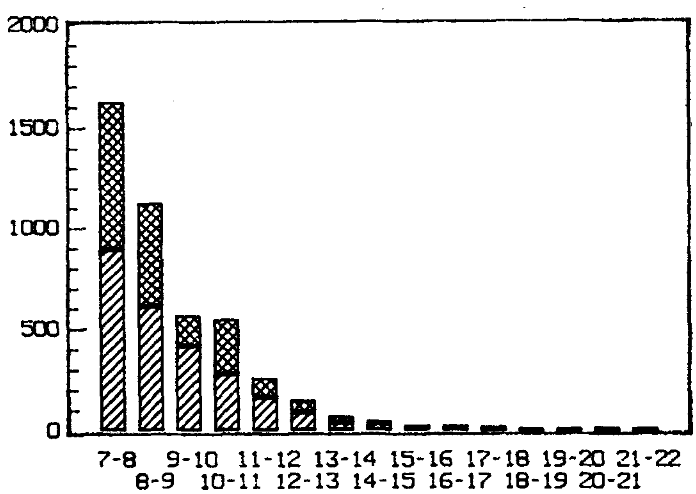

Figure 2 The distribution of the number of flat galaxies over their apparent axial ratio in blue light. Shaded columns: FGC; hatched: FGCE.

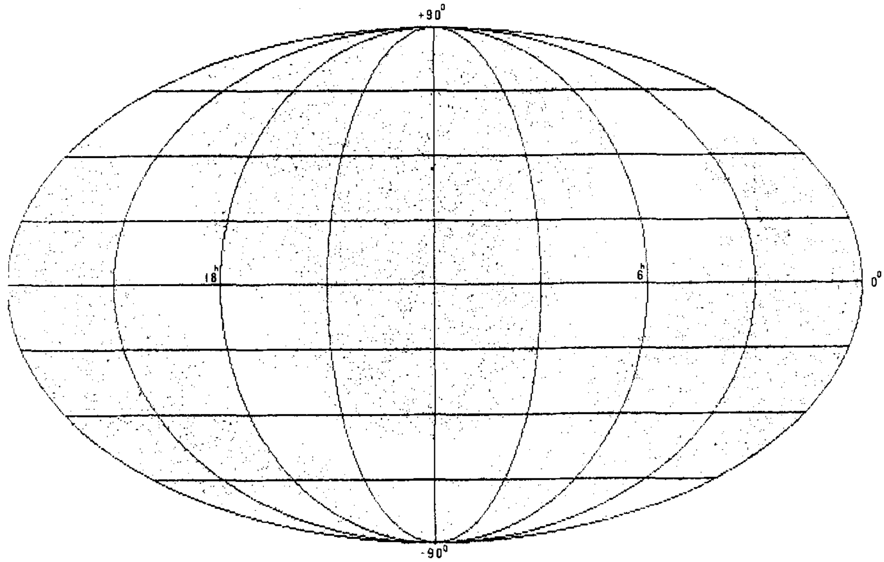

Figure 3 The whole-sky distribution of flat galaxies in equatorial coordinates.

data with the UGC and ESO catalogs, we obtain the mean-square difference $\sigma(\Delta\text{P.A.}) = 1\overset{\circ}{.}2$ in the position angles of flat galaxies. The distribution of all DISKOTEKA objects over their position angle is shown in Figure 4 with a step of 12°. The number of galaxies in each sector, N, is represented by a radial bar. Two thin circles indicate the ring of $\pm(\sigma = \langle N \rangle^{1/2})$ deviations with respect to the average. As follows from the data, the distribution of the orientations of the major axis for the flat galaxies is rather far from the isotropic one. The minimum number of objects occurs in the interval P.A. $= 75 \div 115°$, and the maximum one, at P.A. $= 50°$. That feature is present in both samples, FGC and FGCE. The probability of a chance deviation of the observed N(P.A.) distribution from the isotropic one does not exceed 10^{-7} according to the χ^2-criterion. This statistically significant anisotropy may be due to various reasons, their discussion will be a matter of our next paper.

6. CONCLUSION

In section 1 we mentioned basic properties that are desirable for a catalog aimed at a study of large-scale motions in the Universe. Our new catalog of disklike edge-on galaxies (DISKOTEKA) satisfies all these conditions.

An extensive 21-cm line survey of the DISKOTEKA galaxies began with the Arecibo radio telescope in 1991. Its first results demonstrate that nearly all thin edge-on galaxies are detectable in HI (Giovanelli, 1992). The effective depth of the Catalog is about 150 Mpc, i.e. 3 times the "Great Attractor" distance. The relation between the HI line width and the linear diameter for thin buldgeless galaxies allows to measure their distances with a standard error of dex (0.08),

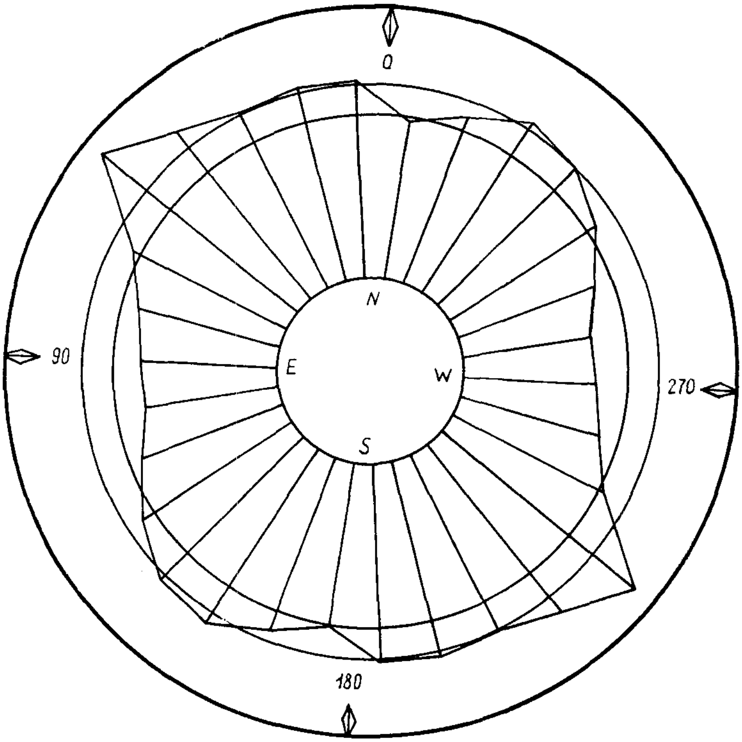

Figure 4 The distribution of the number of flat galaxies over the positional angle of their major axis with a step of 12 degrees.

which is quite acceptable for a search for cosmic streamings of an amplitude ~500 km/s at the scale mentioned.

ACKNOWLEDGEMENTS

Authors are very grateful to O. A. Dobrodij, G. G. Korotkova, and M. E. Sharina who took part in coordinate measurements of the flat galaxies.

References

Aaronson, M., Bothun, G., Mould, J., Huchra, J., Schommer, R. and Cornell, M. (1986). *Astrophys. J.*, **302,** p. 536.
Dressler, A., Lynden-Bell, D., Burstein, D., Davies, R., Faber, S., Terlevich, R. and Wegner, G. (1987). *Astrophys. J.*, **313,** p. 42.
Faber, S. M. and Jackson, R. E. (1976). *Astrophys. J.*, **204,** p. 668.
Gezari, D. Y., Schmitz, M. and Mead, J. M. (1987) (eds) Catalog of Infrared Observations. NASA Reference Publications p. 1196.
Giovanelli, R., Haynes, M. and Chincarni, G. (1986). *Astrophys. J.*, **300,** p. 77.
Giovanelli, R. (1992). Private communication.
Karachentsev, I. (1989). *Astron. J.*, **97,** p. 1566.

Lauberts, A., (1982). *The ESO Uppsala Survey of the ESO(B) Atlas*, ESO Munich, (ESO).
Nilson, P., (1973). *Uppsala General Catalogue of Galaxies*, Uppsala Astron. Obs. Ann 6. (UGC).
Paturel, G., Fouque, P., Lauberts, A., Valentijn, E. A., Corwin, H. G. and Vaucouleurs, G. de. (1987). *Astron. Astrophys.*, **184,** p. 86.
Paturel, G., Fouque, P., Bottinelli, L. and Gouguenheim, L., (1989) *Catalogue of Principal Galaxies*, Lyon. (PGC).
Rubin, V. C., Thonnard, N., Ford, W. K. and Roberts, M. S. (1976). *Astron. J.*, **81,** p. 719.
Tully, R. B. and Fisher, J. R. (1977). *Astron. Astrophys.*, **54,** p. 661.
Vorontsov-Velyaminov, B. A., Krasnogorskaja, A. A. and Arkhipova, V. P., (1962–1974) *Morphological Catalog of Galaxies*, I–IV (MCG).
Zwicky, F., Herzog, E., Wild, P., Karpowicz, M. and Kowal, C. (1961–(1968) *Catalogue of Galaxies and of Clusters of Galaxies*, I–VI. (CGCG).