IS OUR ENVIRONMENT STRATIFIED?

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In a previous paper, we have shown that the external HI regions of galaxies allow for the determination of a direction of parallelism. Being correlated with the supercluster flattening, this direction hints at a stratification. We illustrate the possible role of such a stratification in warping and tidal phenomena of galaxies. This stratification seems to involve various types of objects, and might extend much beyond $z=0.1$.

1. Introduction

The last few years the orientation of galaxies has been much studied. It seems granted that in the case of elliptic galaxies, there exists a correlation between the orientation of galaxies and the elongation of clusters [1,2]. According to some authors, this effect would depend on galaxy type, the results being less significant in the case of spiral or irregular galaxies [3,4]. Yet a weak alignment effect of spiral galaxies parallel to the supercluster flattening has been observed [5].

In the present paper, we show that this effect is very significant when studying the external regions of the spiral or irregular galaxies in the supercluster. This allows for the determination of a direction of parallelism. This direction is correlated to the distribution of nearby galaxies in the sky, which seems to hint at the existence of a stratified structure. We also illustrate that such a stratification might play a role in certain deformations of the HI envelopes of galaxies. As the analysis of a sample of radiogalaxies suggests, this stratification might extend much beyond $z=0.02$. This is in agreement with recent work suggesting that the local supercluster flattening could extend beyond $z=0.1$ [6–8].

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2. Cartography

The well-known formulas

$$\sin(b_\mathrm{P})=\cos(\alpha-\alpha_\mathrm{P})\cos(\delta_\mathrm{P})\cos(\delta)+\sin(\delta_\mathrm{P})\sin(\delta)\,,$$
$$\cos(p_\mathrm{P})\cos(b_\mathrm{P})=-\cos(\alpha-\alpha_\mathrm{P})\cos(\delta_\mathrm{P})\sin(\delta)+\sin(\delta_\mathrm{P})\cos(\delta)\,,$$
$$\sin(p_\mathrm{P})\cos(b_\mathrm{P})=-\sin(\alpha-\alpha_\mathrm{P})\cos(\delta_\mathrm{P}) \qquad (1)$$

may be used to calculate on a plate of the object G the position angle p_P of an object P in terms of the equatorial coordinates (α, δ) of G and $(\alpha_\mathrm{P}, \delta_\mathrm{P})$ of P. The angle b_P intervening in these formulas is nothing but the (P-)latitude of the object relative to the pole P (cf. fig. 1).

The formula

$$p_\mathrm{c}=90^\circ+p_\mathrm{P} \qquad (2)$$

defines the calculated position angle of the object G relative to the pole $\mathrm{P}(\alpha_\mathrm{P}, \delta_\mathrm{P})$. We note that this angle corresponds to the position angle that G would have if it were assimilated to a disk, oriented in space along the direction P. If p is the measured position angle, on the HI map, of the object G, we denote by Δp the difference between the "measured" and "calculated" position angles, $\Delta p=p-p_\mathrm{c}$.

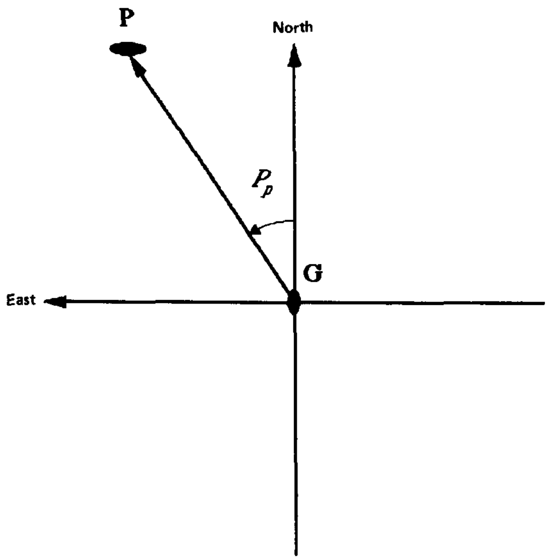

Fig. 1. Definition of the position angle p_P of an object P with coordinates (α_P, δ_P) on the plate of an object G with equatorial coordinates (α, δ).

3. Analysis of a sample of galaxies

The sample under study consists of 96 galaxies from the NBG Atlas catalog [9] that have an extended HI envelope and for which an HI contour map has been published. In table 1, we give for each object the position angle (column 6), the angular width in arc-minutes (column 7), with in column 8 the reference we have used. The other object parameters are obtained directly from the NBG catalog: name (column 1), morphological type (column 2), position in hours (2 digits)-minutes (last 3 digits) (column 3) and degrees (2 digits)-arcminutes (2 digits) (column 4), distance (column 5).

Application of the tests we have developed in a previous study [10] clearly shows that the orientation of the objects is not uniform since the isotropy hypothesis can be rejected with more than 100000000 versus 1. The sole non-geocentric interpretation of this result is that the external regions of galaxies are plane structures parallel to one another. A direction of parallelism (80°, +12°) has been deduced.

In order to study the stratification, a simultaneous plot of the parallelism and the spatial distribution of the objects is instructive. To this end we construct, after the "color triangle", the "triangle of a pole P" (fig. 2) in the following manner.

After the choice of a pole P, we associate to each galaxy in the sample a point with Cartesian coordinates (x, y),

$$x = -\tfrac{1}{2}\cos^2(b_P)\cos(2\Delta p)\,,$$

$$y = \tfrac{1}{2}\sqrt{3}\sin^2(b_P)\,. \quad (3)$$

The horizontal side of the isosceles triangle represents the objects having zero P-latitude, the left-hand side corresponds to $\Delta p = 0°$ and the right-hand side to $|\Delta p| = 90°$. Such a diagram has the advantage of allowing a simultaneous evaluation of the latitude and Δp distribution of the objects: the horizontal lines have constant latitude, while those through the vertex of the triangle have constant $|\Delta p|$.

If the P-latitude of all objects were close to 90°, it obviously would be very difficult, or even impossible, to use the position angle to determine P. For no perspective effect would then allow to single out a greatest elongation direction. The sample pole P is therefore chosen in such a way that the distribution of the objects be as anisotropic and the HI contours as parallel among themselves as possible. In other words, we are looking for the direction P which optimally concentrates the cloud of points in the left

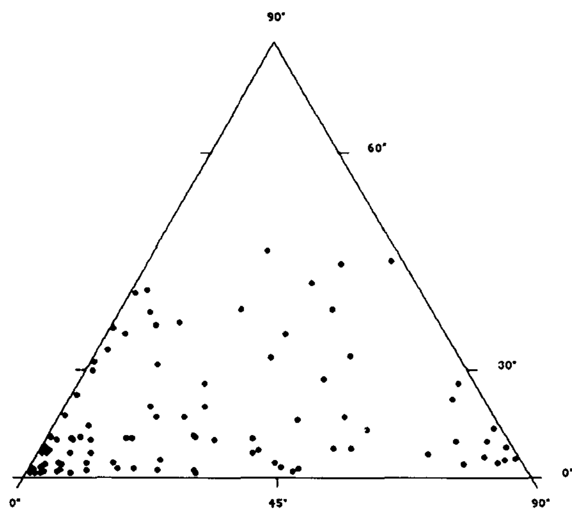

Fig. 2. "Stratification pole triangle" (cf. text), the pole equatorial coordinates are $\alpha = 78°$ and $\delta = 10.5°$.

Table 1
Galaxies having an HI envelope and appearing in the "Nearby Galaxies Catalog".

Name	Type	α	δ	Distance (Mpc)	Position angle (measured)	Diameter (arcmin)	Source
#NGC 55	9B	0012.4	−3928	1.3	132	37	[10]
#IC 10	10B	0017.7	5901	0.7	43	66	[11]
#NGC 224=M 31	3A	0040.0	4100	0.7	33	317	[12]
#NGC 247	7X	0044.6	−2101	2.1	176	38	[13]
#NGC 253	5X	0045.1	−2534	3.0	51	22	[14]
#NGC 300	7A	0052.5	−3757	1.2	162	50	[15]
#NGC 598=M 33	6A	0131.1	3024	0.7	21	59	[16]
NGC 628=M 74=UGC 1149	5A	0134.0	1532	9.7	25	26	[17]
NGC 660	1BP	0140.3	1323	11.8	160	28	[18]
#IC 1727	9B	0144.7	2705	6.4	150	30	[18]
#NGC 672	6B	0145.0	2711	7.5	65	30	[18]
NGC 772	3A	0156.6	1846	32.6	430	22	[18]
NGC 784	8	0158.4	2835	4.7	0	19	[18]
NGC 891	3A	0219.3	4207	9.6	23	15	[19]
NGC 925	7X	0224.3	3322	9.4	102	14	[20]
IC 239	6X	0233.3	3845	14.2	147	40	[21]
NGC 1058	5A	0240.2	3708	9.1	165	13	[22]
NGC 1291	0B	315.5	−4119	8.6	80	18	[23]
#IC 342	6X	0342.0	6756	3.9	39	51	[24]
A 0355	9	0355.0	6659	4.4	125	46	[18]
NGC 1530	3B	0417.0	7512	36.6	0	16	[18]
NGC 1560	7A	0427.1	7148	3.0	25	31	[18]
NGC 2146	2BP	0610.7	7822	17.2	160	60	[25]
NGC 2336	4X	0718.0	8016	33.9	0	21	[18]
NGC 2366=DDO 42	10B	0723.6	6918	2.9	27	14	[20]
#NGC 2403	6X	0732.1	6543	4.2	125	35	[26]
NGC 2541	6A	0811.0	4913	10.6	170	23	[18]
#A 0813+70=Ho II=DDO 50	10	0814.1	7052	4.5	175	14	[27]
NGC 2655	0X	0849.1	7825	24.4	145	40	[28]
NGC 2683	3A	0849.6	3338	5.7	35	21	[18]
NGC 2712	3B	0856.2	4507	28.6	162	16	[29]
NGC 2715	5X	0901.8	7817	20.4	163	27	[28]
NGC 2787	−2B	0914.8	6925	13.0	140	14	[30]
NGC 2805	7X	0916.4	6419	28.0	130	11	[31]
NGC 2841	3A	0918.6	5112	12.0	160	29	[32]
#NGC 2903	4X	0929.4	2144	6.3	35	24	[20]
#NGC 3031=M 81	2A	0951.5	6918	1.4	152	34	[33]
#NGC 3109=DDO 236	10	1000.8	−2555	1.8	93	64	[34]
NGC 3198	5B	1016.7	4549	10.8	32	17	[32]
#IC 2574=DDO 81	9X	1024.8	6840	2.7	45	29	[18]
NGC 3338	5A	1039.5	1401	22.8	90	23	[18]
NGC 3359	5B	1043.4	6330	19.2	172	10	[35]
NGC 3368=M 96	2X	1044.2	1205	8.1	170	20	[18]
#NGC 3521	4X	1103.2	14	7.2	155	33	[18]
NGC 3619	0A	1116.5	5802	27.9	77	2	[36]
NGC 3626	−2A	1117.4	1838	26.3	2	7	[36]
NGC 3718	1BP	1129.9	5321	17.0	13	16	[37]
NGC 3726	5X	1130.7	4719	17.0	171	13	[20]
NGC 3729	1BP	1131.1	5325	17.0	9	2	[37]
NGC 3900	−2A	1146.6	2718	29.4	4	6	[36]

Table 1 (continued).

Name	Type	α	δ	Distance (Mpc)	Position angle (measured)	Diameter (arcmin)	Source
NGC 3938	5A	1150.2	4424	17.0	20	10	[38]
NGC 3953	5B	1151.2	5237	17.0	10	13	[18]
NGC 3998	−2A	1155.3	5544	21.6	15	2	[39]
NGC 4038	10BP	1159.3	−1835	25.5	5	15	[40]
NGC 4096	5X	1203.5	4745	8.8	0	17	[18]
NGC 4151	2X	1208.0	3941	20.3	19	13	[41]
NGC 4203	−2X	1212.6	3329	9.7	24	10	[42]
NGC 4214	10X	1213.1	3636	3.5	150	28	[13]
#NGC 4236	8B	1214.3	6945	2.2	163	26	[26]
NGC 4242	8X	1214.9	4554	7.5	32	8	[20]
NGC 4244	6A	1215.0	3805	3.1	45	30	[13]
#NGC 4258=M 106	4X	1216.5	4735	6.8	152	26	[43]
NGC 4262	−2B	1217.0	1509	16.8	29	6	[44]
#NGC 4395	9A	1223.4	3349	3.6	154	28	[13]
IC 3365=UGC 7563=VCC 980	10	1224.6	1611	16.8	70	2	[45]
NGC 4449	10B	1225.8	4422	3.0	45	62	[46]
NGC 4490	10B	1228.2	4158	9.3	155	57	[34]
IC 3522=UGC 7737=DDO 136	10	1232.3	1530	16.8	95	4	[45]
NGC 4559	6X	1233.5	2814	9.7	157	29	[13]
NGC 4571	6A	1234.4	1429	16.8	40	4	[47]
NGC 4618	9B	1239.2	4125	7.3	35	33	[34]
#NGC 4631	7B	1239.8	3249	6.9	86	32	[48]
NGC 4656	9BP	1241.6	3226	7.2	40	23	[48]
NGC 4725	2XP	1248.1	2546	12.4	28	16	[20]
#NGC 4736=M 94	2A	1248.6	4123	4.3	114	12	[49]
NGC 4747	5BP	1249.3	2602	12.3	46	15	[50]
DDO 154	10	1251.6	2725	4.0	39	21	[13]
#NGC 4826=M 64	2A	1254.3	2157	4.1	115	26	[18]
NGC 5023	5	1310.0	4418	6.0	28	9	[51]
NGC 5033	5A	1311.2	3651	18.7	170	16	[20]
#NGC 5055=M 63	4A	1313.5	4217	7.2	116	33	[32]
N 5101=UGCA 351	0B	1319.0	−2711	27.4	167	10	[23]
#NGC 5194=M 51	4AP	1327.8	4727	7.7	170	11	[52]
#NGC 5236=M 83	5X	1334.2	−2937	4.7	172	96	[53]
NGC 5301	3A	1344.4	4621	27.7	174	18	[29]
NGC 5371	4X	1353.6	4042	37.8	4	7	[20]
NGC 5383=Mark 281	3BP	1355.0	4206	37.8	85	7	[54]
#NGC 5457=M 101	6X	1401.5	5436	5.4	35	102	[55]
NGC 5832	3BP	1457.6	7153	11.5	71	18	[29]
NGC 6503	6A	1749.9	7010	6.1	123	23	[20]
#NGC 6946	6X	2033.8	5959	5.5	62	19	[56]
N 7013	0A	2101.4	2942	14.2	150	7	[57]
NGC 7331	4A	2234.8	3410	14.3	167	17	[32]
IC 5267=2254-434	0A	2254.8	−4340	21.0	145	8	[23]
NGC 7640	5B	2254.4 2319.7	4034	8.6	165	30	[18]
#A 2359-15=WLM=DDO 221	10	2359.2	−1545	1.0	0	33	[18]

Table 2
Sample ordered by increasing $|\Delta p|$. The coordinates of the stratification pole P are $\alpha = 78°$ and $\delta = 10.5°$.

No.	Δp	α	δ	Position angle (measured)	P-latitude	Distance (Mpc)	Diameter (kpc)	Type	Name
1	0.2	1155.3	5544	15	3	21.6	12	2A	NGC 3998
2	−0.3	0856.2	4507	162	31	28.6	133	3B	NGC 2712
3	−0.7	1310	4418	28	−13	6.0	15	5	NGC 5023
4	0.8	1334.2	−2937	172	−36	4.7	131	5X	#NGC 5236
5	0.9	2234.8	3410	167	−2	14.3	70	4A	NGC 7331
6	−1.1	1131.1	5325	9	6	17.0	9	BP	NGC 3729
7	−1.4	1159.3	−1835	5	−14	25.5	111	10BP	NGC 4038
8	−1.6	0849.1	7825	145	17	24.4	283	0X	NGC 2655
9	2.0	1208	3941	19	−4	20.3	76	2X	NGC 4151
10	−3.0	2101.4	2942	150	−22	14.2	28	0A	N 7013
11	3.1	1129.9	5321	13	6	17.0	79	1BP	NGC 3718
12	−3.9	0918.6	5112	160	26	12.0	101	3A	NGC 2841
13	−4.1	1151.2	5237	10	3	17.0	64	5B	NGC 3953
14	−4.2	0219.3	4207	23	41	9.6	41	3A	NGC 891
15	−5.6	0732.1	6543	125	30	4.2	42	6X	#NGC 2403
16	5.9	1150.2	4424	20	1	17.0	49	5A	NGC3938
17	6.2	0052.5	−3757	162	13	1.2	17	7A	#NGC 300
18	−6.3	1043.4	6330	172	13	19.2	55	5B	NGC 3359
19	−6.6	1401.5	5436	35	−14	5.4	160	6X	#NGC 5457
20	6.8	1212.6	3329	24	−7	9.7	28	−2X	NGC 4203
21	7.4	1248.1	2546	28	−16	12.4	57	2XP	NGC 4725
22	−7.9	1319	−2711	167	−33	27.4	79	0B	NGC 5101
23	−8.2	2319.7	4034	165	8	8.6	75	5B	NGC 7640
24	−8.4	1117.4	1838	2	2	26.3	53	−2A	NGC 3626
25	−9.3	1146.6	2718	4	−3	29.4	51	−2A	NGC 3900
26	−11.7	0158.4	2835	0	41	4.7	26	8	NGC 784
27	12.1	0131.1	3024	21	35	0.7	12	6A	#NGC 598
28	12.5	1239.2	4125	35	−9	7.3	70	9B	NGC 4618
29	−12.7	0951.5	6918	152	17	1.4	13	2A	#NGC 3031
30	13.1	0901.8	7817	163	17	20.4	160	5X	NGC 2715
31	13.4	1214.9	4554	32	−3	7.5	17	8X	NGC 4242
32	13.4	2359.2	−1545	0	8	1.0	9	10	#A 2359-15
33	14.1	1457.6	7153	71	−5	11.5	60	BP	NGC 5832
34	14.3	1217	1509	29	−13	16.8	29	−2B	NGC 4262
35	14.9	0044.6	−2101	176	17	2.1	23	7X	#NGC 247
36	−15.7	0914.8	6925	140	20	13.0	52	−2B	NGC 2787
37	−16.5	1230.5	4745	0	−1	8.8	43	5X	NGC 4096
38	−17.1	0140.3	1323	160	38	11.8	96	1BP	NGC 660
39	17.4	1251.6	2725	39	−17	4.0	24	10	DDO 154
40	18.7	1241.6	3226	40	−13	7.2	48	9BP	NGC 4656
41	−18.9	1044.2	1205	170	9	8.1	47	2X	NGC 3368
42	−19.5	1130.7	4719	171	5	17.0	64	5X	NGC 3726
43	20.6	0811	4913	170	36	10.6	70	6A	NGC 2541
44	23.6	1749.9	7010	123	−9	6.1	40	6A	NGC 6503
45	24.1	1234.4	1429	40	−17	16.8	19	6A	NGC 4571
46	24.5	1225.8	4422	45	−6	3.0	54	10B	NGC 4449
47	−25.1	0342	6756	39	31	3.9	57	6X	#IC 342
48	25.1	1249.3	2602	46	−17	12.3	53	5BP	NGC 4747
49	26.5	0040	4100	33	23	0.7	64	3A	#NGC 224
50	26.6	0134	1532	25	37	9.7	73	5A	NGC 628
51	27.0	1215	3805	45	−5	3.1	27	6A	NGC 4244
52	−27.9	0916.4	6419	130	22	28.0	89	7X	NGC 2805

Table 2 (continued).

No.	Δp	α	δ	Position angle (measured)	P-latitude	Distance (Mpc)	Diameter (kpc)	Type	Name
53	−30.3	0012.4	−3928	132	5	1.3	14	9B	#NGC 55
54	−30.3	2254.4	−4340	145	−10	21.0	48	0A	IC 5267
55	−32.5	1353.6	4042	4	−21	37.8	77	4X	NGC 5371
56	34.2	0929.4	2144	35	28	6.3	44	4X	#NGC 2903
57	34.3	0017.7	5901	43	17	0.7	13	0B	#IC 10
58	34.5	1016.7	4549	32	17	10.8	53	5B	NGC 3198
59	35.1	0814.1	7052	175	24	4.5	18	10	#A 0813+70
60	−35.2	1214.3	6945	163	5	2.2	16	8B	#NGC 4236
61	−35.5	1103.2	14	155	2	7.2	69	4X	#NGC 3521
62	−37.2	1311.2	3651	170	−16	18.7	87	5A	NGC 5033
63	−38.4	0144.7	2705	150	39	6.4	55	9B	#IC 1727
64	−42.1	1344.4	4621	174	−17	27.7	145	3A	NGC 5301
65	−42.3	1233.5	2814	157	−12	9.7	81	6X	NGC 4559
66	−42.9	1327.8	4727	170	−14	7.7	24	4AP	#NGC 5194
67	−43.1	0240.2	3708	165	47	9.1	34	5A	NGC 1058
68	−44.2	315.5	−4119	80	32	8.6	45	0B	N 1291
69	−44.8	1223.4	3349	154	−9	3.6	29	9A	#NGC 4395
70	−45.6	1228.2	4158	155	−7	9.3	154	10B	NGC 4490
71	46.7	0849.6	3338	35	35	5.7	34	3A	NGC 2683
72	−47.0	1216.5	4735	152	−3	6.8	51	4X	#NGC 4258
73	−47.6	1213.1	3636	150	−6	3.5	28	10X	NGC 4214
74	47.8	1355	4206	85	−21	37.8	77	3BP	NGC 5383
75	52.2	1024.8	6840	45	14	2.7	22	9X	#IC 2574
76	−52.4	0427.1	7148	25	28	3.0	27	7A	NGC 1560
77	−52.8	0156.6	1846	130	42	32.6	208	3A	NGC 772
78	54.4	1224.6	1611	70	−14	16.8	9	10	IC 3365
79	54.4	0610.7	7822	160	22	17.2	300	2BP	NGC 2146
80	56.5	0145	2711	65	39	7.5	65	6B	#NGC 672
81	57.1	0718	8016	0	19	33.9	207	4X	NGC 2336
82	57.5	0355	6659	125	32	4.4	58	9	A 0355
83	−60.8	0233.3	3845	147	45	14.2	165	6X	IC 239
84	64.9	1239.8	3249	86	−12	6.9	64	7B	#NGC 4631
85	70.5	1116.5	5802	77	8	27.9	16	0A	NGC 3619
86	71.2	0045.1	−2534	51	16	3.0	19	5X	#NGC 253
87	−75.1	0417	7512	0	25	36.6	170	3B	NGC 1530
88	75.5	1000.8	−2555	93	11	1.8	33	10	#NGC 3109
89	−78.1	2033.8	5959	62	−9	5.5	30	6X	#NGC 6946
90	78.9	1232.3	1530	95	−16	16.8	19	10	IC 3522
91	80.0	0723.6	6918	27	28	2.9	11	10B	NGC 2366
92	81.2	0224.3	3322	102	45	9.4	38	7X	NGC 925
93	81.6	1039.5	1401	90	10	22.8	152	5A	NGC 3338
94	−85.3	1254.3	2157	115	−19	4.1	31	2A	#NGC 4826
95	87.0	1313.5	4217	116	−14	7.2	69	4A	#NGC 5055
96	89.8	1248.6	4123	114	−10	4.3	15	2A	#NGC 4736

hand corner of the diagram. Calculation yields the direction P(78°, 10.5°). It should be noted that this direction differs very little, less than 3°, from those obtained by the P-latitude-independent tests described in ref. [58]. This seems to indicate that the sample galaxies do indeed lie in a flattened structure whose pole is that of galactic parallelism, in full agreement with the flattened structure of the supercluster [6].

Table 2 displays the objects by increasing $|\Delta p|$, as follows. Column 1 enumerates the object, column 2 the Δp value, columns 3 and 4 its equatorial coordinates, column 6 its P-latitude, column 7 its distance, column 8 the size of its HI region in kpc, column 9 its morphological type after the NBG catalog, and column 10 its name, preceded by a sharp if it belongs to the local cloud. The list is grouped into intervals of 15°. In view of this table, it appears that up to about 40 Mpc, the stratified structure does not depend on the type, nor the size, nor the distance, nor the membership of the objects to the local cloud. This suggests that the stratification is a large scale structure of cosmological type.

4. Examples of galaxies

If such a stratified structure exists, it implies a privileged direction for external HI cloud elongation even when these regions are irregular or the central regions have no preferred orientation. We examine the four galaxies whose HI maps are given in ref. [59]; they are typical examples for certain phenomena. We have superimposed the stratification direction for comparison with the shape of the object contour. Those galaxies which are observed edge on usually very elongated HI contours. For some of these, the contours are regular and indicate no warping of the HI regions. Such is the case of NGC 891, which happens to be quite elongated along the calculated direction, as fig. 3 shows. Other, apparently isolated galaxies display symmetrically warped HI envelopes. Such is the case of the isolated galaxy NGC 4013, which is strongly warped towards the assumed stratification direction, as fig. 4 shows.

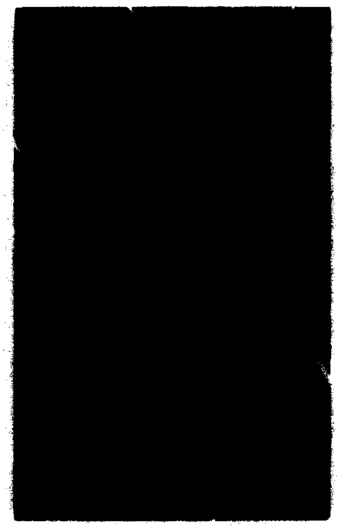

Fig. 3. NGC 891 (after ref. [59]), the calculated position angle p_c is 27°.

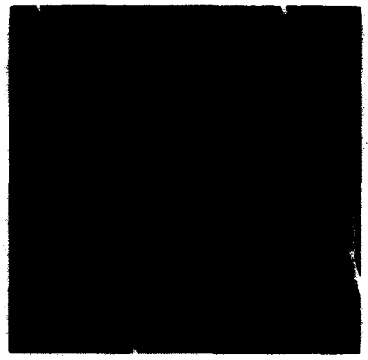

Fig. 4. NGC 4013 (after ref. [59]), the calculated position angle p_c is 15°.

Also described by Sancisi [59] are galaxies with strongly asymmetrical HI regions. Such are the cases of NGC 1023 (fig. 5), apparently isolated, and of Mkn 348 (fig. 6). For these objects, no position an-

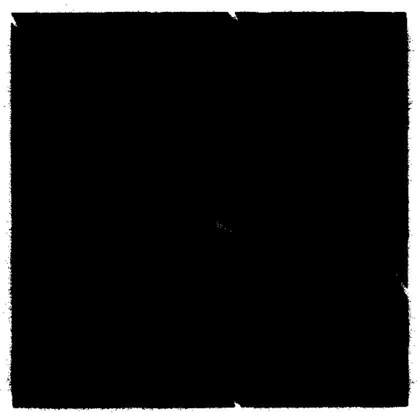

Fig. 5. NGC 1023 (after ref. [59]), the calculated position angle p_c is 29°.

Fig. 6. Mkn 348 (after ref. [59]), the calculated position angle p_c is 3°.

gle can be determined by standard methods; yet the plates allow for a comparison of the contour with the calculated stratification direction, which does indeed coincide with the contour elongation.

The above examples, which are not exceptional, suggest that the stratification of our environment might well be responsible for the warping of galaxies, and should be taken into account in explaining certain asymmetries of the external regions. Thus, the areas where the warping is observed might connect a flattened halo to a toppled direction of the central part. This would seem to be corroborated by galaxy simulation models using flattened halos [60]. In case of a stratification, the tidal or merger effects putatively responsible for the observed asymmetries should involve objects belonging to the same stratum.

5. Radiogalaxy sample

Thus, a stratified structure, compatible with the supercluster flattening, appears to be observed up to 40 Mpc; the difference of about 30 degrees between the stratification and supergalactic poles might stem from the difficulty in determining the latter. There arises the question whether this stratification is specific to the supercluster. As a first test, we have studied the extended radiogalaxy sample of Jägers [61]. This sample consists of 9 radiogalaxies whose maps are sufficiently detailed to allow for the estimation of a position angle. Table 3, where the objects are ordered by increasing Δp, displays a Δp distribution quite analogous to that of the first sample. This might hint at the cosmological character of a stratification which would extend beyond the commonly accepted limits of the supercluster (about 40 Mpc) and involve the various types of objects. To confirm or infirm this fact, it would therefore be important to avail ourselves of a larger number of remote objects with well-defined external regions.

6. Conclusion

All of the following facts seem to hint at a general stratification at the cosmological scale: the parallelism of the external regions of galaxies; the orientation of galactic systems such as Andromeda, M83, M81 (cf. ref. [62]); the anisotropic spatial distri-

Table 3
List of radiogalaxies. The coordinates of the stratification pole P are $\alpha=78°$ and $\delta=10.5°$.

No.	Δp	α δ	p	p_c	Name	
1	−0.7	0844.9	3158	−12	−11.3	B2
2	2.7	0415	3754	64	61.3	C111
3	−4.1	0110	4910	12	16.1	C35
4	−8.5	0936.9	3607	−14	−6.5	C223
5	23.4	0106	7255	48	24.6	C33.1
6	31.0	1845.5	7943	−36	−67.0	C390.3
7	−36.6	1209.5	7436	−20	−16.6	C74.17
8	−52.3	1155.8	2638	−38	14.3	C26.35A
9	89.6	2243.5	3926	77	−13.6	3C452

bution of nearby galaxies (local cloud); the flattening of large structures such as the supercluster, which might extend beyond $z=0.1$; the distribution of remote radiosources parallel to the supercluster plane [9]; the previously studied distribution of quasars [62]. It would thus be interesting to confront this structure with other observations (background radiation), and to study the implied stability problems (plane kinematics).

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