Galaxies in Isolation, May 2009, Granada (Spain)

Properties of 500 isolated galaxies in the Local Supercluster

or

Local Orphan Galaxy sample

by

- **Igor Karachentsev, Dmitry Makarov** **(SAO RAS, Russia)**
- **Valentina Karachentseva, Olga Melnyk** **(AO Kiev Univ., Ukraine)**

The main our goal is to derive a representative sample of nearby isolated galaxies useful for testing galaxy evolution in low density regions

At present , there are two all-sky samples of isolated galaxies:

a) N ~ 200 galaxies in the Local Volume (D < 10 Mpc) with a negative «tidal index», and

b) N ~ 3000 objects in KIG/2MIG catalogs with a typical distance ~ 80 Mpc.

To fill up the gap between them, we created a new sample

of LOGs in the LSC with D < 45 Mpc.

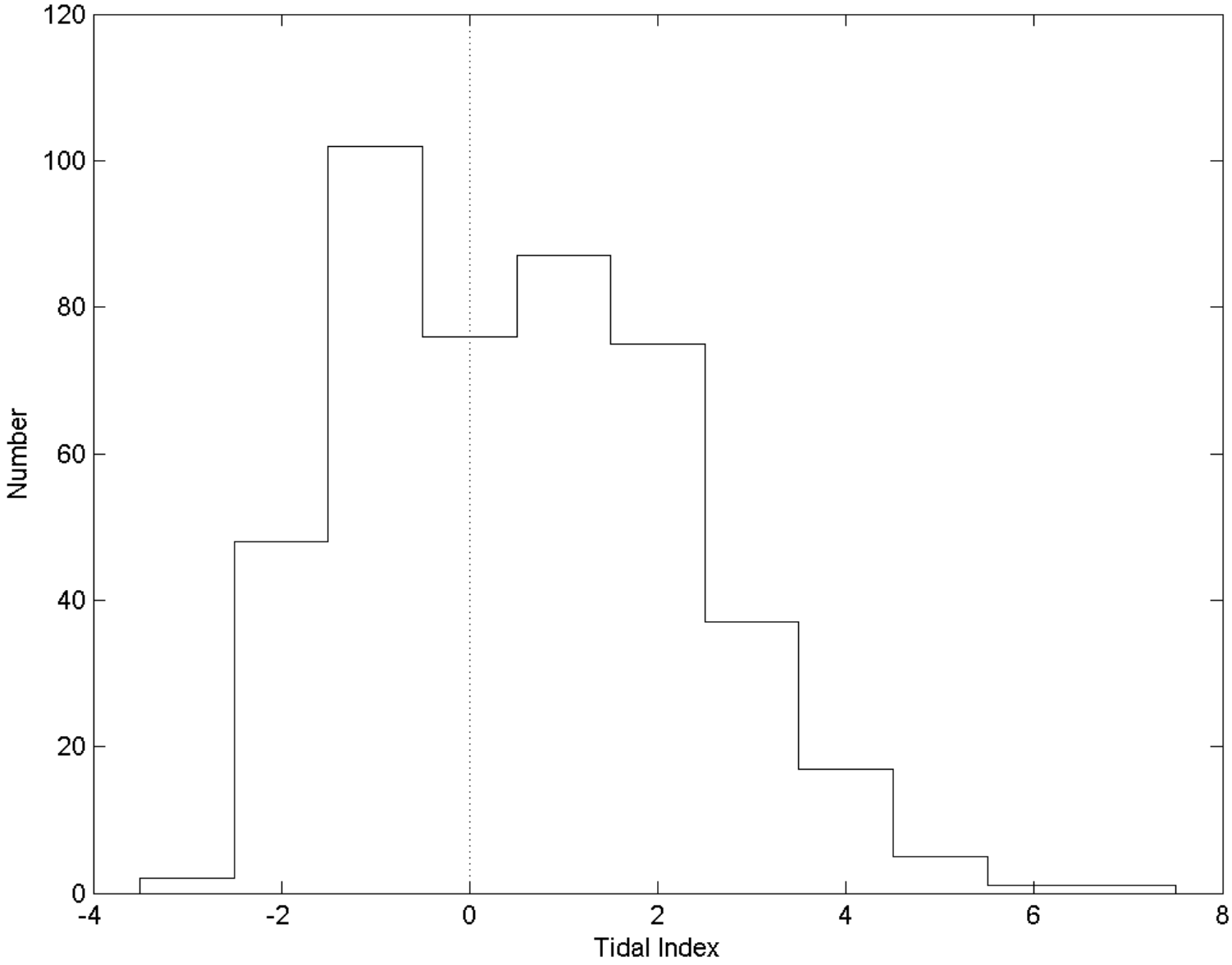
To describe the local mass density around a galaxy «i», we have introduced the so-called «Tidal Index»:

$$TI_i = max\ \{log\ (M_k / R^3_{ik})\} + C, \qquad i = 1,2,...N$$

where M_k is the total mass of any neighboring galaxy separated from the considered galaxy by a space distance R_{ik}. For every galaxy «*i*» we found its «main disturber», producing the highest tidal action or a maximum density enhancement, M_k/R^3_{ik}.

Here we determine the total mass of every galaxy from its luminosity.

The value of C is chosen so that $TI = 0$ when the Keplerian cyclic period of the galaxy with respect to its main disturber equals the cosmic time $1/H_0$. In this sense, galaxies with $TI < 0$ may be considered as undisturbed, isolated objects.


120
100
80
60
40
20
0
Number
-4
-2
0
2
4
6
8
Tidal Index

15 KIGs in the Local volume

KIG	Name	V_{LG}	T	TI	M.Disturber
45	U 685	+349	9	-1.6	N 253
105	N 925	+738	7	-0.9	N 891
121	N1156	+510	9	-1.7	N 925
190	DDO 43	+371	10	-1.5	N 2337
197	N2403	+268	6	-0.0	M 81
237	N2537	+477	9	-1.4	N 2683
239	Holm II	+311	10	+0.6	M 81
388	SexB	+111	10	-0.7	M. Way
523	N4236	+160	8	-0.4	M 81
530	U7605	+317	10	+0.7	N 4244
543	N4605	+276	8	-1.1	M 81
559	N4826	+364	2	-1.7	M 51
610	M 101	+379	6	+0.6	N 5474
624	N5585	+459	4	-0.8	M 101
837	N6503	+301	6	-1.2	N 6949

The initial sample of data:

N = 10500 galaxies with

V_{LG}< 3500 km/s, |b| > 15^{o}

after cleaning spurious data from SDSS, 2dF, 6dF,

DEEP2, etc.

+ new optical identifications for HIPASS,

K_s -magnitudes from H, I, R, V, B.

New B-magnitudes and Types, when absent.

Clusterization algorithm

We consider two arbitrary galaxies as a virtual bounded pair if they satisfy the condition of negative total energy

$$V^2_{ik} R_{ik} / 2GM_{ik} < 1 \qquad (1)$$

where M_{ik} is the total mass of the pair. We use also additional condition that the pair components are located inside the «zero-velocity» sphere

$$\pi H^2 R^3_{ik} / 8GM_{ik} < 1. \qquad (2)$$

We determine the masses of galaxies from their K-band luminosity assuming one and the same ratio

$$M/L_k = \kappa (M_\odot / L_\odot), \qquad (3)$$

where $\kappa = 6$.

We first identify all pairs satisfying conditions (1-3)

and then group all pairs having a common

component into a single entity.

This algorithm leaves 46% of the galaxies to be

unclusterized, «field». Increasing the κ

in (*ii = 40*) times, we derive a fraction

of isolated galaxies as 10%.

Finally, applying to them the Karachentseva,1973

criteria, we obtain

the sample of 513 LOGs.

Catalog of 513 local orphan galaxies

Name	RA (2000.0) DEC.	V_{lg}+- e	T	m_K	ii	lgF_{HI}	K73	Note
ESO 149-013	J000246.3-524618	1420 10	10	13.39	60	1.06	+	
ESO 149-018	J000714.5-523712	1709 9	9	13.61	73	0.74	+	
UGC 00064	J000744.0+405232	554 17	10	12.80	96	1.24	+	
UGC 00063	J000750.8+355759	715 5	10	12.72	112	0.36	+	
UGCA 003	J001017.8-181551	1634 5	10	13.20	65	0.84	+	
LCRS...	J001108.7-385915	3180 43	6	13.95	149	0.3:	+	
6dF...	J001408.3-353648	3268 29	7	14.31	176	0.71	:	
SDSS...	J001500.1-110804	3467 5	6	14.78	84	0.3:	+	
ESO 241-027	J001502.7-431731	3235 74	6	12.42	98	0.05	+	
6dF...	J001550.9-225511	3213 34	6	12.54	124	0.56	+	
ESO 539-005	J001710.2-191805	3270 8	5	9.96	72	0.44	+	IR
ESO 194-002	J001830.4-473921	1433 10	9	12.92	49	0.3:	+	
DDO 001	J001848.3-190028	3279 7	9	12.72	83	1.05	+	pec
AM 0016-575	J001909.3-573830	1636 5	2	12.12	66	1.28	+	pec
UGC 00199	J002051.8+125122	2015 5	10	16.34	65	0.53	+	

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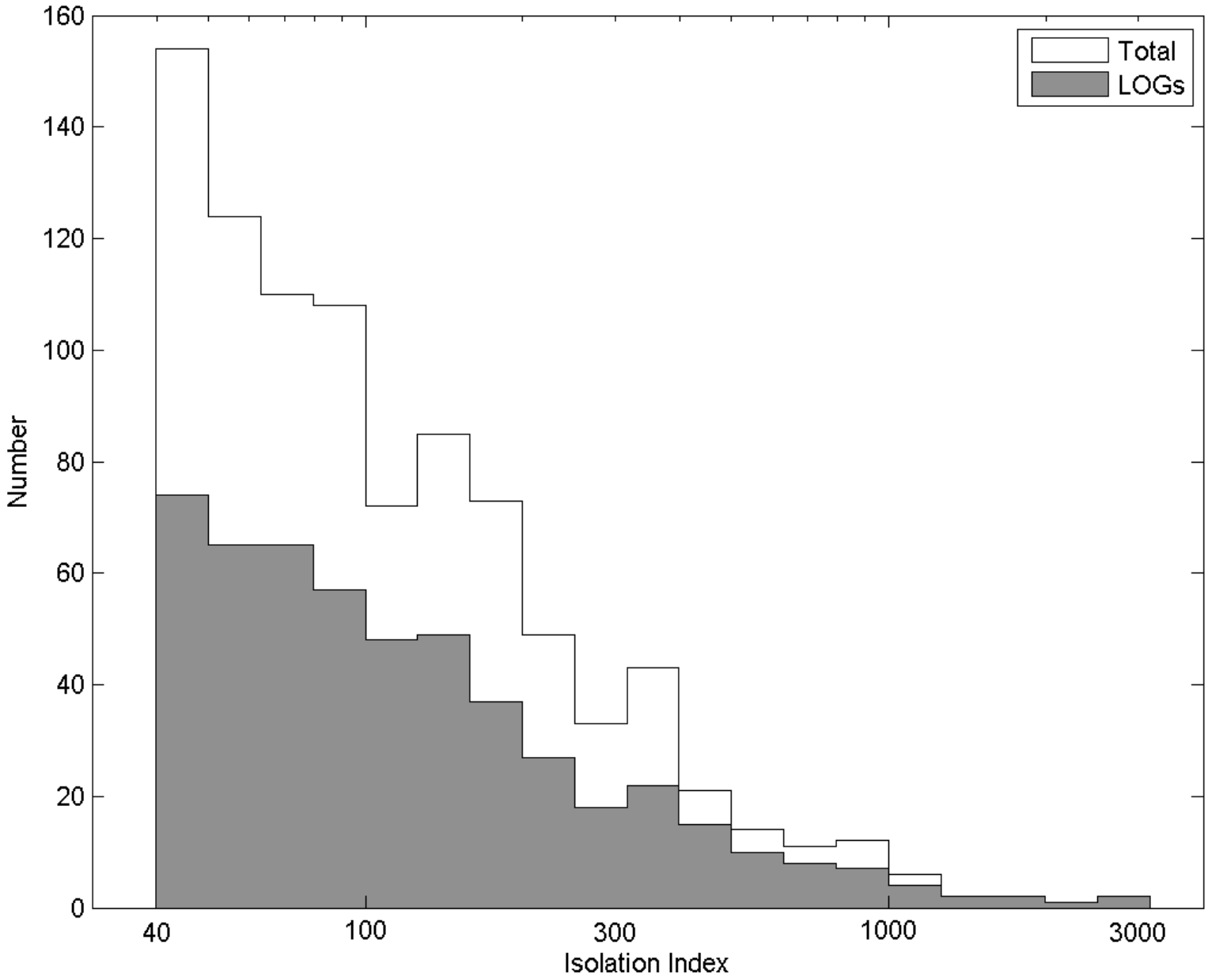
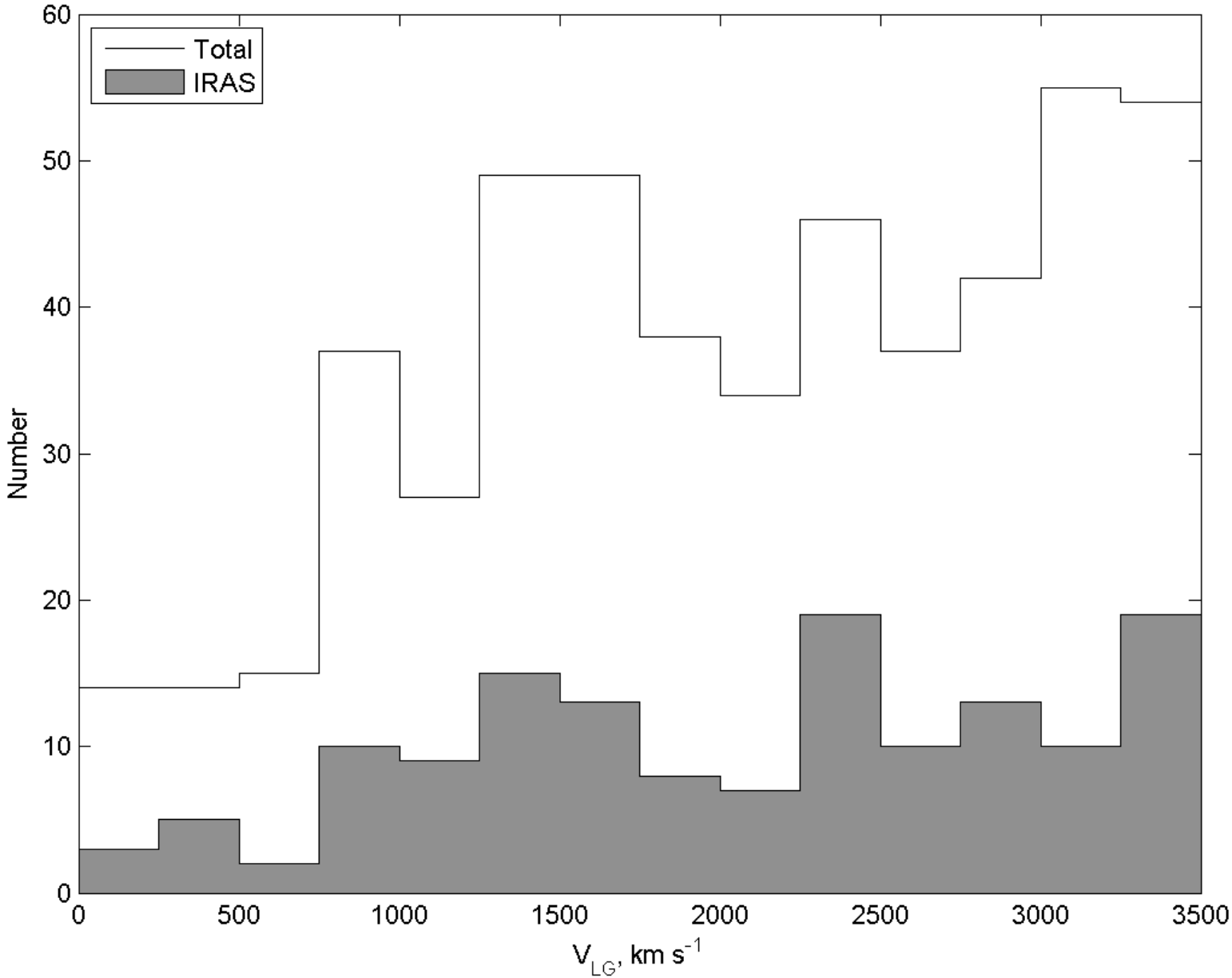

Total
LOGs
160
140
120
100
80
60
40
20
0
Number
40
100
300
1000
3000
Isolation Index


Total
IRAS
Number
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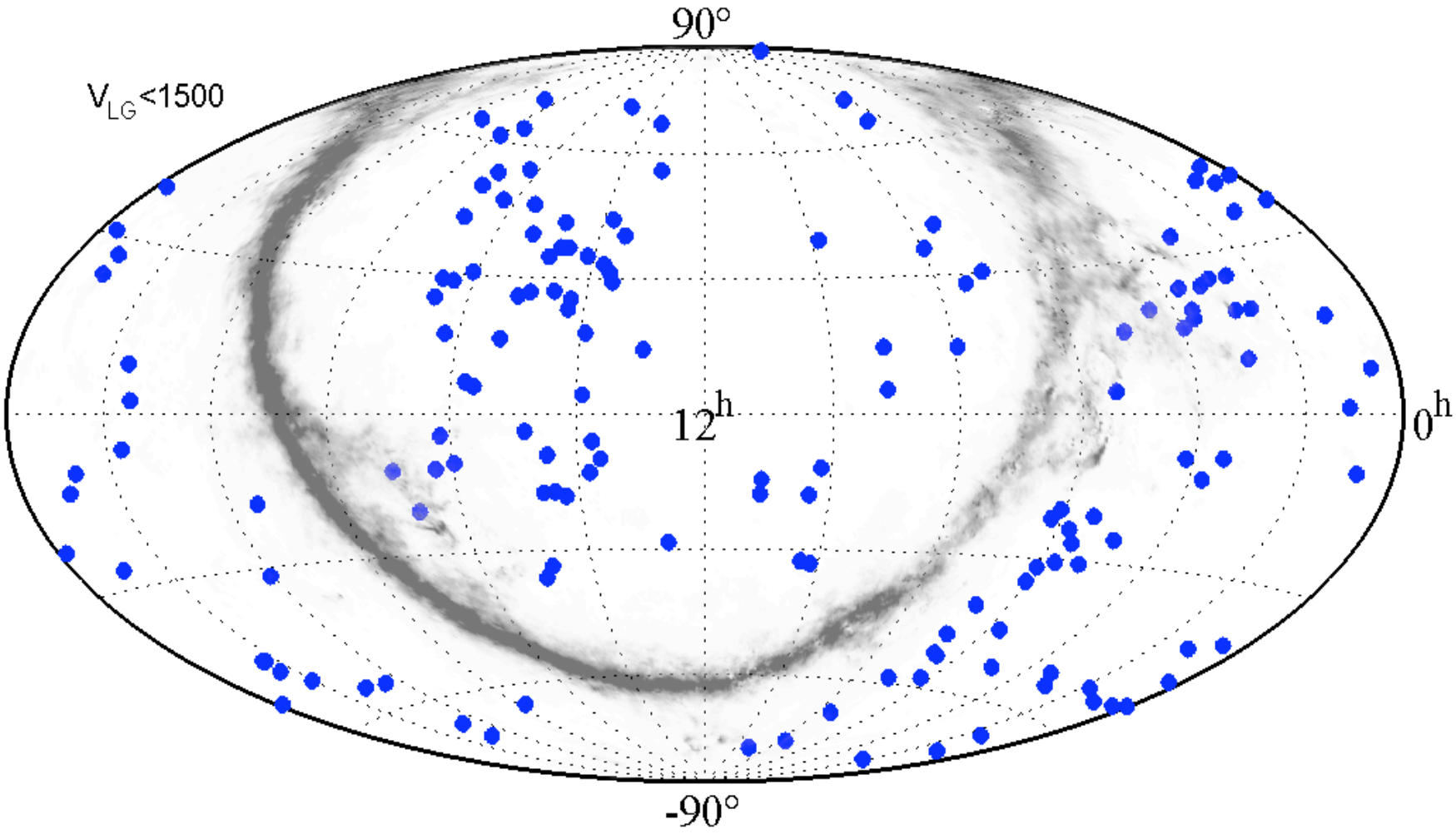
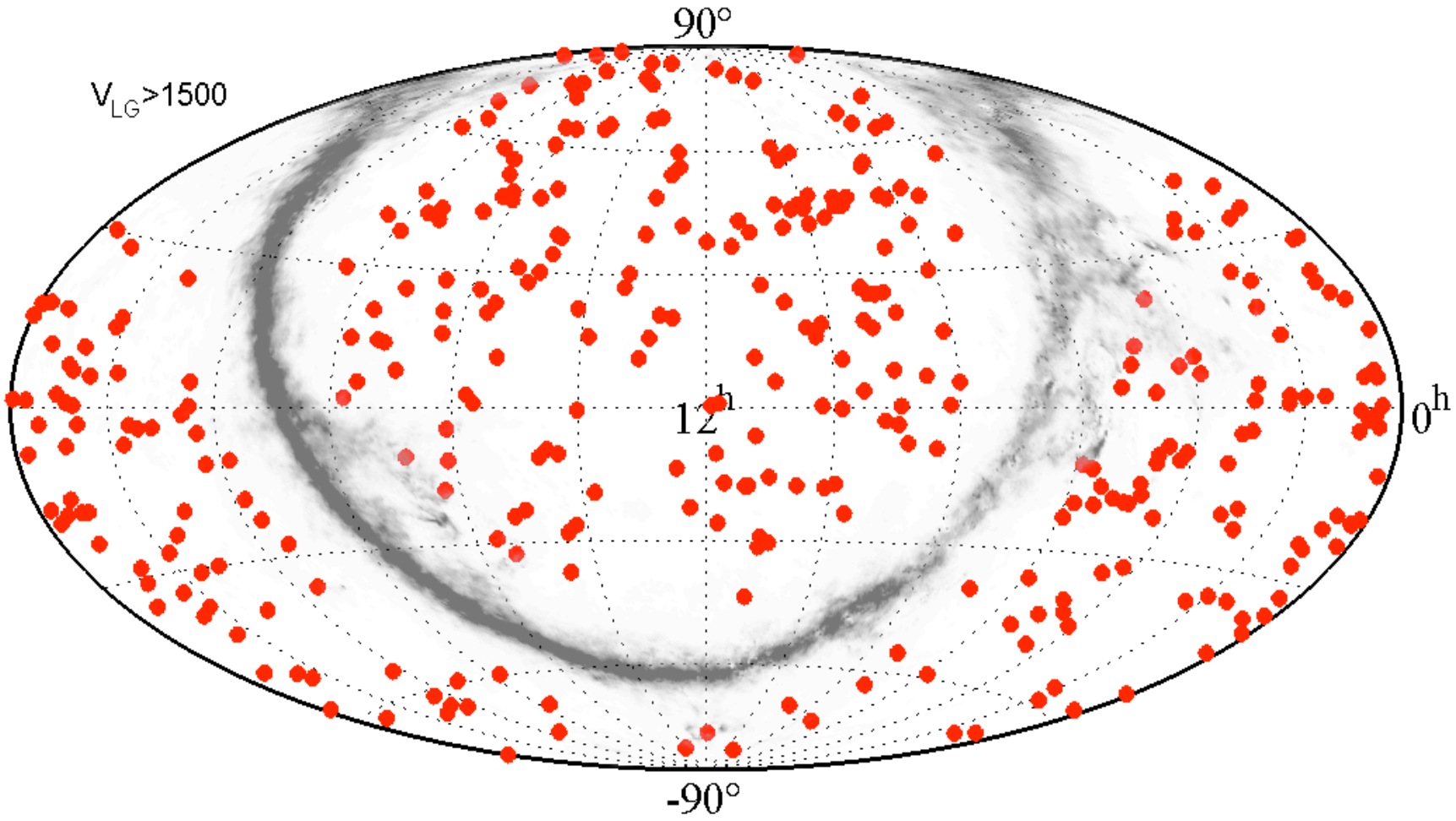
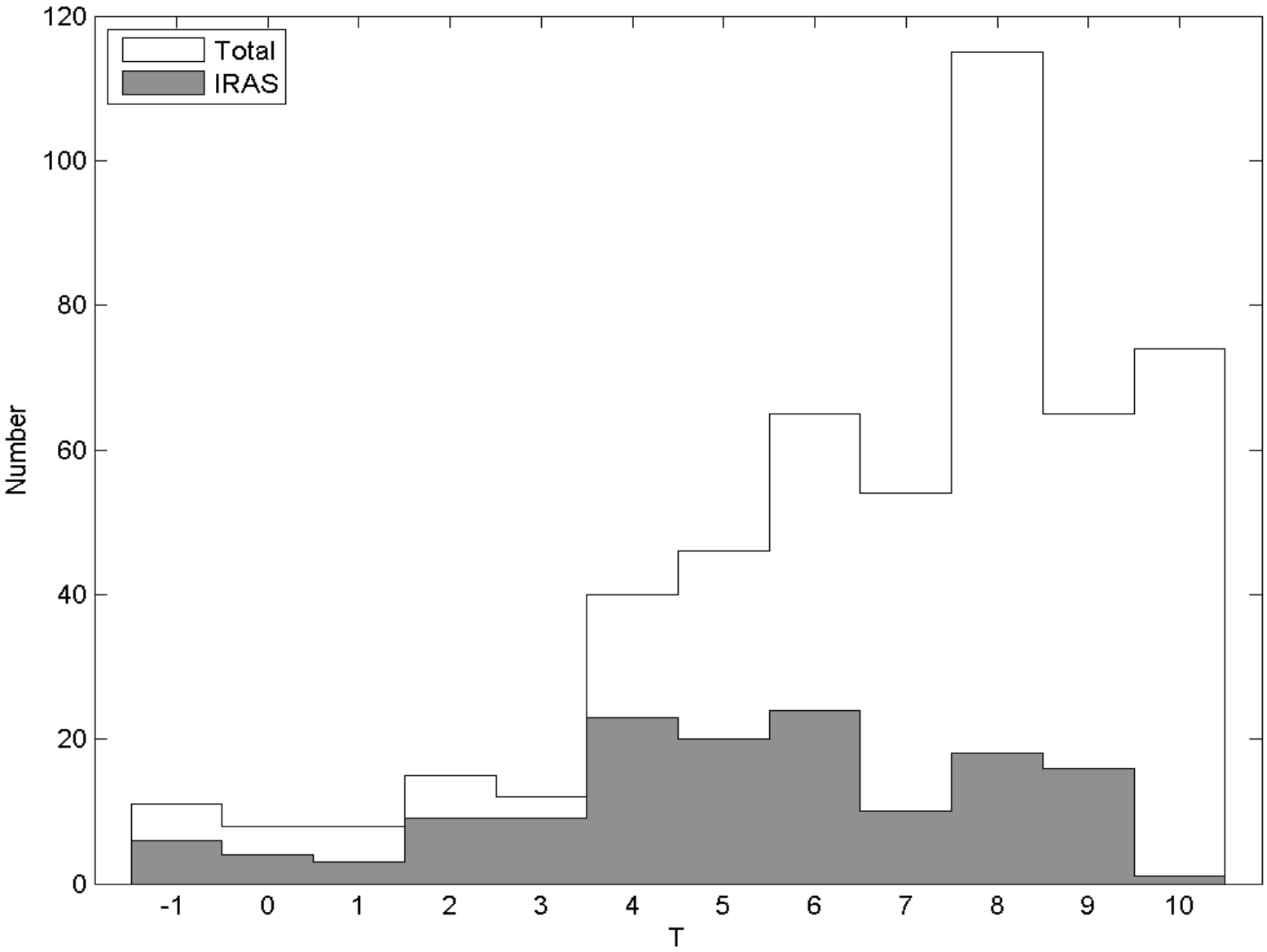
10
20
30
40
50
60
0
500
1000
1500
2000
2500
3000
3500
V_LG, km s^-1


90°
V_{LG}<1500
12h
0h
-90°


90°
V_{LG}>1500
12h
0h
-90°


Total
IRAS
Number
T
0
20
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80
100
120
-1
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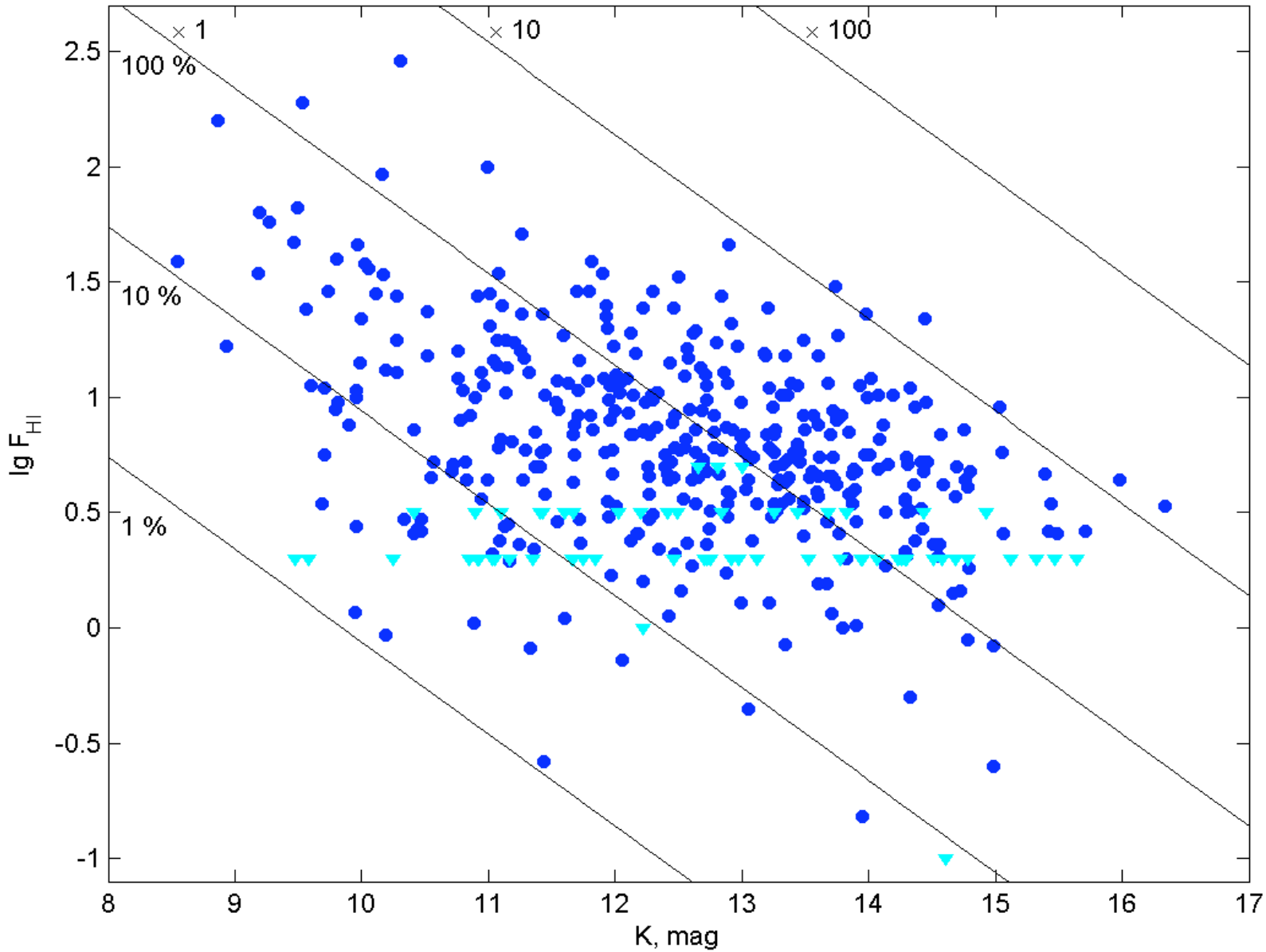

× 1
× 10
× 100
100 %
10 %
1 %
lg F_HI
K, mag
2.5
2
1.5
1
0.5
0
-0.5
-1
8
9
10
11
12
13
14
15
16
17

Some nearest orphan galaxies

Name	D_{MW} Mpc	Type	M_B	Tidal index	Isol. index	P*	F*
SagDIG	1.04	10	-11.5	-0.3	977	-0.58	0.62
KKR 25	1.86	-2	- 9.9	-0.7	280	-1.0	-0.2:
IC 5152	1.97	9	-15.6	-1.1	323	-0.35	-0.09
GR 8	2.13	10	-12.1	-1.2	77	0.68	-0.78
KK 230	2.14	10	- 9.8	-1.0	679	-1.5:	1.8:
DDO 187	2.24	10	-12.5	-1.3	1048	-0.59	0.59
IC 4662	2.44	9	-15.6	-0.6	118	0.72	-0.82
KKH 98	2.45	10	-10.8	-0.7	2855	0.06	0.23
KKH 86	2.60	10	-10.3	-1.5	50	-2.1:	1.7:
NGC 404	3.06	-1	-16.6	-1.0	60	-0.08	-0.70
NGC 6789	3.60	9	-14.3	-1.4	45	-0.02	-1.37
Median	2.24	10	-12.1	-1.0	280	-0.35	-0.09

Where $P^* = \log(SFR^*T_0/L)$, $F^* = \log(M_{HI}/SFR^*T_0)$

Early type LOGs

Name	RA (2000.0) DEC.	V_{lg}	T	M_K	log M_{HI}	Note
CGCG 410-002	J004448.4+050809	3066	0	-21.5	<8.9	IRAS
NGC 0404	J010927.0+354304	218	-3	-18.9	7.9	IRAS
UGC 01198	J014917.7+851538	1408	-2	-20.6	8.0	IRAS
ESO 420-013	J041349.7-320025	3449	-1	-23.9	<9.0	IRAS
CGCG 309-028	J071804.4+682034	2796	0	-22.1	-	
6dF...	J094208.4-233544	3043	0	-22.1	<8.9	
UGC 05467	J100812.9+184225	2768	-2	-22.1	9.2	IRAS
CGCG 364-019	J110734.3+825114	1876	0	-19.0	-	
2MASX...	J114234.8-165210	2226	-3	-21.6	<8.8	
MCG-02-32-012	J122758.8-133130	3249	-2	-21.5	<9.0	
UGC 09519	J144621.1+342214	1782	0	-21.7	-	IRAS
KKR 25	J161347.9+542216	70	-2	-11.7	<4.9	
VII Zw 744	J174137.7+830759	2120	-1	-20.3	-	
MRK 1119	J175236.9+374453	3431	0	-21.4	-	IRAS
NGC 6762	J190537.1+635603	3205	0	-23.1	-	
2MASX...	J201731.5+720726	2692	-1	-22.2	-	IRAS
ESO 186-045	J202733.8-550525	756	-5	-18.8	<7.7	
CGCG 471-002	J211652.9+241215	3164	0	-22.8	<9.1	IRAS
ESO 469-006	J225508.0-305520	3027	-1	-21.7	<9.1	IRAS
Median				-21.6	<8.9	

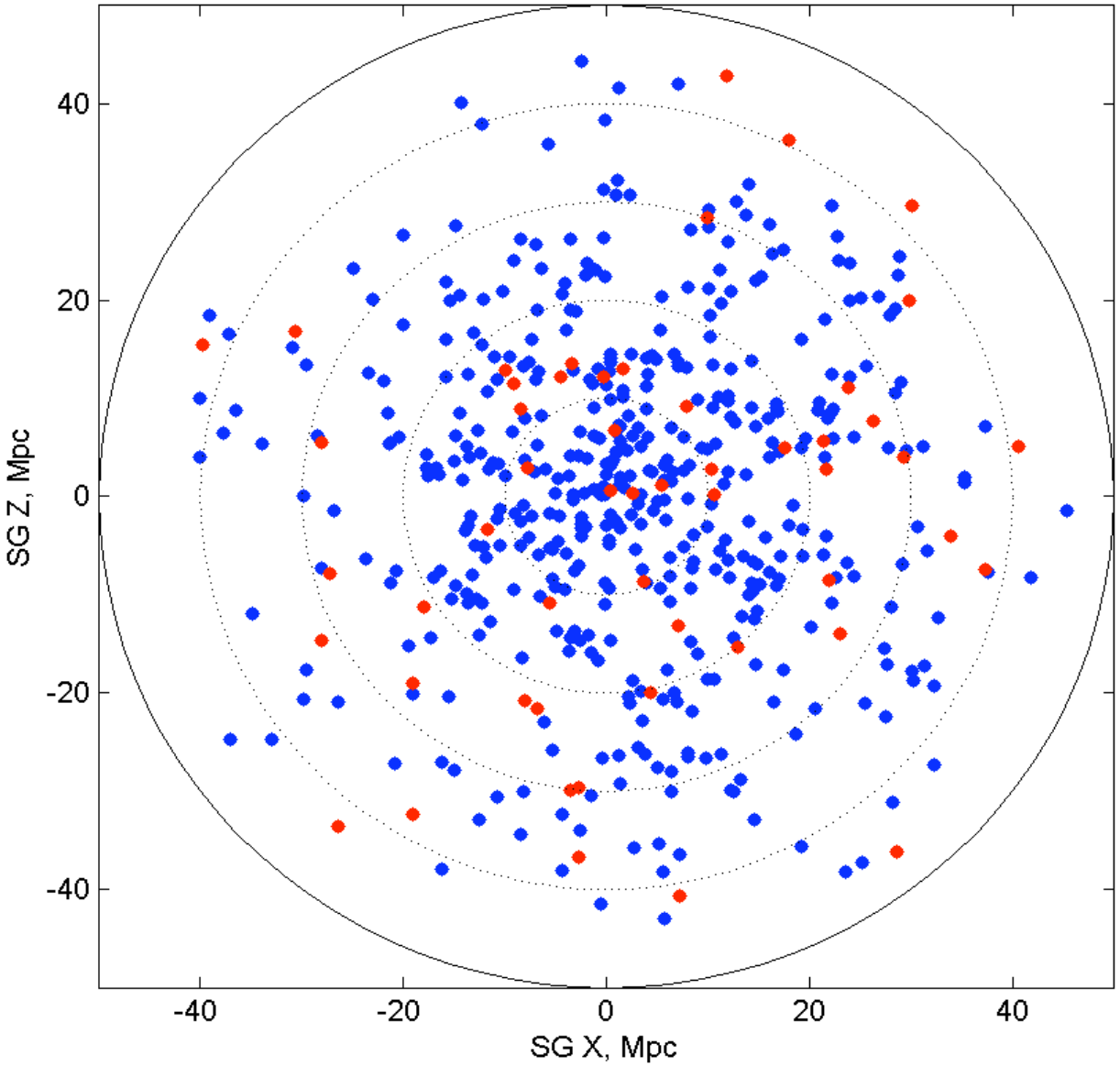
Under random orientation of thin disks,

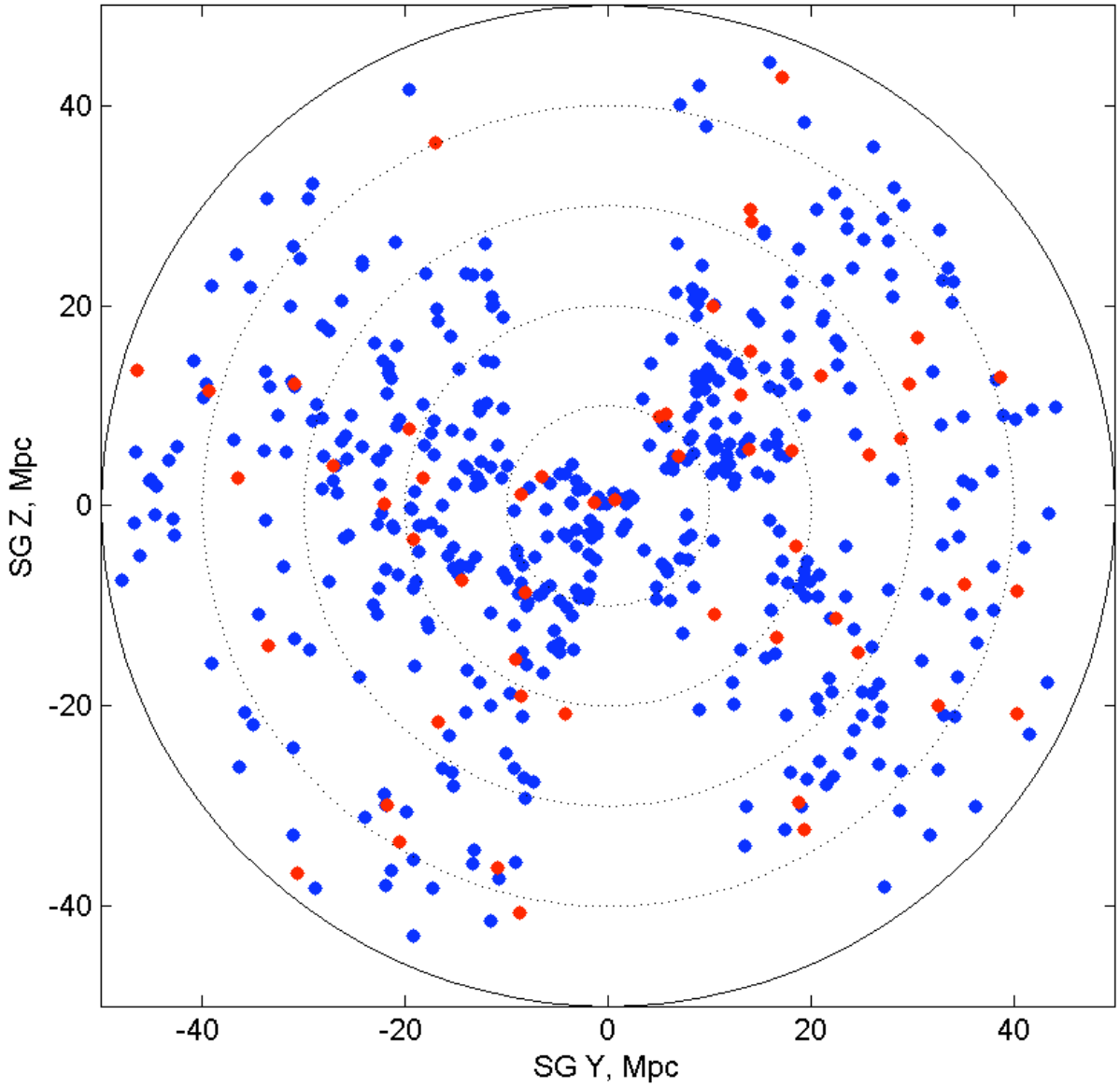
the expected number of flat edge-on galaxies

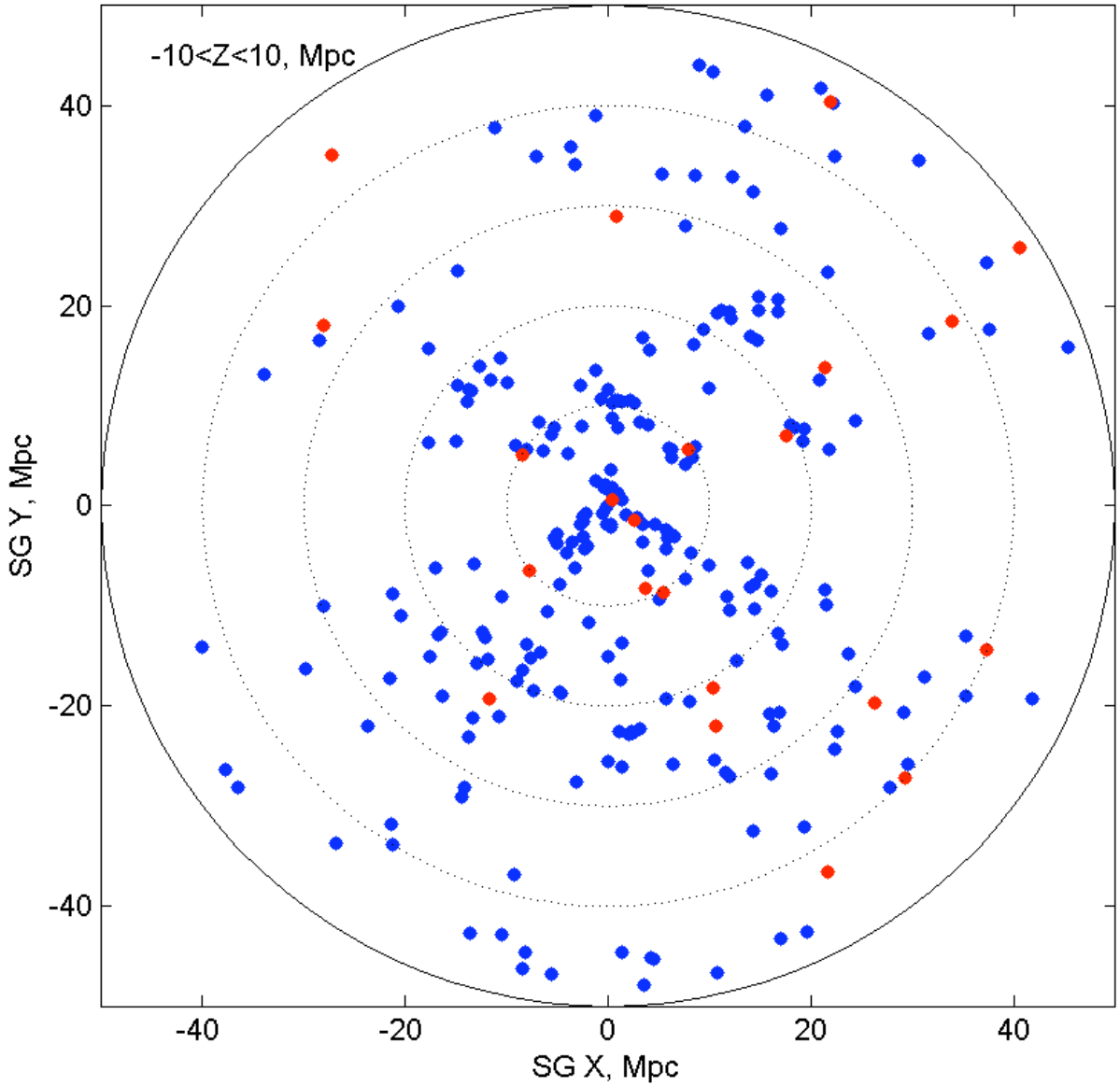
among 513 LOGs is (17 – 32). But their

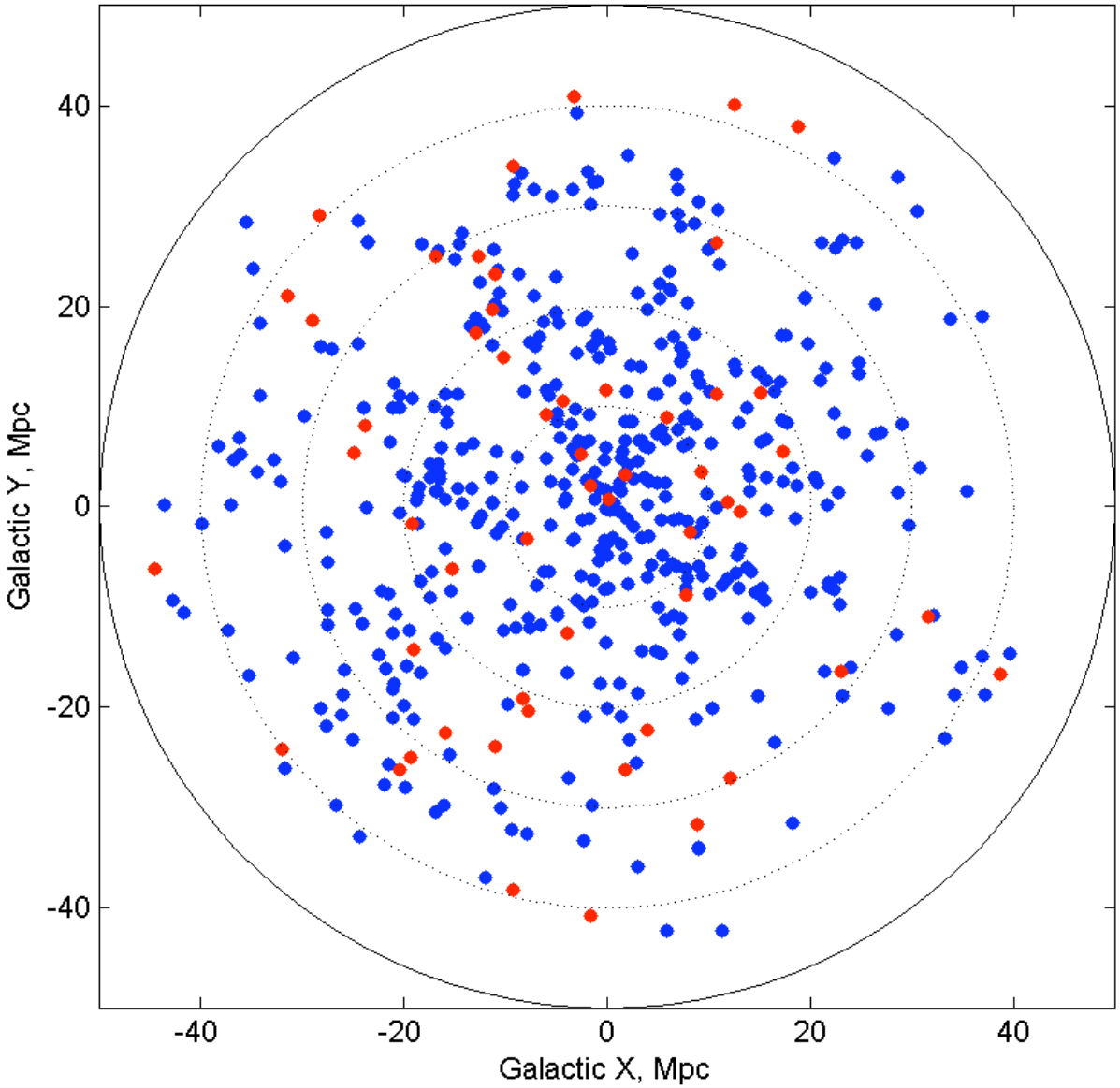
observed number is 68. Therefore, thin disks are

surviving mostly in «calm harbors».


40
20
0
-20
-40
SG Z, Mpc
-40
-20
0
20
40
SG X, Mpc

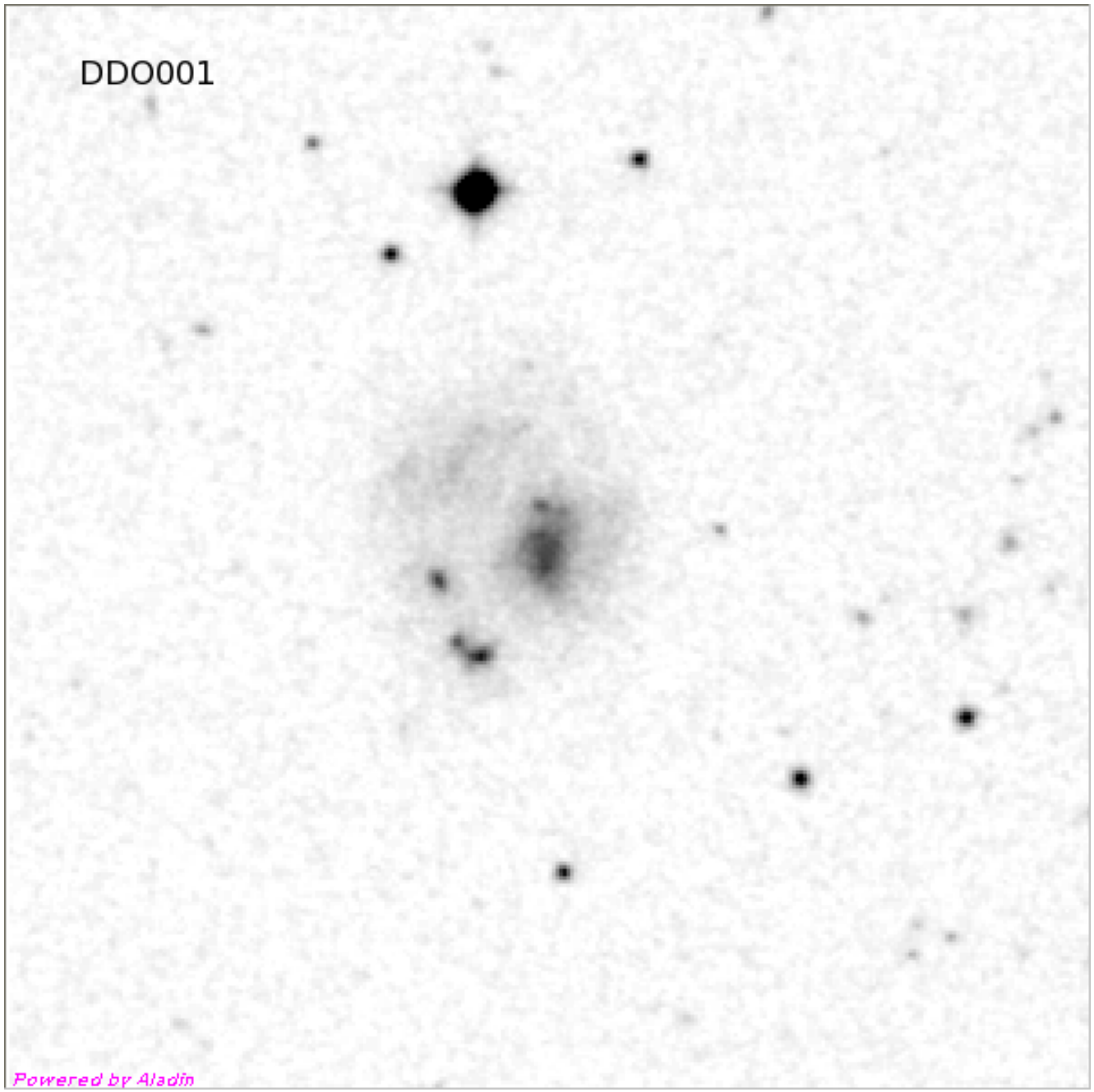

40
20
0
-20
-40
SG Z, Mpc
-40
-20
0
20
40
SG Y, Mpc


-10<Z<10, Mpc
40
20
0
-20
-40
SG Y, Mpc
-40
-20
0
20
40
SG X, Mpc


40
20
0
-20
-40
Galactic Y, Mpc
-40
-20
0
20
40
Galactic X, Mpc

Isolated galaxies (LOGs) with peculiar structures

Name	V_{LG}	T	m_K	Structural peculiarity
DDO 001	3279	9	12.72	asymmetric arm/tail
AM 0016-575	1636	2	12.12	outer LSB ring
MCG-01-11-002	2777	8	13.72	wide curved tail
MCG-02-12-046	2327	8	12.67	disturbed, spotted
UGC 03672	964	10	13.74	disturbed, spotted
NGC 2504	2419	4	11.42	one arm from a compact body
UGC 04176	3092	7	12.65	asymmetric
UGC 04722	1705	7	12.64	wide tail
SGC...	2377	8	13.05	disturbed, spotted
ESO 265-018	2635	10	12.46	disturbed, spotted
AM 1213-220	2141	10	14.36	disturbed, spotted
HIPASS...	1246	8	12.99	hammer-like
DDO 184	939	8	11.14	disturbed, peripheric blue knots
UGC 09024	2331	2	13.49	LSB periphery, likes Malin-1
2MASX...	1477	9	13.63	comet-like
ESO 581-012	3350	7	13.79	asymmetric
ESO 513-022	3469	4	11.71	curved tail
NGC 6239	1134	4	10.05	disturbed, double nuclei, merger?
ESO 187-051	1313	8	12.55	asymmetric, spotted
UGC 12856	2017	8	13.21	disturbed, spotted
NGC 7800	1976	10	11.26	disturbed, with loops


DDO001
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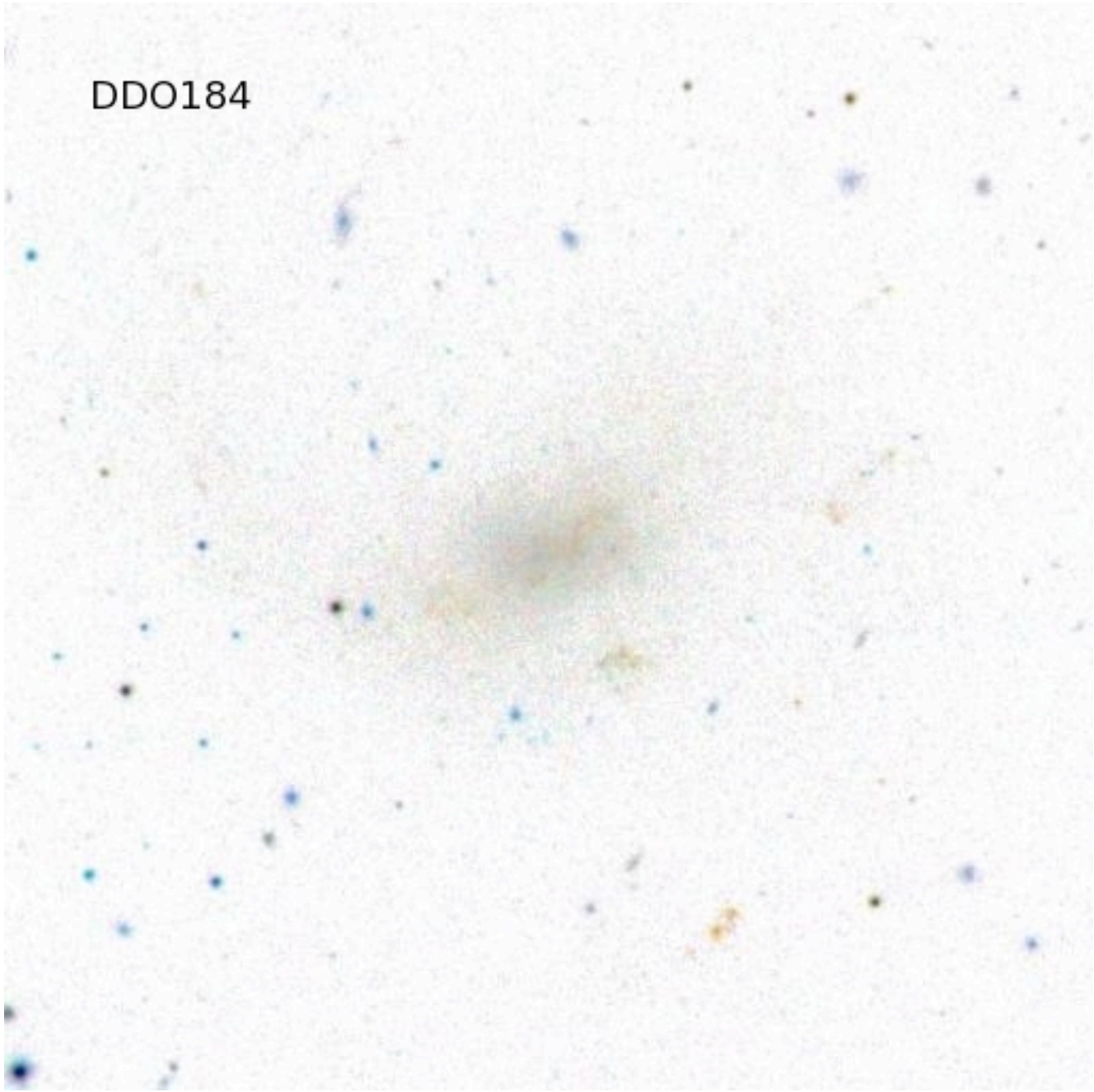
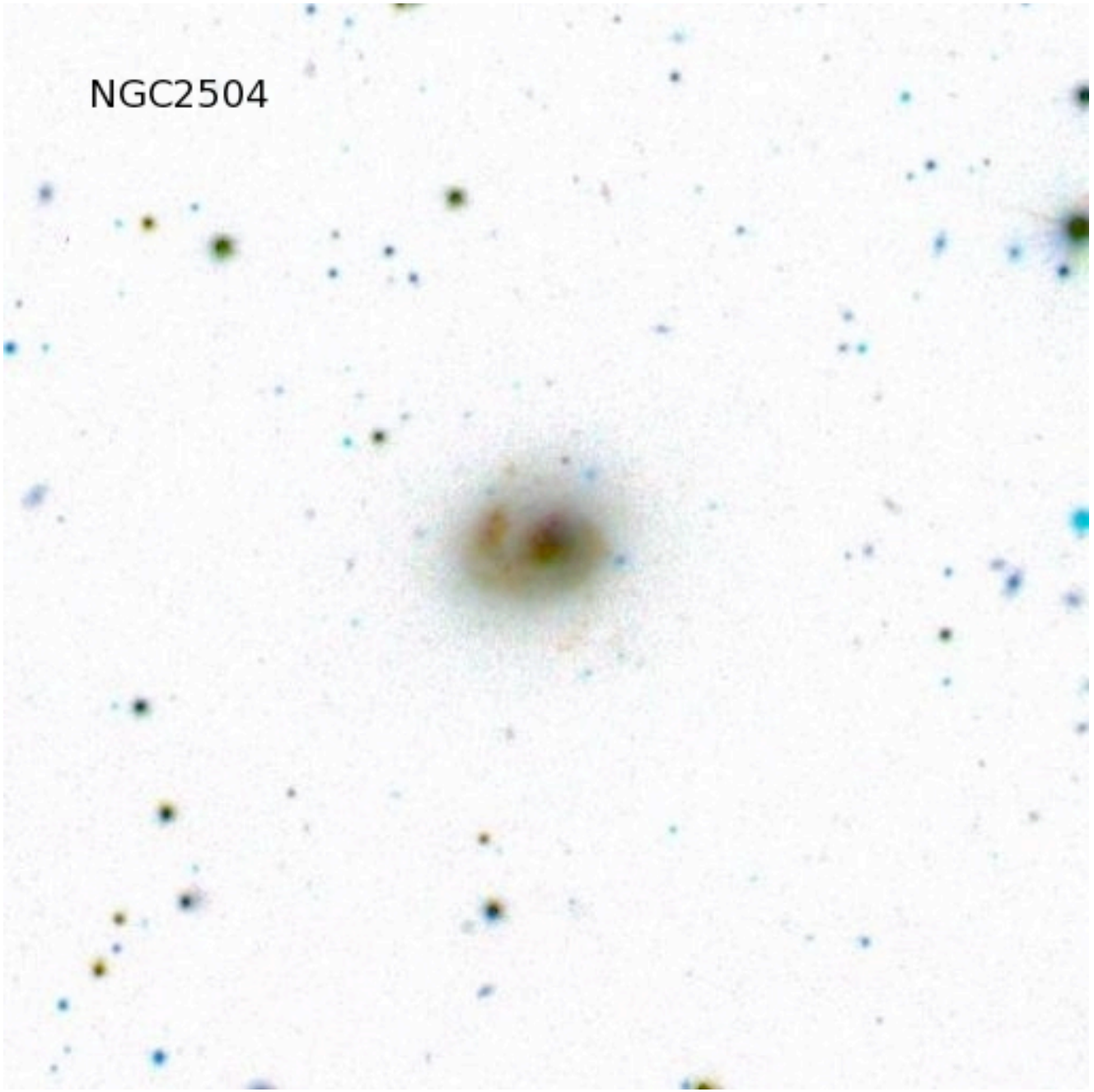
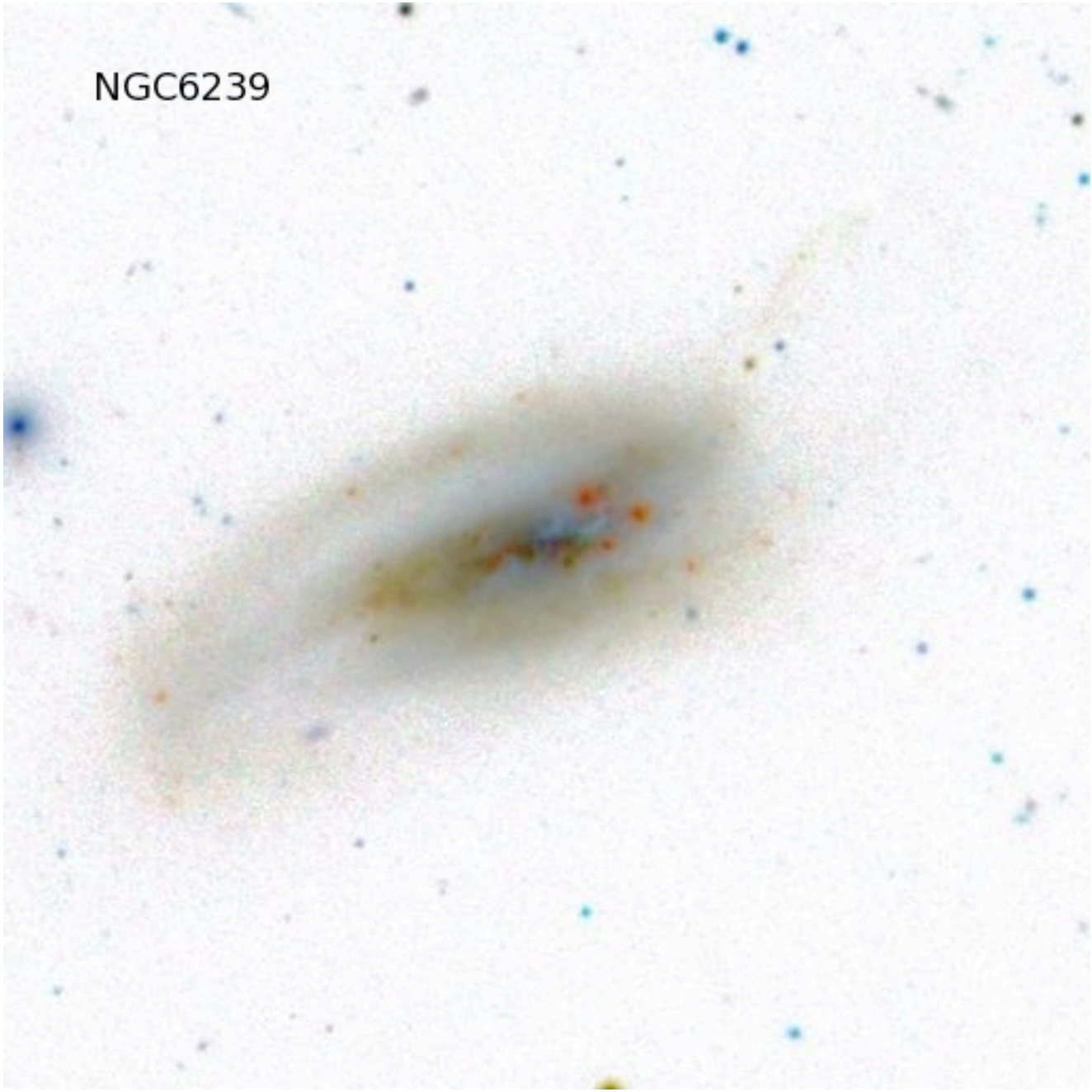

DDO184


NGC2504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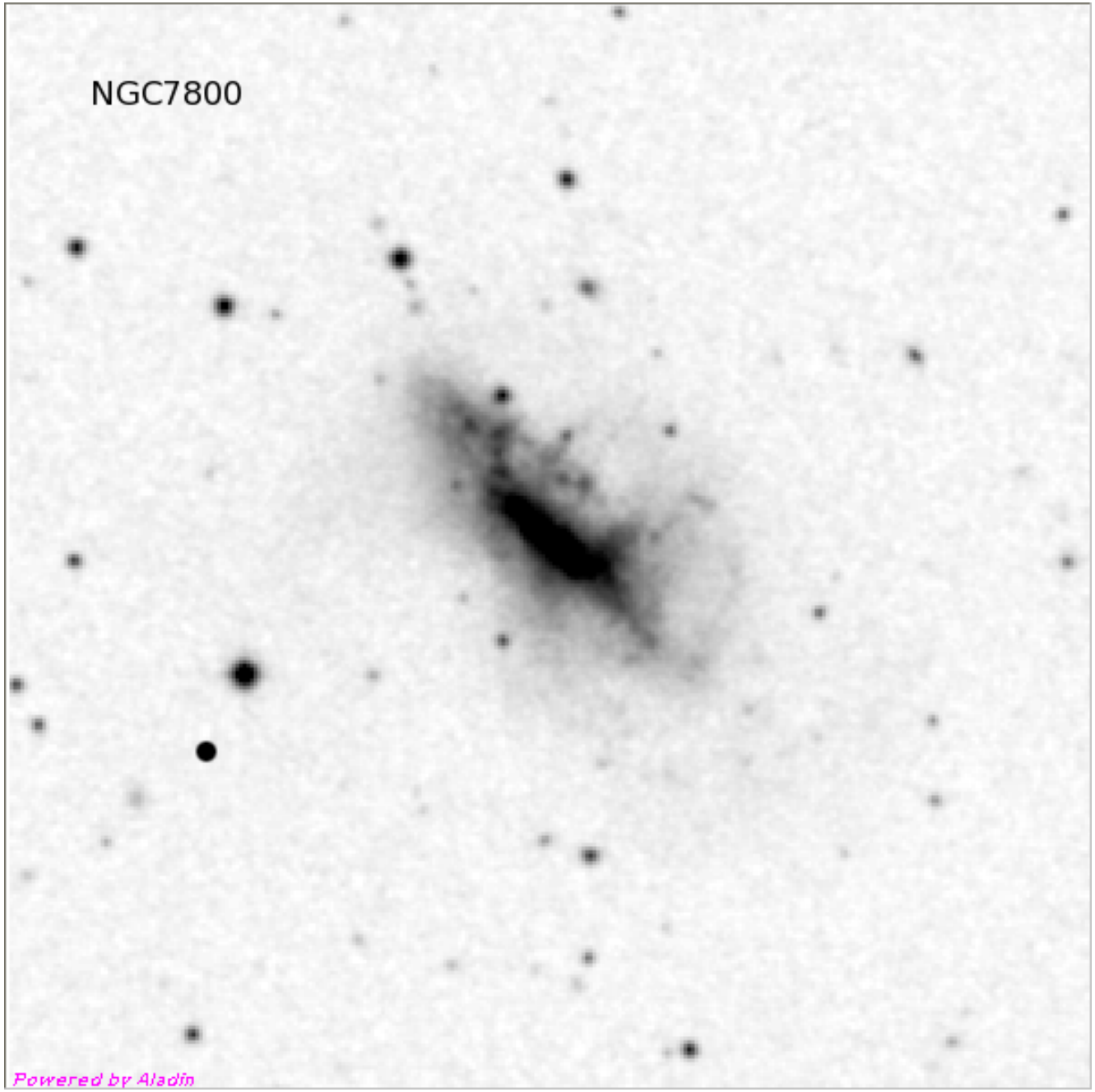
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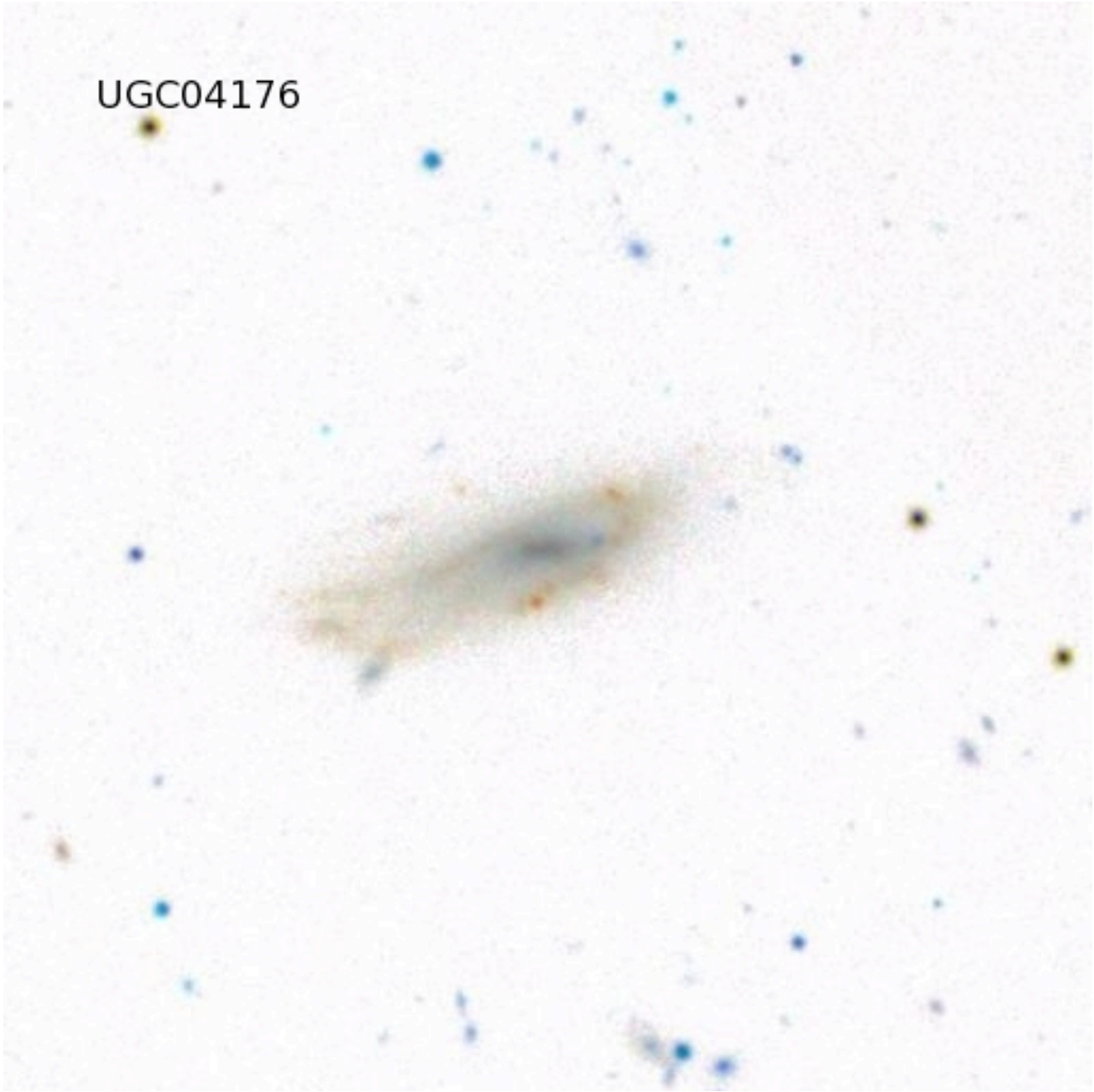
Powered by Aladin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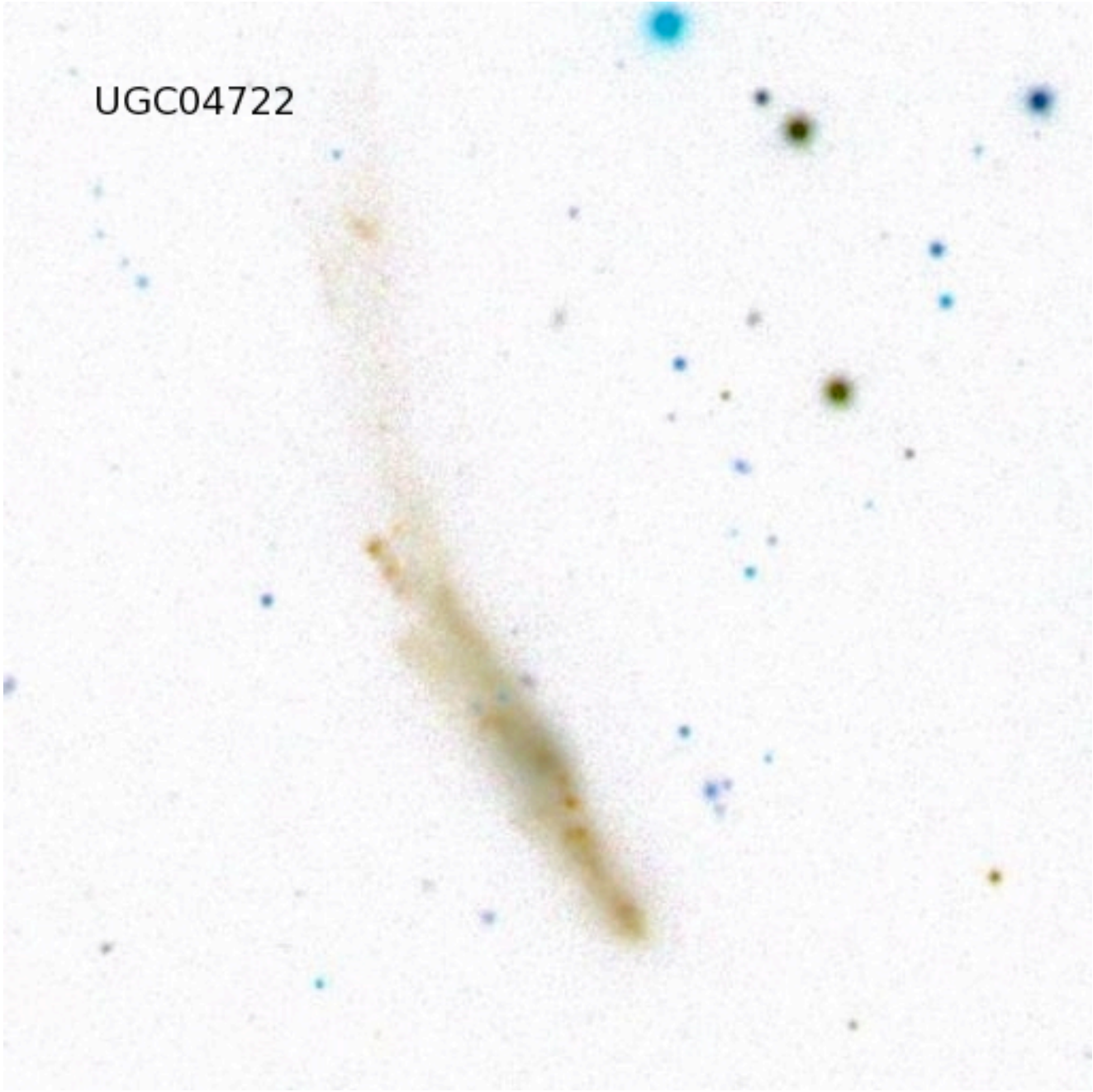
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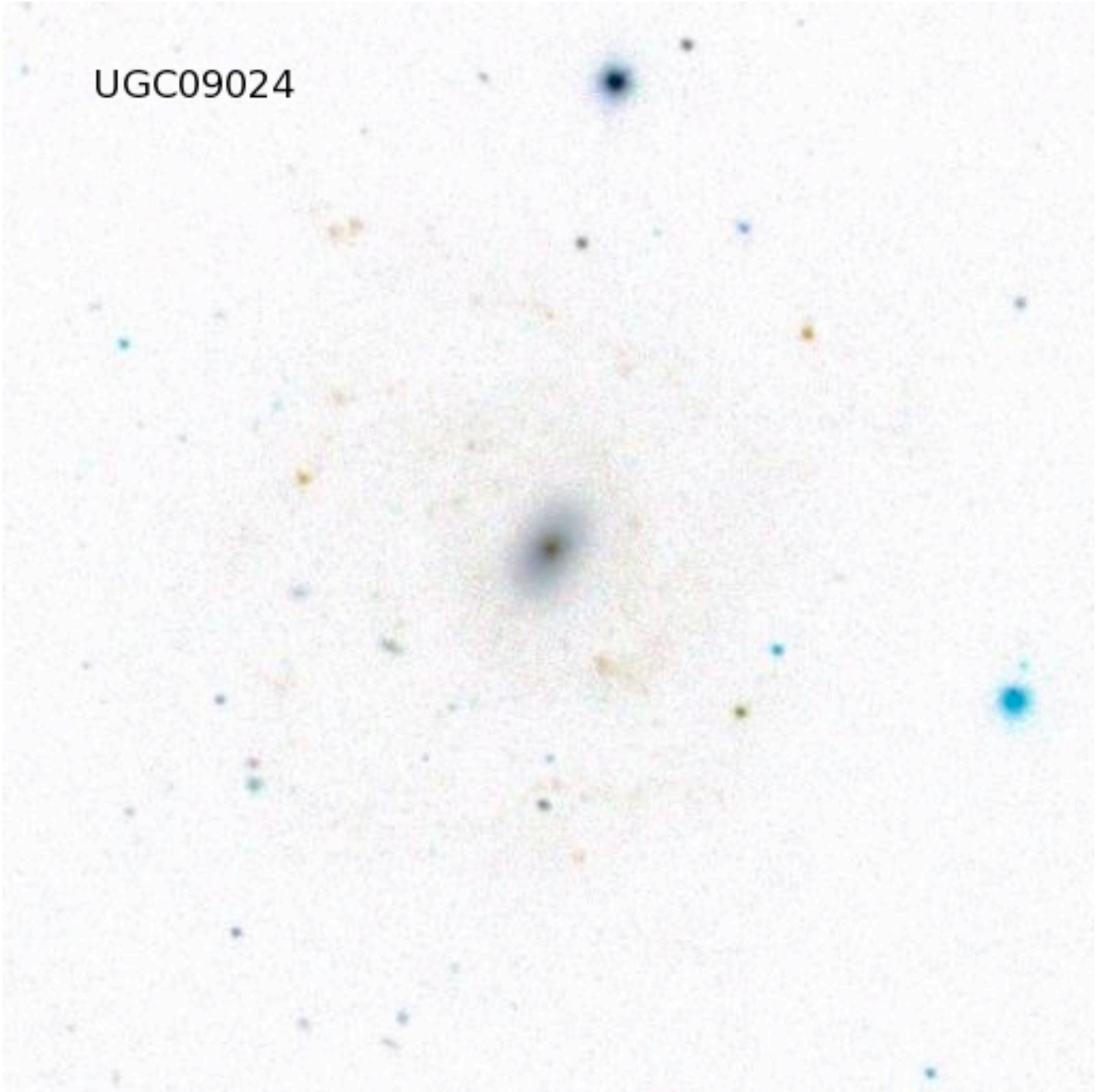
UGC09024

Our subsequent spectral observations of neighboring galaxies around the LOGs exhibit that most of them turn out to be background objects with a median difference of radial velocities +9400 km/s regarding to the LOGs. As a result, we conclude that our sample of 513 LOGs amounts to 88% true, spatially well isolated galaxies.

conclusions

We presented the all-sky catalog of 513 most isolated nearby galaxies with radial velocities V_{LG}< 3500 km/s. This kind of cosmic orphans consists of 4% among all known galaxies within the same velocity range. The sample of LOGs is 75%-dominated by flat, bulgeless (T > Sc) galaxies having the median M_{gas}/M_{star} ~1. The E and S0 galaxies, like NGC 404, amounts to a minor (~4)% fraction of LOGs, displaying a low median luminosity (M_B = -17.6 ^{m}), and the presence of gas and dust.

The large-scale distribution of LOGs seems to be moderately clumpy.

Peculiar structure of some isolated galaxies can be interpreted as a result of their interaction with a massive dark body (sub-halo).

Thanks

for your attention