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ASTRONOMY AND ASTROPHYSICS

Some noteworthy DENIS galaxies near the galactic plane

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Abstract. From a visual inspection of J and K images obtained within the Deep Near Infrared Survey (DENIS) we detected 37 noteworthy galaxies near the galactic plane ($|b| < 15$ deg). Most of these galaxies are yet uncatalogued. They have either a large dimension (more than 1 arcmin in J-band) or a position very close to the galactic plane ($|b| < 3$ deg). Some of these galaxies are simply not visible on the Digitized Sky Survey. Among them 15 galaxies are suspected to be spirals and could be detected from HI observations. Several large galaxies near the assumed position of the Great Attractor suggests that a concentration of galaxies may be present around the equatorial position: $\alpha_{2000} = 16h15m$, $\delta_{2000} = -30\,\mathrm{deg}$. An inspection of this field from the Digitized Sky Survey and from available 2MASS data confirms the presence of extragalactic structures.

Key words: infrared: galaxies – cosmology: large-scale structure of Universe – galaxies: general – catalogs – surveys – ISM: dust, extinction

1. Introduction

The DEep Near Infrared Survey (Hereafter DENIS; Epchtein et al., 1997) was the first general survey using direct images from CCD and NICMOS detectors. It covers the southern sky (from $\delta = +2\,\mathrm{deg}$ to $\delta = -87.2\,\mathrm{deg}$) in three photometric bands I,J and K ($Gunn - i = 0.8\,\mu m$, $J = 1.25\,\mu m$ and $K = 2.15\,\mu m$, respectively).

The I-band has been used to detect new galaxies (Vauglin et al., 1999) at high galactic latitudes ($|b| > 15\,\mathrm{deg}$). At lower galactic latitude the J and K bands are more appropriate. An estimation has shown that below $|b| \approx 5\,\mathrm{deg}$ the K-band is more suitable while J is better in the intermediate zone $5\,\mathrm{deg} < |b| < 15\,\mathrm{deg}$. The reason for the K-band being better below $|b| = 5\,\mathrm{deg}$ is (of course) the smaller extinction. That the J-band is better at intermediate latitudes is because the Denis K-band magnitude limit is rather bright - in other words at those latitudes (or rather intermediate extinction levels) the 'loss' by higher extinction in J is cancelled out by the fainter magnitude limit and therefore the J-band is superior (see Schröder et al. 1999, for more detailed study).

Although automatic galaxy recognition programs (Bertin & Arnouts, 1996, Paturel et al., 2000) work reasonably well at high latitude the crowding of the field makes them less efficient near the galactic plane. In the present paper we made instead a visual inspection of J and K bands for $|b| < 15\,\mathrm{deg}$.

Each J or K frame is $12' \times 12'$ with pixels of $3''$, i.e. 256×256 pixels. Using microscanning this resolution is improved and it produces 768×768 logical pixels of $1''$ each. The integration time is $9\,s$. Measurements are made along strips covering $30\,\mathrm{deg}$ in declination. Each strip contains 180 elementary frames.

An extended catalogue in the Zone of Avoidance (ZoA, for galactic latitude $|b| < 15\,\mathrm{deg}$) is in preparation. It contains about 2000 galaxies (Vauglin et al. 2000, in preparation) with J and K photometry. It will be used to underline some structures behind the Milky Way. Nevertheless, before its completion, it is interesting to extract galaxies with noteworthy characteristics in order to stimulate complementary observations. Two main characteristics are searched for: (1) galaxies very close to the galactic plane (below $3\,\mathrm{deg}$) (2) galaxies with a large diameter.

2. Observations and method

Each image is checked by eye to detect non-stellar objects. The external diameter is measured on the J frame. Because the preliminary coordinates provided by the telescope positionning are not secure enough, each galaxy has been measured on the Digitized Sky Survey following the procedure previously used (Paturel et al., 1999). Some galaxies are visible and the positioning of the center can be done in a direct manner. When the galaxy is

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barely or not visible the centering is made by a direct comparison of J plate and DSS plate. The accuracy of the coordinates is a few arcseconds.

We checked that these objects are not known as Globular clusters (Harris & Racine, 1979), Open clusters (Lynga, 1983), Bright Nebulae (Lynds, 1965), HII regions (Sharpless, 1959), Planetary Nebulae (Acker et al., 1992). Further, we checked that they were not previously catalogued by teams currently searching galaxies near the galactic plane (Weinberger, 1980; Saito et al., 1990, Saito et al. 1991; Roman et al., 1996; Roman et al., 1998; Seeberger et al. 1996; Lercher et al. 1996; Saurer et al. 1997; Seeberger & Saurer, 1998; Kraan-Korteweg et al. 1995; Woudt et al. 1999; Weinberger et al. 1999; Kraan-Korteweg, 2000).

Nevertheless, five galaxies were known in the catalogue of 2.7 Million galaxies automatically extracted from the DSS (MIGAL catalogue, Paturel et al., 2000). This catalogue is now loaded in the LEDA database with the acronym of the Principal Galaxy Catalog (PGC, Paturel et al., 1989). These five galaxies are:

$$\begin{aligned} \#8 &= PGC0934968; \quad \#24 = PGC0484547; \\ \#25 &= PGC0377390; \quad \#26 = PGC0457765 \quad \text{and} \\ \#30 &= PGC0668889. \end{aligned}$$

Incidentally, this shows that we will be able to discover new, bright galaxies in the galactic plane using this MIGAL catalogue. One galaxy ($\#16 = 134403.3 - 601936$) was also discovered independently by A. Schröder.

Further we checked the second release of the 2MASS survey. Ten galaxies are reported in the Extended Source catalogue. They are: #1, #2, #3, #4, #6, #7, #9, #30, #33, #37. The coordinates agree within $2''$ ($2.1''$ in RA and $1.7''$ in DEC). Owing to the fact that the center of a galaxy can hardly be defined with an accuracy better than two or three pixels, the agreement is satisfactory and, anyway, good enough for identifying a galaxy without ambiguity. Obviously, this study will be conducted also with the full sample of 2000 galaxies.

3. Catalogue

The galaxies are presented in two tables. Table 1 gives the galaxies very close to the galactic plane ($|b| < 3$ deg). Table 2 gives galaxies with a diameter larger than one arcminute and located at low galactic latitude ($|b| < 15$ deg).

Both tables have the same arrangement of columns.

Column 1: Running number
Column 2: Galactic longitude (in degrees)
Column 3: Galactic latitude (in degrees)
Column 4: Right Ascension and Declination for equinox 2000 (in hours, minutes, seconds and tenths and degrees, arcminutes and arcseconds)
Column 5: Apparent diameter visually measured from the J frame (in log of 0.1 arcmin)
Column 6: Comments. S for spirals, E for Elliptical, M for multiple or interacting, A for very absorbed,? for uncertainty.

Table 1. List of galaxies very close to the galactic plane ($|b| < 3$ deg).

#	l	b	RA2000 DEC2000	logD	note
	deg	deg	$h\ min\ sec \quad deg\ '\ ''$		
1	229.68	−0.25	072145.5 − 145841	0.70	
2	230.82	−0.85	072148.0 − 161557	0.58	
3	233.17	−1.36	072435.0 − 183431	0.72	
4	233.72	−1.65	072435.7 − 191150	0.75	
5	225.87	2.70	072503.3 − 101332	0.58	
6	235.70	−1.52	072905.7 − 205242	0.68	
7	235.65	−1.45	072916.1 − 204808	0.73	
8	229.41	2.03	072932.1 − 133932	0.60	
9	229.82	1.85	072942.4 − 140602	0.73	
10	263.34	1.88	085451.0 − 420618	–	S
11	287.77	2.10	105537.6 − 571910	0.78	
12	296.75	−2.17	115350.8 − 642041	0.45	S M
13	295.96	2.46	115551.4 − 593941	0.73	
14	300.78	2.82	123413.3 − 595900	1.04	S
15	304.69	2.97	130525.1 − 595109	0.82	A
16	309.40	1.88	134403.3 − 601936	0.72	
17	324.61	1.08	153120.1 − 545451	0.83	
18	330.84	−0.16	160914.9 − 515853	0.99	S
19	354.52	−0.51	173358.7 − 335115	0.78	?
20	23.79	−0.31	183544.8 − 081617	0.85	A
21	29.18	2.47	183547.6 − 021235	0.62	? A
22	34.07	1.64	184739.6 + 014538	0.60	

Table 2. List of galaxies with large diameters ($D_J > 1'$).

#	l	b	RA2000 DEC2000	logD	note
	deg	deg	$h\ min\ sec \quad deg\ '\ ''$		
23	286.51	12.78	111601.1 − 470152	1.07	S
14	300.78	2.82	123413.3 − 595900	1.04	S
24	301.26	14.13	124138.0 − 484250	1.03	
25	304.15	4.19	130045.1 − 583946	1.03	S
26	315.46	9.61	141127.4 − 511800	1.07	S?
27	324.40	−3.81	155143.9 − 585657	1.02	E?
28	325.29	−4.73	160135.6 − 590446	1.22	S?
29	323.24	−7.35	160305.7 − 622358	1.06	E
30	343.27	12.96	160930.7 − 335839	1.10	S M
31	337.26	6.45	161031.2 − 424618	1.01	S?
32	340.09	9.38	161038.1 − 384252	1.01	S?
33	345.97	13.89	161517.6 − 312758	1.07	E?
34	347.96	15.67	161536.6 − 285050	1.24	E?
35	342.48	−8.03	173315.0 − 480005	1.08	S
36	15.27	13.71	172935.5 − 085229	1.07	
37	351.20	−8.57	180017.0 − 404917	1.20	S A

One galaxy ($\#14 = J1234133 - 595900$) belongs to both lists because it is large (diameter=1.1') and close to the galactic plane ($b = 2.8$ deg).

For each galaxy we present a finding chart extracted from the Digitized Sky Survey (Figs. A.3 and A.4)[1]. Each chart is $5' \times 5'$. The North direction is on the top and the East direction is on the left. The precise location of the new galaxies is just

[1] Finding charts are of better use in B-band because in J or K-bands the field may look quite different.

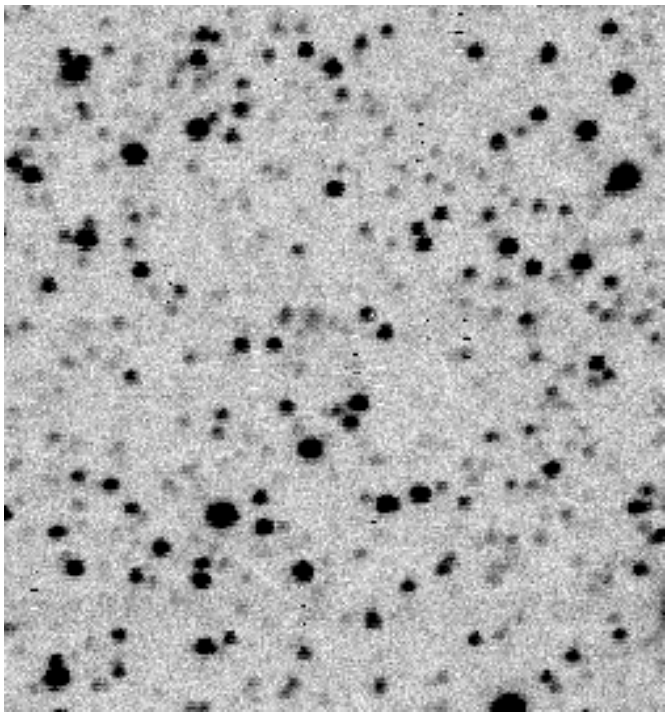

Fig. 1. J-frame presenting the galaxy $\#18 = J160914.9 - 515853$ not visible on Fig. A.3. The galaxy is probably a late type galaxy with a relatively low surface brightness. It is visible slightly above the center of the frame. The orientation is the same than the one of Fig. A.3. The field is roughly $3' \times 3'$.

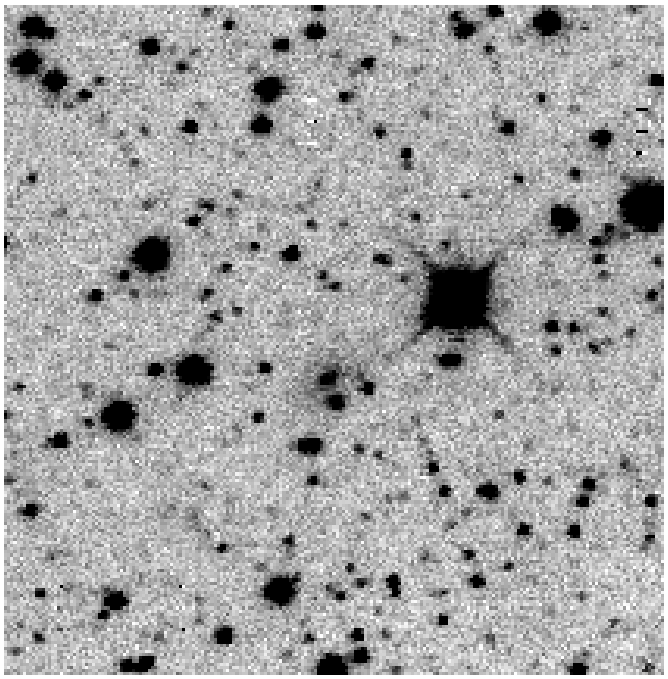

Fig. 2. J-frame presenting the galaxy $\#28 = J160135.6 - 590446$ not visible on Fig. A.4. The galaxy is probably an early type spiral with a relatively bright bulge and a visible disk. It is visible slightly below the center of the frame. The orientation is the same than the one of Fig. A.4. The field is roughly $3' \times 3'$.

between the internal tick marks. The provisional DENIS name constructed with the coordinates is given on each finding chart. As an example we also present three J-frames where galaxies, unvisible on the B plate, are clearly visible on the J one. We present respectively, one late type galaxy (#18, Fig. 1), one early type spiral (#28, Fig. 2) and one Elliptical (#29, Fig. 3). Each frame is about $3' \times 3'$.

4. Discussion

An inspection of the DSS images shows that some of these objects could have been discovered on the blue plates, but most of them are simply not visible. Some have been classified as spirals (S) or possibly spirals (S?). They will be observed in neutral hydrogen (HI).

One large galaxy ($\#23 = J111601.1 - 470152$) is very bright in B. It has high surface brightness and a relatively sharp edge. Despite being elongated, it looks like a planetary nebula. It would be interesting to confirm with a spectrum that this object is an extragalactic object.

The position of these new objects along the galactic plane may reveal either the presence of nearby groups or transparent regions. We present the positions of these new galaxies on a Flamsteed equal area projection in supergalactic coordinates (Fig. 4). In such a projection a part of the galactic plane appears on the vertical, central meridian and on the edge of the graph (the dashed curves show the $|b| = 15\,\mathrm{deg}$ limits). The putative Great

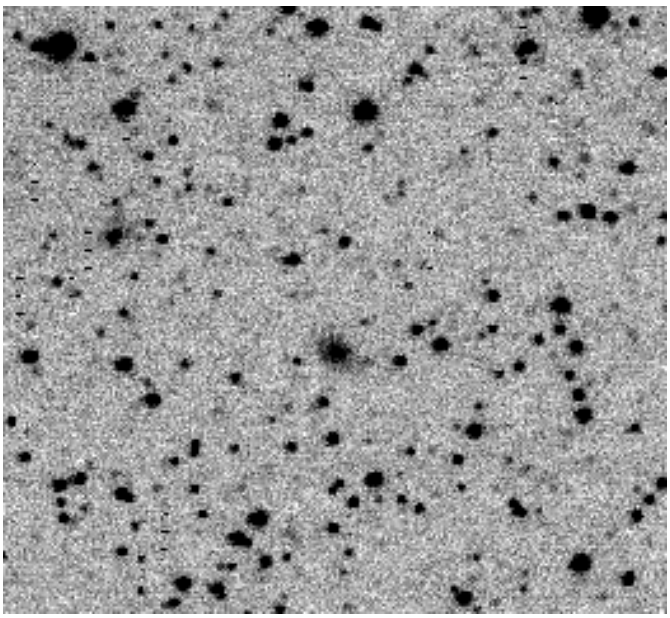

Fig. 3. J-frame presenting the galaxy $\#29 = J160305.7 - 622358$ not visible on Fig. A.4. The galaxy is probably an elliptical. It is visible slightly below the center of the frame. The orientation is the same than the one of Fig. A.4. The field is roughly $3' \times 3'$. Another faint galaxy is visible on the left side (East) slightly above the center.

Attractor is indicated at the supergalactic coordinates $SGL = 180\,\mathrm{deg}$ and $SGB = 0\,\mathrm{deg}$, (i.e., $\alpha_{2000} = 16h15m$, $\delta_{2000} = -60\,\mathrm{deg}$). The galactic plane is well delineated by the galaxies

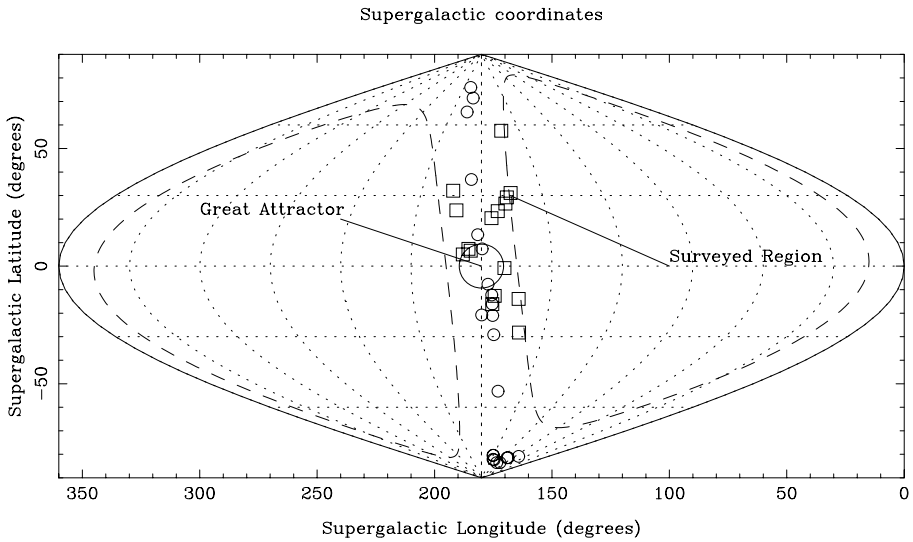

Fig. 4. Distribution of the noteworthy galaxies in a supergalactic Flamsteed projection. Galaxies very close to the galactic plane are represented by open circles, while large galaxies are represented by open squares. The dashed curves show the $|b| = 15\,\mathrm{deg}$ limits. The possible position of the Great Attractor is represented by a very large open circle. There is a remarkable concentration of large galaxies above the Great Attractor.

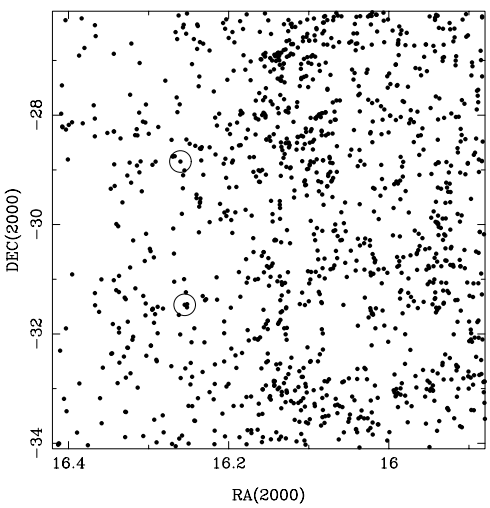

Fig. A.1. Distribution of galaxies as seen from a detailed inspection of the DSS. The positions of the elliptical galaxies detected in the DENIS J and K-bands are seen as large open circles. The galactic plane is roughly parallel to the Y-axis, on the left side.

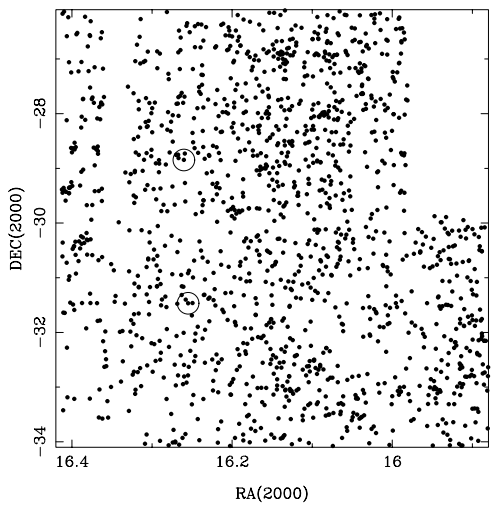

Fig. A.2. Distribution of extended objects detected from 2MASS.

with $|b| < 3\,\mathrm{deg}$ (small open circles), which are well distributed along the longitude.

Several large galaxies above the position of the Great Attractor suggests that a concentration may be present near this position (equatorial position: $\alpha_{2000} = 16h15m$, $\delta_{2000} = -30\,\mathrm{deg}$). Two galaxies in the center of this concentration are elliptical galaxies ($\#33 = J161536.6 - 285050$ and $\#34 = J161517.6 - 312758$). No Abell cluster (Abell et al. 1989) is found at this position. This is noteworthy because, among 2000 galaxies discovered from the visual inspection of the randomly chosen DENIS strips, five of the largest galaxies are in this concentration. A survey of the field near the ESO chart #451 (Appendix 1) confirms that there are many galaxies in this region. Some elliptical are amazingly bright.

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Appendix A: inspection of the field around 16h15m -30 deg

We inspected the region around the equatorial coordinates $RA(2000) = 16h15$, $DEC(2000) = -30\,\mathrm{deg}$ by searching visually galaxy-like objects on the Digitized Sky Survey. The field centered at 16h15m -30 deg was covered by 60×60 fields

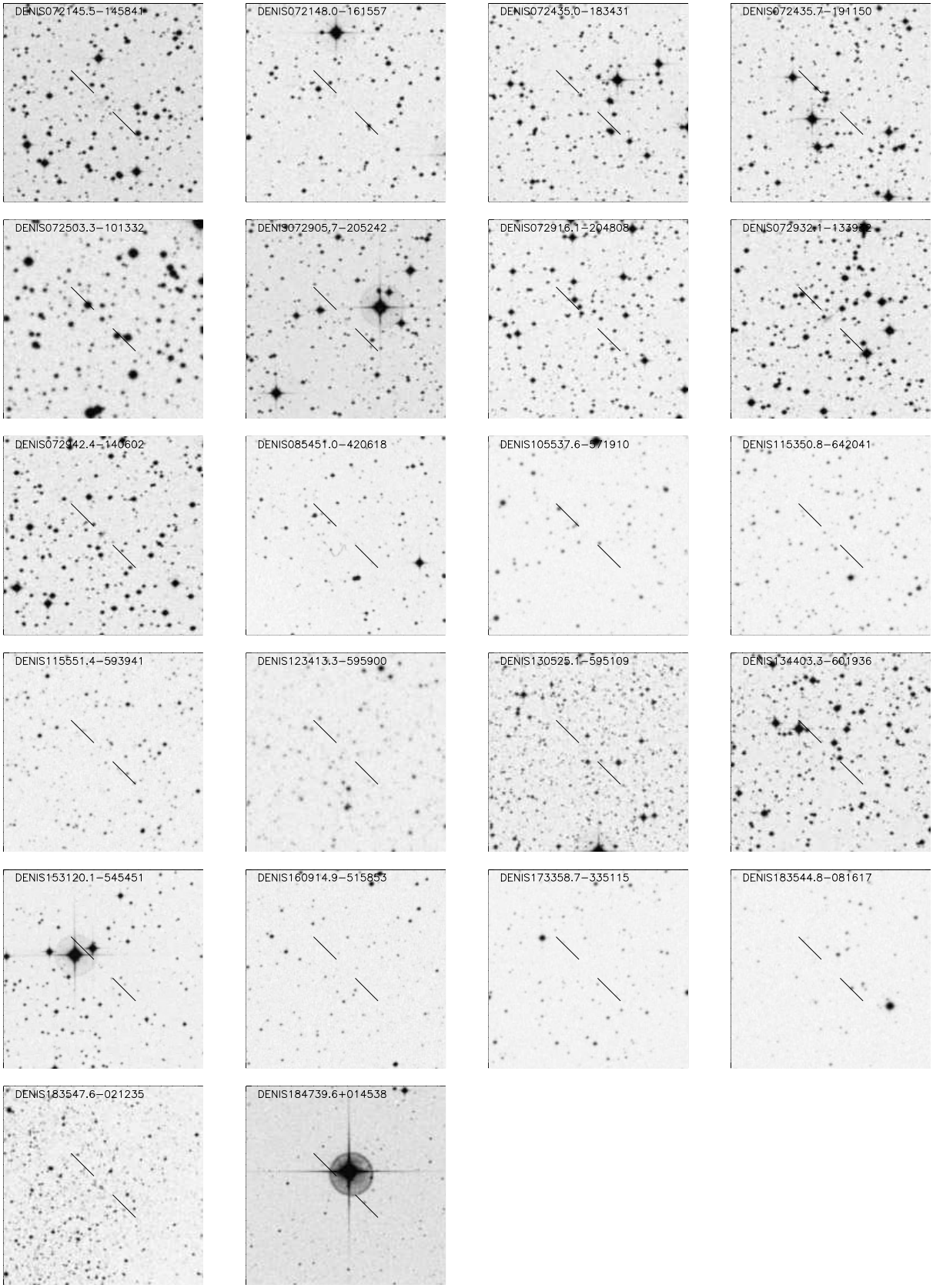

Fig. A.3. Finding charts for galaxies very close to the galactic plane ($|b| < 3\,\mathrm{deg}$). The frame is $5' \times 5'$. North is on the upper side, East is on the left side. The new galaxies are located in the center, between the two central tick marks. The 2000 equatorial coordinates are given on the top of each frame.

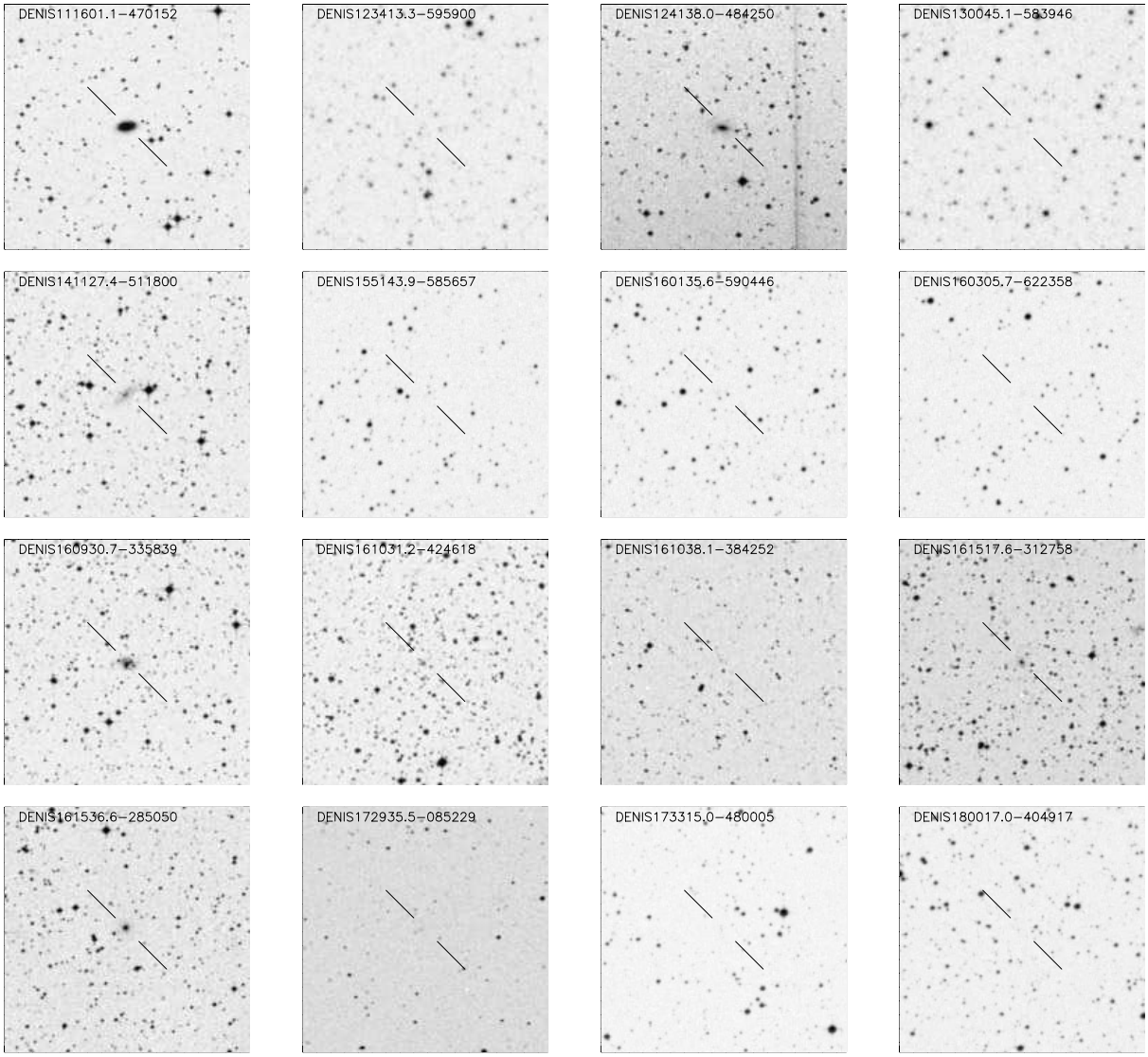

Fig. A.4. Same as Fig. A.3 for galaxies larger than 1 arcmin.

of $10' \times 10'$ each, with an overlap of $1'$ on each side. The total field is thus $8deg \times 8\,\mathrm{deg}$. For each galaxy-like object we measured the coordinates and extracted the main parameters (diameter, axis ratio, position angle and apparent magnitude) with the same procedure than the one described in Paturel et al. (2000). Further, we assigned a morphological type for each galaxy.

The catalogue resulted in 1500 measurements. After an internal cross-identification 1212 extended objects remain (from overlapped surface one expects about 1131 remaining objects). For each of them the following parameters are given:

Column 1: Right Ascension and Declination for equinox 2000 (in h mn s and deg $'$ $''$)

Column 2: Apparent diameter (log of 0.1 arcmin)

Column 3: Decimal log of axis ratio log D/d

Column 4: Position angle in degrees (from North to the East)

Column 5: Apparent magnitude

Table A.1. Beginning of the catalogue. The whole catalogue contains 1202 galaxies. It is available in electronic form at the CDS.

RA2000 DEC2000 h mn s deg. ' "	logD D in '	logR	p.a. deg.	m	Type
J155248.3-333309	0.64	0.56	143.	17.58	Sm
J155250.5-331530	0.49	0.06	109.	17.00	E
J155239.1-330152	0.42	0.31	54.	17.90	S0
J155255.1-325241	0.84	0.17	54.	15.86	Sc
J155304.4-324400	0.54	0.12	63.	16.99	Sb
J155249.5-325210	0.36	0.28	2.	17.90	Sm
J155305.0-322836	0.23	0.11	32.	18.40	Sm
J155259.3-320600	0.77	0.57	131.	17.08	Sc
J155316.3-320414	0.75	0.16	104.	15.50	Sa
J155317.4-314515	0.75	0.17	94.	15.70	Sb
J155322.1-314658	0.74	0.11	103.	15.72	Sb
...					

Column 6: Morphological type visually estimated for each object assuming it is a galaxy.

We made a cross-identification of this catalogue with the second release of the 2MASS survey. 1476 extended objects are found up to a limiting J magnitude of 16.5. By crossidentifying, 490 objects are found in common. An inspection of remaining objects reveals that 591 extended objects in the 2MASS list are probably not galaxies.

The questions are whether the distribution seen by our inspection is similar to the one seen by 2MASS and whether one can see some structures. In Figs. A.1 and A.2 we show the distribution of extended objects from the present catalogue and from 2MASS.

It is clear that both surveys describe the same structures with the same concentrations and voids. However, when approching the galactic plane (on the left of Figs. A.1 and A.2) there are less objects visible in B than in JHK. Obviously, the extinction explains this lack of galaxies.

An inspection of a larger field around the region of the putative Great Attractor shows that there are many large and deep concentrations of galaxies like the one reported here. This is also visible on a plot made from MIGAL.

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