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Galaxy coordinates

III. Accurate positions for 17124 galaxies including 3301 new companions of UGC galaxies⋆

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Abstract. This paper gives accurate coordinates and diameters for 3301 galaxies, companions of UGC galaxies. (about 2764 companions were not yet available in electronic form). In addition previously poor equatorial coordinates are re-measured for 13823 galaxies. These coordinates which have an accuracy of 5″ or better will be used for facilitating the cross-identification with forthcoming catalogues of millions of galaxies.

Key words: galaxies — catalog

1. Introduction

This series of papers aims mainly at improving the accuracy of equatorial galaxy coordinates in order to facilitate the cross-identification with the very large catalogue we built from the Digitized Sky Survey using an automatic galaxy recognition program (Paturel et al. 2000). Nevertheless, it is also important to enter new galaxies well identified visually, especially when they are either close to large galaxies or when they have a low surface brightness. Indeed, these two characteristics make difficult an automatic recognition.

This paper presents two independent sections, both aiming at improvement of equatorial coordinates of galaxies. In Sect. 2 we describe the catalogue of companions of UGC galaxies. Most of these galaxies are not yet entered in large databases. Then, in Sect. 3 we give a short description of additional 13935 coordinate measurements. These measurements are performed in a way similar to the one described in our previous paper (Paturel et al. 1999; Paper II).

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⋆ Full Tables 1 and 2 are available in electronic form at CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

2. Catalogue of UGC galaxy companions

Many years ago Peter Nilson (1973) produced his famous UGC catalogue with nearly 13000 galaxies larger than one arcminute. This catalogue was integrated a long time ago in general extragalactic databases like NED or LEDA. At the end of the UGC catalogue Nilson gave many additional pieces of information about the UGC galaxies and their environment. For instance, small galaxies surrounding a UGC galaxy and listed in the CGCG catalogue (Zwicky et al. 1961-1968) are given with their original CGCG coordinates. Further, Nilson identified many small companions around his UGC galaxies.

There is no clear definition of such companions. They are simply "close" to a UGC galaxy. Nilson did not measure the equatorial coordinates for these galaxies but instead made an identification in polar coordinates with respect to the central UGC galaxy. This relative position is given by the position angle β (measured in degrees from north through east) and the angular separation ρ (measured in arcminute from the center of the parent UGC galaxy). In addition, Nilson gives major and minor axes (in arcminute) of these small companions.

This catalogue of UGC companions was keypunched by one of us (CP) ten years ago. This was a difficult task because of the very compact printing format of this catalogue. If the coordinates of these companion galaxies had been deduced at that time from the polar coordinates, any deplacement of the parent galaxy would have completely distorted the look of the field. Of course this could have been solved by moving the companions at the same time but it is not obvious to know which galaxy is a companion and which is not. Our catalogue remained ten years on our computer disk.

Today, thanks to the remarkable work by Cotton et al. (1999), all UGC galaxies have accurate equatorial coordinates. This suggested to us that we use this catalogue as a source of equatorial coordinates for the central UGC galaxies. However, instead of calculating the equatorial coordinates from the polar ones we prefered to use the plate

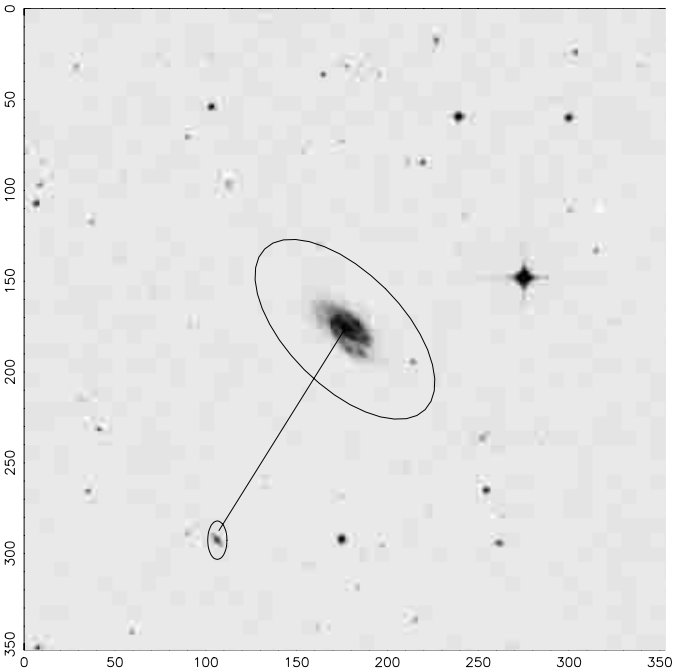

Fig. 1. A typical image from the Digitized Sky Survey got from ESO. The frame is $10' \times 10'$. North is on the upper side, East is on the left side. The large galaxy in the center is the parent UGC galaxy (UGC 5). The companion is the small galaxy at the end of the line. The diameter of the companion is drawn according to twice the Nilson's measurements

solution given by the Digitized Sky Survey. The first reason is that the accuracy of the measurements of position angle and angular separation is not good enough to provide us with accurate equatorial coordinates. The position angle is known with an accuracy of one or two degrees and the angular separation is known with an accuracy of $6''$ to $10''$ leading to an uncertainty of $14''$ at a distance of $5'$ from the center of the parent galaxy. The second reason is that the uncertainties on both axes (R.A. and DEC.) would have been correlated in a complicated manner.

Instead, the polar coordinates are used for an easy identification of companion galaxies by displaying simultaneously the DSS image, centered on the parent UGC galaxy, and the location of companions. In Fig. 1 we present such a display.

The coordinates are obtained by clicking on the center of the companion. This is done with special routines developed from the PGPLOT package. The center is estimated visually.

2.1. Treatment of images

We selected first UGC galaxies with companions and made the histogram of the radial vectors of their companions. This histogram is given in Fig. 2.

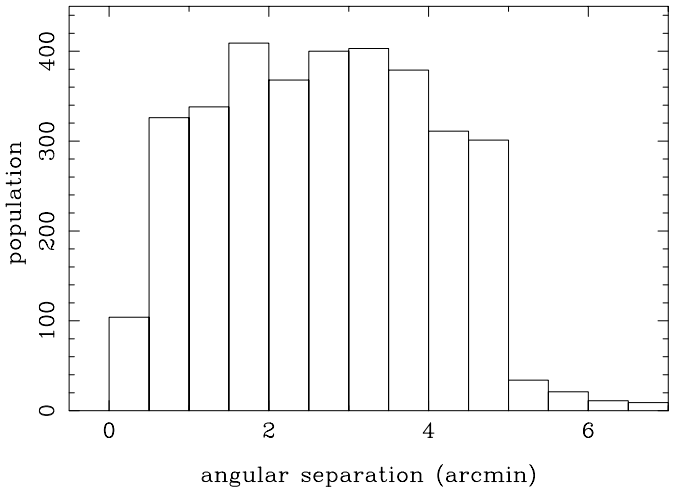

Fig. 2. Histogram of angular separations of parent galaxy and companions. We considered only companions with a separation smaller or equal to $5'$

The coordinates of the UGC galaxies are taken from the LEDA database[1]. For efficiencies sake we loaded all DSS images (i.e. about 2600 images) from the ESO facility.

Then, the measurements were done. Sometimes, the identification is not possible either because we have a choice between two companions or because of an error in the input catalogue. These cases were treated individually by refering to the original UGC catalogue or by analysing the field carefully.

This work results in 3301 new accurate coordinates for companions of 2597 UGC galaxies. Most of these companions are not available in large databases. For each companion we give the major axis and minor axis diameters as measured by Nilson.

2.2. The final catalogue

The catalogue is now loaded in LEDA but it will be distributed in an electronic form via the Astronomy and Astrophysics archives. Here we simply reproduce a sample page (Table 1). This table gives measurements for 3301 galaxies (539 were already known).

The following data are given:

Column 1: PGC number according to LEDA database (Paturel et al. 1989).

Column 2: Name according to some well-known catalogues, if applicable. In Table 3 we give the acronyms used for these catalogues.

Column 3: Right Ascension and Declination for equinox 2000 (in hours, minutes, seconds and tenths and degrees, arcminutes and arcseconds).

Column 4: Major axis diameter in arcminute measured

[1] After having loaded the astrometry of UGC galaxies by Cotton et al. (1999).

Table 1. Catalogue of UGC galaxy companions. The full list is availbale in electronic form

PGC	Name	R.A.2000 DEC2000	D	d	ugc-parent
		h min sec deg $'$ $''$	$'$	$'$	
0000037	MCG 4- 1- 9	000031.6 + 261819	0.25	0.15	12896
0215025		000047.8 + 285602	0.30	0.10	12901
0000089	MCG 2- 1- 9	000113.3 + 130836	0.80	0.30	12906
0215026		000114.1 + 344059	0.20	0.10	12904
0000092	MCG 2- 1- 10	000115.1 + 130647	0.50	0.15	12906
0215027		000129.5 + 130551	0.50	0.40	12906
1422918		000145.3 + 130601	0.40	0.40	12906
0215028		000211.2 + 173337	0.50	0.30	12916
0215029		000212.8 + 125643	0.40	0.40	12919
0215030		000216.3 + 125501	0.30	0.20	12919
0212450		000227.4 + 445333	0.35	0.25	00002
0000185	IC 5379	000240.7 + 163602	0.70	0.35	00001
0212451		000253.6 + 185041	0.50	0.30	00003
0212453		000308.0 + 155836	0.40	0.20	00007
0212452		000313.6 − 015809	0.30	0.15	00005
0212454		000318.0 + 083641	0.60	0.20	00010
0000234	KUG 0000+271	000325.0 + 272412	0.30	0.30	00013
0212457		000329.1 + 041747	0.30	0.20	00015
0212455		000334.4 + 220456	0.50	0.35	00011
0000252	CGCG 408- 17	000337.7 + 083810	0.70	0.30	00010
...					

by Nilson (1973).
Column 5: Minor axis diameter in arcminute measured by Nilson.
Column 6: UGC Name of the parent galaxy.

It is to be noted that two galaxies are companion of two different UGC galaxies. (PGC 12267 is companion of UGC 2639 and UGC 2651; PGC 212567 is companion of UGC 408 and UGC 423. In the catalogue they are given on the same line).

3. Additional list of new accurate equatorial coordinates

At the beginning of this work the percentage of galaxies with good coordinates in LEDA was about 90%. We selected galaxies still having poor coordinates (standard deviation less than $10''$). About 18500 galaxies were listed for which DSS images were extracted from ESO in Münich. Then, our procedure of measurement was applied leading to 13823 accurate coordinates which are listed in Table 2. The following data are given:
Column 1: PGC number according to LEDA (Paturel et al. 1989).
Column 2: Name according to Table 3, if applicable.
Column 3: Right Ascension and Declination for equinox 2000 (in hours, minutes, seconds and tenths and degrees, arcminutes and arcseconds).
Column 4: Flag to mention an uncertainty on name.

After having loaded this list and the UGC-companion list 97.8% of the galaxies (about 190000 galaxies) in LEDA had accurate coordinates[2]. In practice, 365 galaxies presented an inconsistency of names between LEDA and NED. These cases were analyzed with special care. They are noted with an asterisk in Table 2. This shows the urgent need of homogeneization of galaxy designation. Indeed, some galaxies identified in old catalogues with very poor coordinates and very poor description cannot be retrieved in a secure manner in the new catalogues. Then, giving such a name to this or that object is just a matter of convention. We should either abandon the old, inaccurate designation (this is what seems suitable to us) or decide that a given old name designates a given object (the same convention must be adopted by all databases). This requires regular exchanges and dialogues between the different existing general databases.

4. Accuracy of galaxy coordinates

According to our previous tests (Paper II) an accuracy of about $5''$ to $7''$ is obtained for large galaxies (diameter of about $1.7'$). This uncertainty comes essentially from the uncertainty in the estimate of the galaxy center. For smaller galaxies we expect better accuracy. In order to test the present measurements with small galaxies we measured 285 faint galaxies measured by Munn et al. (1997).

[2] We recently loaded our 2.7 million galaxy catalogue extracted from the DSS. The percentage of accurate coordinates in LEDA jumped to 99.9% but the same 4272 galaxies remain with uncertain coordinates. For these galaxies it is actually an identification problem, not simply a problem of measurement.

Table 2. New measurements of equatorial coordinates. The full table is available in electronic form

PGC	Name	R.A.2000 DEC2000
		h min sec deg ′ ″
0089489		000008.4 − 603304
0141432		000009.8 − 633540
0089490		000018.2 − 605343
0000027	MCG -1- 1- 18	000023.3 − 065612
0165937	IRAS 23578-5307	000023.8 − 525031
0000041		000025.8 − 054640
0000036	IC 5373	000029.0 + 324656 *
0000046		000029.7 − 054636
0000037	MCG 4- 1- 9	000031.6 + 261819
0000040	MCG 0- 1- 17	000035.6 − 014550
0097568	IRAS 23583+1813	000054.2 + 183022
0141433		000058.8 − 604956
0000079	IC 5374	000104.6 + 043006
0097569	IRAS 23586-0116	000113.3 − 005937
0000122	MCG -7- 1- 7	000130.9 − 404912
0141435		000137.7 + 172919
0100354		000201.2 + 145837
0000152	MCG -5- 1- 25	000205.4 − 303709
0000150	FAIR 1065	000205.4 − 512056
...		

Table 3. Acronyms used in Tables 1 and 2 for galaxy identification

Acronym	Reference
CGMW	Catalogue of Galaxies Behind the Milky Way; Saito et al., 1990-1991; Roman et al., 1996-1998
DRCG	Dressler Catalogue of Cluster of Galaxies; Dressler, 1980
ESO	European Southern Observatory catalogue; Lauberts, 1982
FAIR	Fairall lists; Fairall; 1977-1988
HICK	Compact Groups of Galaxies; Hickson, 1993
NGC	New General Catalogue; Dreyer, 1889
IC	Index Catalogue; Dreyer, 1895-1910
CGCG	Catalogue of Galaxies and Cluster of Galaxies; Zwicky et al. 1961-1968
nZW	Catalogue of Selected Compact and Post-eruptive Galaxies; Zwicky, 1971; Zwicky et al., 1975 (n is the number of the list from 1 to 8)
nSZW	Zwicky Compact Galaxies in two southern fields; Rodgers et al., 1978 (n is the number of the list from 1 to 2)
IRAS	IRAS Point Source Catalogue, 1988
KAZA	Kazaryan lists; Kazaryan, 1979-1983
KCPG	Karachentsev Catalogue of Pair of Galaxies; Karachentsev 1972
KUG	Kiso Survey of Ultraviolet Excess Galaxies: Takase and Miyauchi-Isobe, 1993
MCG	Morphological Catalogue of Galaxies: Vorontsov-Vel'jaminov et al. 1963-1974
MK	Markaryan lists; Markarian 1967-1981 (list 1-15)
POX	Catalogue of active galaxies; Kunth; 1981
RB	Rood and Baum Catalogue: Rood and Baum, 1967
UGC	Uppsala General Catalogue; Nilson, 1973
UGCA	Catalogue of Selected non-UGC Galaxies; Nilson, 1974
UM	University of Michigan lists; Mac Alpine et al., 1977-1981
VCC	Virgo Cluster Catalogue; Bingelli et al., 1985
WEIN	Galaxies behind the Milky Way; Weinberger et al., 1980

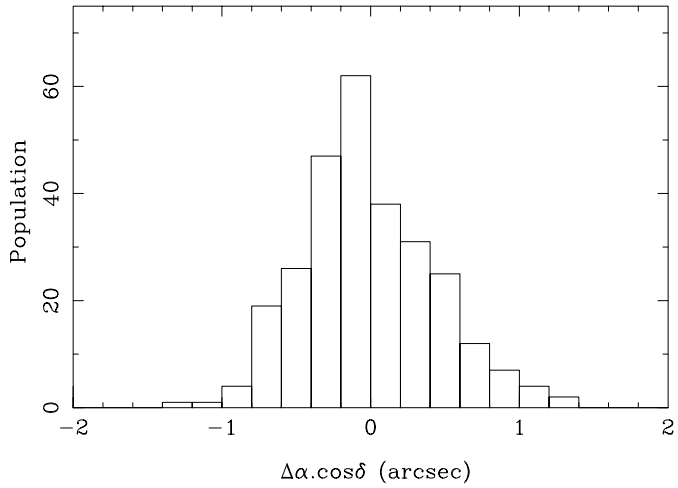

Fig. 3. Histogram of the differences between the Right Ascensions given by Munn et al. and this paper. The standard deviation is 0.6″

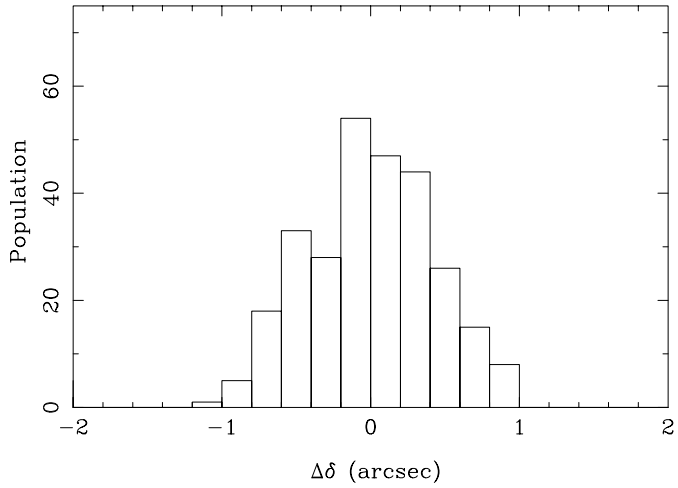

Fig. 4. Histogram of the differences between the Declination given by Munn et al. and this paper. The standard deviation is 0.8″

In Figs. 3 and 4 we present the histograms of the differences between our measurements and those given by Munn et al., for Right Ascensions and Declinations, respectively. There is no significant deviation from zero. For the Right ascension we obtained: $\Delta\alpha \cos\delta = 0.02 \pm 0.04''$ ($n = 285$). For Declination we obtained: $\Delta\delta = 0.08 \pm 0.05''$ ($n = 285$).

The standard deviation is 0.6″ and 0.8″ for Right Ascensions and Declinations, respectively. This confirms that the accuracy of coordinates calculated with the DSS plate solution mostly depends on the accuracy of the definition of the galaxy center. For small galaxies (diameter smaller than 1′) the accuracy is better than 1″.

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