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Properties of isolated disk galaxies[⋆]

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Abstract. We present a new sample of northern isolated galaxies, which are defined by the physical criterion that they were not affected by other galaxies in their evolution during the last few Gyr. To find them we used the logarithmic ratio, f, between inner and tidal forces acting upon the candidate galaxy by a possible *perturber*. The analysis of the distribution of the f-values for the galaxies in the Coma cluster lead us to adopt the criterion $f \leq -4.5$ for isolated galaxies. The candidates were chosen from the CfA catalog of galaxies within the volume defined by $cz \leq 5000$ km s^{-1}, galactic latitude higher than 40° and declination $\geq -2.5°$. The selection of the sample, based on redshift values (when available), magnitudes and sizes of the candidate galaxies and possible perturbers present in the same field is discussed. The final list of selected isolated galaxies includes 203 objects from the initial 1706. The list contains only truly isolated galaxies in the sense defined, but it is by no means complete, since all the galaxies with possible companions under the f-criterion but with unknown redshift were discarded. We also selected a sample of perturbed galaxies comprised of all the disk galaxies from the initial list with companions (with known redshift) satisfying $f \geq -2$ and $\Delta(cz) \leq 500$ km s^{-1}; a total of 130 objects. The statistical comparison of both samples shows significant differences in morphology, sizes, masses, luminosities and color indices. Confirming previous results, we found that late spiral, Sc-type galaxies are, in particular, more frequent among isolated galaxies, whereas Lenticular galaxies are more abundant among perturbed galaxies. Isolated systems appear to be smaller, less luminous and bluer than interacting objects. We also found that bars are twice as frequent among perturbed galaxies compared to isolated galaxies, in particular for early Spirals and Lenticulars. The perturbed galaxies have higher $L_{\rm FIR}/L_{\rm B}$ and $M_{\rm mol}/L_{\rm B}$ ratios, but the atomic gas content is similar for the two samples. The analysis of the luminosity-size and mass-luminosity relations shows similar trends for both families, the main difference being the almost total absence of big, bright and massive galaxies among the family of isolated systems, together with the almost total absence of small, faint and low mass galaxies among the perturbed systems. All these aspects indicate that the evolution induced by interactions with neighbors would proceed from late, small, faint and low mass Spirals to earlier, bigger, more luminous and more massive spiral and lenticular galaxies, producing at the same time a larger fraction of barred galaxies but preserving the same relations between global parameters. The properties we found for our sample of isolated galaxies appear similar to those of high redshift galaxies, suggesting that the present-day isolated galaxies could be quietly evolved, unused *building blocks* surviving in low density environments.

Key words. galaxies: interactions – galaxies: evolution – galaxies: spiral

1. Introduction

Galaxies are most commonly found in aggregates of different densities. Inside these aggregates, the observed morphology and the segregation of types (Dressler et al. 1997; Fasano et al. 2000) may have been determined by the local density of matter and by the subsequent interactions between galaxies. Exchanges and interaction with its neighbors can affect the galaxies global properties and their star formation rates, as shown by the members of dense groups or pairs (Moles et al. 1994a), even if the effects, in general, are not as dramatic as they are in the strongest cases (Moles et al. 1994b; Márquez & Moles 1999).

Another way to look into the effects of interaction on the overall equilibrium of a galaxy is through the analysis of the relations found between the structural parameters for different families of galaxies. The E/S0 cluster (Faber et al. 1987; Davis & Djorgovski 1987; Jørgensen et al. 1996), and field galaxies (Treu et al. 2001) satisfy the Fundamental Plane (FP) relation, even if its form is not the same for both families. The Spiral (S) galaxies satisfy the Tully-Fisher (TF) relation. It has

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[⋆] Tables 1 and 2 are only available in electronic form at `http://www.edpsciences.org` been indicated that the TF relation defined by isolated spiral galaxies presents a smaller scatter than non-isolated galaxies (Márquez & Moles 1996; Márquez et al. 2002; van Kannappan et al. 2002).

To find isolated galaxies, a physically grounded and operational definition of isolation has to be given. Often the term field galaxies refers to systems that are not in dense aggregates, but frequently they are still under the influence of neighboring galaxies and cannot be considered as genuinely isolated objects (see for example Márquez et al. 2002). The first systematic compilation of isolated galaxies was made by Karachentseva (1973), who used as the main criterion that they do not show companions within 20 diameters in the PSS plates. Later, Turner & Gott (1976), while searching for groups of galaxies, found that some of the galaxies could not be assigned to any of the identified groups. It was argued that they would trace a cosmological homogeneously distributed population of galaxies. This conclusion was however challenged by Huchra & Thuan (1977) who used a deeper sample ($m \leq 15.7$ instead of $m \leq 14$). Vettolani et al. (1986) adopted stricter criteria to find isolated galaxies. Their conclusion was that it was very unlikely that there was a cosmological component of galaxies without any kind of clustering (at least at small redshift). But an important observation was the detection of galaxies in such poor environments that they had very probably evolved without any external perturbation, as if they were isolated. In that perspective what is needed is an operational definition of isolation that could lead to identifying galaxies that have evolved free from external influences for most of their lives, a point of view adopted by Márquez & Moles (1996) and Márquez et al. (1999). In this context, it was noticed that non-axisymmetric structures like bars, tails or plumes, which are usually explained invoking gravitational interaction with companions or satellites, can also be present in isolated galaxies, posing the problem of their origin in the absence of sizable interactions (Moles et al. 1994, 1995).

In the present work we discuss the criteria used to find isolated galaxies and build a statistically well-defined sample to analyze their properties. Due to the lack of redshift information for most of the faint, possible *perturbers*, the final sample is by no means complete, our main goal being to keep only truly isolated galaxies, discarding all the suspect systems. In the last section we compare the properties of the family of the isolated galaxies with those of confirmed perturbed galaxies.

We also consider the similarity of some of the properties of present-day isolated systems with those reported for the presumed *building blocks* in the distant Universe (Ferguson et al. 2003; Trujillo et al. 2003). Stellar systems situated in regions of very low density would have evolved differently from galaxies in aggregates without a significant contribution from the surroundings and, therefore, they might be similar to those original building blocks.

2. Isolation criteria

From an operational point of view, we will consider a galaxy to be isolated when its evolution in terms of structure and stellar content has been dominated by internal forces for most of its life. Or, in other terms, when the external forces are judged to be unable to have produced noticeable changes in at least the last 2×10^9 years. As found by Athanassoula (1984) and Byrd & Howard (1992), an external interaction can only have influence on the structure of a given system when the corresponding tidal force amounts to ≥1% of the internal force.

The results of numerical simulations of encounters between galaxies can be described in terms of a tidal perturbation parameter (see Byrd & Howard 1992). This gives the ratio between the tidal force exerted by the perturber, P, on the primary galaxy, G, and the internal force per unit mass in the outer parts of the primary. Given a galaxy of mass $M_{\rm G}$ and size R, and a perturber of mass $M_{\rm P}$ with a closest approach pericenter distance given by b, that ratio is

$$\frac{F_{\rm ext}}{F_{\rm int}} \propto \left(\frac{M_{\rm P}}{M_{\rm G}}\right) \times \left(\frac{R}{b}\right)^3 . \tag{1}$$

In this expression the masses of the galaxies can be evaluated using the diameters or the luminosities. Actually, since there is a relation between luminosity and size, both parameters should lead to similar results. We preferred to use the magnitudes here instead of the sizes (used for instance by Dahari 1984) since they are known for a larger number of galaxies and are easier to correct. Indeed, it is assumed that M/L is reasonably similar for all the galaxies. Admittedly this is a rough hypothesis but appropriate since the final criteria for isolation we are going to adopt is likely insensitive to the differences in M/L from galaxy to galaxy.

Regarding the pericenter parameter, b, Icke (1985), when studying the influence on the gas in the disk of a galaxy of the flyby of another galaxy, found that the maximum pericenter distance still able to trigger star formation in the gas disk is given by

$$b = \left(4\pi g \frac{v}{s} \mu\right)^{1/3} r \tag{2}$$

where g is a geometrical factor describing the encounter that ranges between 0 and 1, v the gas speed at the distance r of the center of the disk, s the sound speed at the same distance, and μ the ratio of the perturber's mass to the central galaxy mass. The factor in brackets is, at most, of the order of a few, and therefore b is, at most, of the order of or a few times the radius of the perturbed galaxy. Thus, only close encounters could produce important effects in the internal dynamics of the gas in the other system, in agreement with the results by Athanassoula (1984) and Byrd & Howard (1992).

Since the pericenter parameter b cannot be directly estimated, we adopted instead the projected distance $D_{\rm p}$ between the galaxy and the perturber on the plane of the sky at the primary's distance. Thus, the final expression for the perturbation parameter is

$$f = \log\left(\frac{F_{\rm ext}}{F_{\rm int}}\right) = 3 \log\left(\frac{R}{D_{\rm p}}\right) + 0.4 \times (m_{\rm G} - m_{\rm P}) \tag{3}$$

where $m_{\rm G}$ and $m_{\rm P}$ are the apparent magnitudes of the primary and perturber galaxies, respectively.

In fact $D_{\rm p}$ can be greater than the impact parameter, b, depending on the orbit type, the orientation of the line of nodes

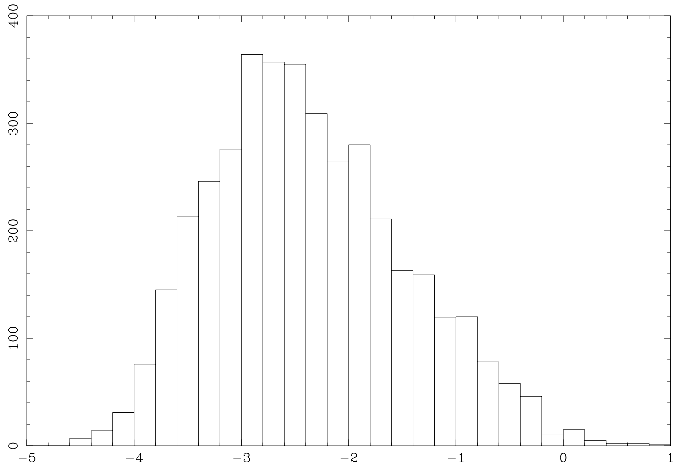

Fig. 1. The distribution of the f-values for galaxies in the Coma Cluster.

with respect to the observer and the position of the perturber on its orbit around the primary, all quantities totally unknown. In those cases a galaxy would be judged more isolated (i.e., smaller f-values) than it really is, which would compromise our selection criterion. The error in f assuming $D_{\rm p}$ instead of b is $3 \times \log\ (D_{\rm p}/b)$. As we will see, given that we are going to make a statistical use of f, and the restrictive limits we impose in order to consider a galaxy as isolated, the adopted criterion is robust enough and only in very extreme (i.e. very improbable) cases, a perturbed system might be considered as isolated.

The theoretical results by Athanassoula (1984), Byrd & Howard (1992) and Icke (1985) consistently show that values of $f \geq -2$ are required to produce sizable effects on a given disk galaxy. However, before fixing the limit f-value to consider a galaxy isolated, we must consider the fact that we are using rather rough estimates for the masses of the galaxies and for the pericenter distance. Thus, systems with f-values now observed to be smaller than −2 could had have presented larger values in the past, depending on the details of the orbit and of the reaction to the interaction.

To evaluate the typical f values existing in well defined galaxy aggregates, we studied their distribution for the galaxies of the Coma Cluster. As far as it can be considered to be in a stationary state, the range of f-values we find at a given moment should be statistically representative of the values it can have over time, and it would be possible to extract conclusions that are valid for the whole duration of the stationary state. Therefore we took data from Godwin et al. (1983), and considered all the galaxies in Coma with photometry in the B and R bands, a total of 4075 objects. They cover a wide range of magnitude and size. The distribution of the f-parameter values is presented in Fig. 1. The median value of the distribution is −2.7 and, as it can be seen in the figure, there are no galaxies with $f < -4.5$.

In view of these results for Coma, it seems safe to adopt the formal criterion $f \leq -4.5$ to select what we will call isolated galaxies.

From the preceding considerations it is clear that the f cut-off value is probably too strict for situations where a candidate galaxy has only a few possible companions at most. Thus it is robust enough to cope with probable errors in the different observable parameters entering the definition and ensure that all the selected objects are actually isolated. From expression (3), it is simple to verify that errors of 20% in size and/or luminosity translate into errors of only a few tenths in f at most, still very far from critical values. Similarly, even a ratio between the projected distance and the pericenter distance as large as $D_{\rm P}/b = 3$ would produce an f-value greater than the *true* value by 1.4 units, still far from critical values. Only for very eccentric orbits, and when the perturber is around the apocenter, our criterion would fail and could select *false* isolated galaxies.

Another aspect to consider is the possibility of inducing biases in the family of the selected objects, given the dependency of f on the luminosity and size. A galaxy might have a different probability of being taken as isolated for a fixed population of possible companions. However, given a direct relation between size and luminosity, we expect only a small net effect on f. Thus, considering $L \propto R^2$, the difference in the f-values produced by a given perturber on galaxies with luminosities of the ratio 1/1.5 would amount to only 0.17, well inside the uncertainties in M/L or any other parameter, and unable to approach critical values.

Given the preceding considerations we do not expect strong biases in the family of selected isolated galaxies.

2.1. Comparison with previous criteria

Karachentseva (1973) considered a galaxy of diameter $d_{\rm i}$ as isolated when there were no companions with size, $d_{\rm c}$, between 1/4 and $4 \times d_{\rm i}$, within $20 \times d_{\rm c}$. To compare this with our criteria we have to assume that the luminosity is proportional to some power of the size, say $L \propto R^2$. It is easy to verify that both criteria are similar. However, Karachentseva's criterion does not exclude the possibility of small, faint perturbers that could have some effect if they are close enough to the primary galaxy.

Márquez & Moles (1996) defined a galaxy as isolated if there are no companions within a projected radius of 0.5 Mpc, and with a relative redshift less than 500 km s^{-1}. They also made a visual inspection of the POSS images to search for faint companions. Applying the f-value criterion to their data, we find that over 90% of the galaxies considered isolated by Márquez & Moles (1996) are also isolated using our criterion.

Vettolani et al. (1986) considered as isolated the galaxies without companions with $m \leq 14.5$, within a radius that varies with the distance to the galaxy to keep constant the probability of finding a galaxy in a given volume. The work was complemented with a search for fainter companions in the POSS plates, without a clearly stated objective criterion. We found that 15 out of the 43 galaxies in their sample have faint companions. We applied our f-parameter selection method to the other 28 galaxies, to find that only 2 of them would be considered as isolated with our criterion. This is a clear illustration of the problems that can be encountered when the difference between field and isolated galaxies is not clearly stated.

3. The selection process

The starting point of our search was the CfA catalog of galaxies (Huchra et al. 2000). Our aim was to build a volume-limited, statistically meaningful sample of isolated spiral galaxies. To that end we first selected all the galaxies classified as disk galaxies (Spiral and Lenticular), with $cz \leq 5000$ km s^{-1}. Only objects at high galactic latitudes, $|b| \geq 40°$, were retained, to avoid problems with the extinction correction. Finally we considered only objects with declinations north of $-2.5°$. 1706 galaxies satisfy all these conditions. The properties of these galaxies were extracted from the LEDA database (Paturel et al. 1997). The distances were calculated using the LEDA kinematical distance modulus, corrected for extinction and Virgocentric flow.

Each galaxy was then searched for companions in the same LEDA catalog, complete to $m = 18$. The identification of the CfA objects with LEDA objects is not always straightforward since offsets in the coordinates up to $1'$ are not infrequent. When there was a possibility of misidentification we decided after visual inspection. Once all the CfA objects were identified in LEDA, we started the search for companions. The searching field was limited to that defined by the maximum distance at which a bright (massive) galaxy with $M = -23$ would produce a value of $f = -4.5$. Special care was taken to avoid confusion with extended objects that are not galaxies, and with double or distorted star images that were taken as galaxies in the preliminary version of the catalog we used.

We also imposed two more restrictions, on size and luminosity, to eliminate as many background objects as possible. The suspected companions were retained only if, at the distance of the parent galaxy, they would be larger than 2 kpc in diameter, and brighter than $M_{\rm P} = -12$. For some faint galaxies present in the search field no magnitudes were listed in the LEDA catalog. In these cases we calculated the apparent magnitude that those objects would have to produce $f = -4.5$, and we compared it with the estimation from visual inspection. Only companions found brighter than that value were retained. Using those restrictions we could reject most of the possible companions. For the doubtful cases the central galaxy was taken as perturbed. In a final step we discarded all the companions for which the (known) redshift is different from that of the primary galaxy by more than 500 km s^{-1}. The f values for all the possible perturbers within the search volume were computed, and only those with $f > -4.5$ and satisfying the conditions on size and luminosity were finally taken as possible perturbers. The above selection process reduced the list of candidate galaxies to 329.

We then examined the DSS data looking for the presence of possible perturbers with $m_{\rm P} < 18$. The process was only applied to the volume where those faint galaxies would still produce $f \geq -4.5$. The size and magnitude of all the possible perturbers were measured, and the size and luminosity criteria applied. More than 100 galaxies were found to have companions. At the end of the process a list of 203 isolated S and S0 galaxies was produced. This represents less than 12% of the initial sample. We insist that the list is not complete since all the galaxies with faint companions ($m_{\rm P} < 18$ and $f \geq -4.5$) without known redshift were discarded. Besides that catalogue of isolated galaxies we selected another sample of non-isolated galaxies containing systems having companions with $f > -2$, and $\Delta z < 500$ km s^{-1}. A total of 130 objects were extracted from the original sample. This sample will be used as a comparison for the properties of isolated galaxies. In the text, we shall refer to this sample as *perturbed* galaxies.

4. Properties of disk isolated and perturbed galaxies

The database we used for the properties of the galaxies is the LEDA Catalogue. The identification and main properties of the isolated and perturbed galaxies are presented in Tables 1 and 2[1] respectively.

The data presented in these tables have been extracted from various sources, as described in the following. To standardize the information contained in our catalogue we extracted from the LEDA (Paturel et al. 1997) catalogue for each galaxy: PGC number, morphological type code t, the geometrical parameters at the 25 mag arcsec^2 isophote log D_{25} and log r_{25}, the corrected colors $(U - B)_0$ and $(B - V)_0$. the mean surface brightness at the same isophote μ_{25}, the kinematical parameters W_{20} (the 21-cm line width at 20% of the peak), log σ (velocity dispersion), log $v_{\rm m}$ (the maximun rotational velocity), the redshift cz, the kinematic distance modulus $(m - M)_{\rm cin}$, the blue corrected absolute magnitude $M_{\rm B}$, the far infrared magnitude $m_{\rm FIR}$ and the 21-cm line magnitude m_{21}. The distance moduli are mainly derived from redshifts, corrected for Virgocentric inflow and adopting $H_0 = 70$ km s^{-1} Mpc^{-1}. When redshift was not available, we used the photometric distance modulus, if present in LEDA. The absolute values were calculated using these distance moduli. The entry coded as FIR-B in Table 1 corresponds to $M_{\rm FIR} - M_{\rm B}$.

Information lacking in LEDA for some galaxies was completed using the ADS bibliographic archive, the NED database or the SIMBAD service of the Strasbourg Centre of Données Stellaires (CDS), as indicated in the references of Table 1. They are:

1) the HI masses in solar units, calculated from m_{21}, with the expression:

$$\mathrm{Log}\, M_{\rm HI} = 5.37 - 0.4(m_{21\rm c} - 17.4) + 2\,\mathrm{Log}\, d$$

or calculated from 21-cm fluxes S_{21}, in Jy km s^{-1}, by the formula:

$$\mathrm{Log}\, M_{\rm HI} = 5.37 + \mathrm{Log}\, S_{21} + 2\,\mathrm{Log}\, d;$$

2) the molecular gas masses in solar units from CO(1–0) line fluxes ($S_{\rm CO}$ in Jy km s^{-1}) by the formula:

$$\mathrm{Log}\, M_{\rm mol} = 4.17 + 2\,\mathrm{Log}\, d + \mathrm{Log}\, S_{\rm CO}$$

that implicitly assumes a constant CO/H$_2$ conversion factor $\chi = N(\mathrm{H}_2)/I_{\rm CO} = 2.3 \times 10^{20}$ mol/K km s^{-1} (Strong 1988); $M_{\rm mol}$ includes the helium mass fraction, equal to 36% of the H$_2$ mass.

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[1] Only available in electronic form at `http://www.edpsciences.org`.

Table 3. Comparison of the main properties of Isolated (Is) and Perturbed (Pt) galaxies. The statistical parameter z from the U-test is given in the third column. In the last three columns we give the median values for the three morphological bins defined in the text. The first row contains the results for the morphological types, the numbers in parentheses corresponding to the number of galaxies used in the comparison. The second row gives the fraction of galaxies with bars. The other rows correspond to the other properties we considered.

	Status	z-value	S0	Early Sp	Late Sp
Type	Is (196)	2.79	21.4%	36.7%	41.8%
	Pt (129)		31.0%	43.4%	25.6%
Bars	Is (64)	–	15.7%	34.9%	38.2%
	Pt (66)		39.2%	71.1%	41.2%
M_B	Is (203)	4.74	−17.88 (42)	−19.55 (72)	−19.27 (89)
	Pt (130)		−19.60 (40)	−19.90 (56)	−19.73 (34)
$\log D_{25}$	Is (203)	6.05	0.90 (42)	1.21 (72)	1.20 (89)
	Pt (130)		1.28 (40)	1.38 (56)	1.35 (34)
$(U-B)$	Is (45)	3.84	0.22 (11)	0.03 (19)	−0.12 (15)
	Pt (67)		0.40 (26)	0.15 (27)	−0.07 (14)
$(B-V)$	Is (58)	3.69	0.76 (11)	0.66 (19)	0.51 (28)
	Pt (78)		0.85 (29)	0.68 (31)	0.53 (18)
μ_{25}	Is (203)	2.73	23.29 (42)	23.04 (72)	23.39 (89)
	Pt (130)		23.50 (40)	23.38 (56)	23.38 (34)
$\log v_m$	Is (149)	3.99	1.87 (13)	2.20 (55)	2.09 (81)
	Pt (94)		2.21 (15)	2.31 (48)	2.13 (31)
$\log \sigma$	Is (23)	3.15	2.06 (10)	2.23 (6)	1.99 (7)
	Pt (46)		2.25 (26)	2.18 (16)	2.05 (4)
W_{20}	Is (139)	5.09	164 (13)	290 (53)	240 (73)
	Pt (87)		327 (14)	386 (45)	264 (28)
$M_{FIR} - M_B$	Is (104)	3.02	−0.80 (11)	−0.80 (45)	−0.31 (48)
	Pt (44)		−1.06 (1)	−0.34 (27)	−0.25 (16)
$\log (M_{HI}/L_B)$	Is (151)	0.91	−0.74 (14)	−0.67 (55)	−0.46 (82)
	Pt (93)		−1.17 (15)	−0.66 (47)	−0.38 (31)
$\log (M_{mol}/L_B)$	Is (21)	2.61	−0.89 (2)	−0.64 (5)	−1.15 (14)
	Pt (20)		–	−0.62 (13)	−0.62 (7)

When only mass values were available in the references, they were scaled to the distances assumed here. When data for a single galaxy were available in several catalogues, we compared the mass values producing a weighted mean value. When both upper limits and detections were available, only detections were used to compute mean values. Moreover, when several upper limits were available, only the lowest value was adopted. All the above mass data were normalized by the total blue luminosity in solar units, calculated from M_B.

4.1. Main properties of the samples

The first aspect we considered was the distribution of the galaxies in both samples by morphological types (Fig. 2). The differences between the isolated and perturbed galaxy distributions are apparent. Given the clear non-normality of the distributions, we applied the Mann-Whitney U-test. The results indicate that the two distributions are different with a significance level >99.5%. The largest differences are found for Sc galaxies, that are more abundant among isolated galaxies (in agreement with earlier results by Márquez 1994; Márquez & Moles 1996; Márquez et al. 1999), and for S0 galaxies, that are more abundant among perturbed galaxies (see also Table 3).

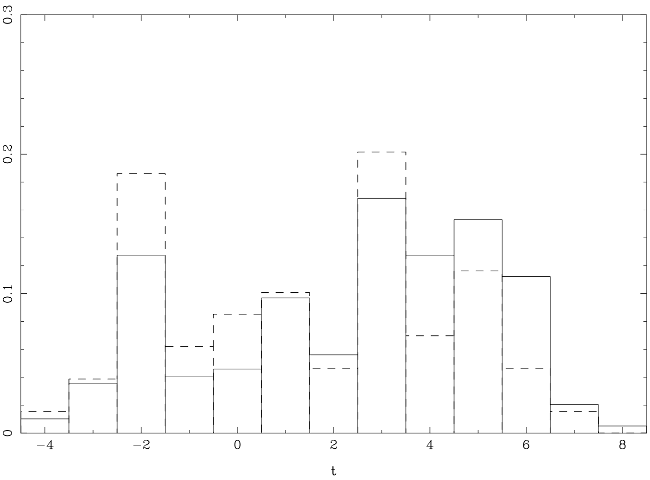

Fig. 2. The normalized distributions of morphological types for Isolated (solid line) and Perturbed (dashed line) galaxies.

To compare all the other properties of isolated and perturbed galaxies we grouped them into three morphological categories, S0 ($-4.5 < t \leq -0.5$), early Sp ($-0.5 < t \leq 3.5$) and late Sp ($t > 3.5$).

It appears that barred galaxies are far more abundant (about twice) among perturbed galaxies. The difference is very marked for Lenticular and early Sp types, whereas there is no difference for late Sp galaxies (see Table 3). We also compared all the other catalogued properties of the two samples. The differences were tested with the Mann-Whitney U-test. We found that the two samples are different at a highly significant level (>99.5%) in all the main catalogued properties, including the absolute blue magnitude, $M_{\rm B}$, the infrared luminosity normalized to the B luminosity, $M_{\rm FIR} - M_{\rm B}$, the size, D_{25}, the color indexes $(U - B)$ and $(B - V)$, the mean surface brightness within the isophote 25, μ_{25}, the maximum velocity rotation of the gas, $v_{\rm m}$, the stellar central velocity dispersion, σ, and the 21-cm line width at 20% of the peak, W_{20}. In Table 3 we give the median values of those properties for the different families.

The only property that appears to be similar for both samples is the amount of atomic gas as measured by log $(M_{\rm HI}/L_{\rm B})$. Looking at the different morphological bin there is a hint of a possible difference for lenticular galaxies.

It can be seen that the isolated galaxies are smaller, less luminous and bluer than the perturbed systems. We also notice the consistency of the results regarding the dynamical variables. $V_{\rm max}$, σ and W_{20} are smaller for the isolated galaxies. They also present lower FIR luminosity and molecular gas content. Notice that the same trend is seen in all the morphological bins we considered, even if the largest and more significant differences are found in most cases for the lenticular and early Sp galaxies.

Since the content of molecular gas is not given in LEDA we searched the literature using the same references and approach as Bettoni et al. (2003, the references are given in the Notes of Tables 1 and 2). We found data for only 21 isolated and 20 perturbed galaxies. We found that the perturbed galaxies have higher $M_{\rm mol}/L_{\rm B}$ values, the difference being statistically significant at >99.5%. Notice that the difference arise only in the late SP morphological bin.

We analyzed the relation between global structural parameters. We found that both families satisfy the same Luminosity-Size relation (Fig. 3). We notice the almost absence of bright and large isolated galaxies, together with the almost absence of small and faint perturbed galaxies. This tendency cannot be due to the selection criteria, based on f values, and depending on sizes and luminosity as in Eq. (3). More massive and less extended systems are less subject to perturbations by the surrounding galaxies. One may expect that galaxies selected on the basis of a lower f could be biased toward smaller but brighter systems. On the contrary, isolated galaxies in our sample appear smaller, i.e. producing smaller f-values, but fainter, i.e. producing higher f-values.

In Fig. 4 we present the M versus L relation. The masses have been estimated using a central, point-like mass model, with $M(M_\odot) = 2.3265 \times v^2 R_{25}$ (v, from LEDA, in km s^{-1} and R_{25} in kpc). It can be seen in the figure that both families, isolated and perturbed galaxies, define very approximately the same relation, and share an important region in the diagram. The differences arise because there are no isolated galaxies with high mass (and luminosity), whereas there are no perturbed galaxies with low mass (and luminosity).

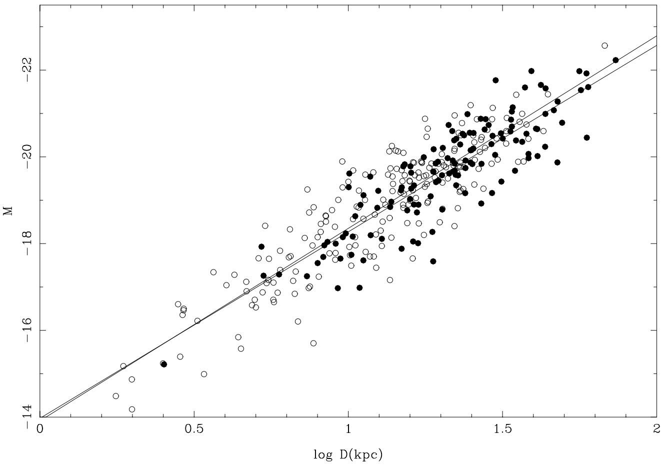

Fig. 3. The luminosity-size relation for Isolated (empty circles) and Perturbed (filled circles) galaxies. The lines are the best fit to the two families.

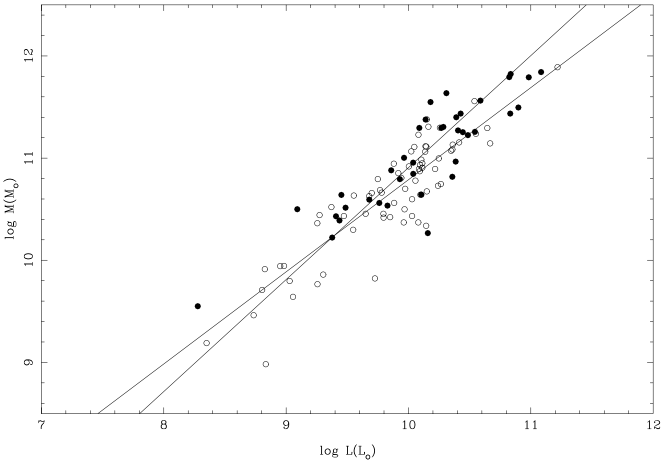

Fig. 4. The mass-luminosity relation for Isolated and Perturbed galaxies. Same symbols as in Fig. 3. The rotation velocity was corrected for inclination. Only galaxies not later than Scd, with inclinations between 40 and 70 degrees have been plotted. The lines are the fits to both families.

The Tully-Fisher relation for S galaxies in both samples is presented in Fig. 5. Even if both families follow the standard TF relation (Tully & Pierce 2000), the scatter is important and no conclusion about possible differences can be extracted before more homogeneous and accurate data are available. Apparently the presence of bars does not have any influence on the position of a galaxy in the T-F diagram, in agreement with the results reported by Courteau et al. (2003).

5. Conclusions

We used a well-defined, physically meaningful criterion to define isolated galaxies. We performed a search for isolated galaxies using as the parameter the logarithmic ratio f between the internal and tidal forces at the outskirts of a given galaxy. The adopted limit, $f < -4.5$, was checked with results from numerical simulations (Byrd & Howard 1992), and with data from the Coma Cluster. Similarly, a sample of *perturbed*

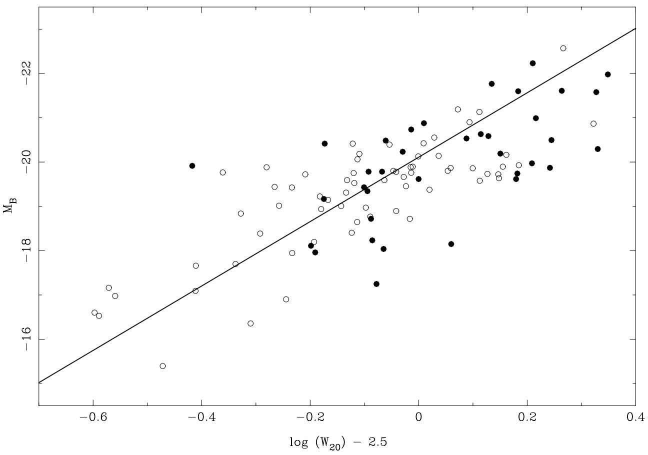

Fig. 5. The Tully-Fisher relation for Isolated and Perturbed galaxies. Same symbols and galaxies as in Fig. 4. The line represents the fit to the T-F relation as given by Tully & Pierce (2002).

galaxies was defined comprising galaxies with confirmed companions satisfying $f \geq -2$.

Comparison of the properties of the galaxies in both samples was made using the Mann-Whitney U-test. The first result to notice is the significant differences in morphological types, with Sc types being more abundant among isolated galaxies, whereas S0 galaxies are significantly more abundant among perturbed systems. We also found that barred galaxies are more frequent (about twice) among perturbed than among isolated galaxies except for late type Spiral galaxies.

They also differ in all the properties we have examined, except in atomic gas content, with similar values of the ratio $M_{\rm HI}/L_{\rm B}$. The isolated galaxies appear to be smaller and fainter, with bluer color indices. They also have less molecular gas and smaller FIR luminosity per unit of blue luminosity. The dynamical parameters are also consistently smaller for isolated galaxies. Even if the differences are appreciable for all the families (S0, early Sp and late Sp), the biggest differences are for S0 and early Sp. The exception is in molecular gas content, for which the maximum difference is found for late-type Sp galaxies.

The *M*-*L* and *M*-size relations consistently show the absence of large, luminous and massive systems among the isolated galaxies. Moreover, we also found the almost complete absence of perturbed systems with small sizes, low luminosities and low masses. We also found that barred galaxies do not occupy a particular region of the T-F diagram.

In view of these results it is tempting to consider the differences as arising from the different evolutionary conditions. Our results indicate that the gravitational interaction in aggregates would produce evolution from late Spiral, relatively faint and low mass galaxies, toward earlier more luminous and massive Spiral and Lenticular types. This would also favor the formation of bars in early-type Spirals and Lenticulars. However, the relations between global parameters are similar for both families, even if they tend to occupy different regions in the corresponding plots (see Figs. 2–4)

Since the isolated galaxies would not have had the opportunity to accrete other systems and grow in the way the hierarchical models predict, they would still be similar today to the high redshift systems supposed to be the *building blocks* for the formation of larger galaxies. This view is consistent with the results reported by Ferguson et al. (2003) showing that the sizes of galaxies at $z \approx 4$ are smaller than nearby luminous galaxies. If, as it is generally assumed, cannibalism and accretion in the early phases of galaxy evolution are important to fix the final global properties such as size, luminosity and mass, then present day isolated galaxies would be the left-over fragments in that early process of galaxy formation.

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Online Material

Table 1. Main properties of the Isolated galaxies. All the propertis were extracted from LEDA except the molecular gas content.

PGC	t	$\log D_{25}$ (0′.1)	$\log r_{25}$ (0′.1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (mag/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_\mathrm{m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_\mathrm{cin}$	M_B	FIR-B	$\log \frac{M_\mathrm{HI}}{L_\mathrm{B}}$	$\log \frac{M_\mathrm{mol}}{L_\mathrm{B}}$	Ref.	Notes
218	2.0	1.75	0.33	0.40	0.88	23.68	460	2.23	2.38	1053	31.01	−19.93		−1.04	<−1.11	b, d	
1525	5.9	1.73	0.93	−0.15	0.41	24.49	221		1.99	842	30.54	−18.49		0.02		d	
2600	5.3	1.20	0.07			23.29			2.24	4452	34.04	−20.87	−1.51	−0.79		d	
3043		0.87	0.22			23.44	192		1.98	1623	31.77	−16.58		0.46		d	
3763	2.2	0.94	0.31			22.91	181		1.93	4668	34.15	−19.88	−2.56	−0.77		d	
4785	−0.1	1.29	0.22	0.06	0.66	23.47	244		2.08	2133	32.46	−19.55	0.03	−0.83		c, d	
4948	4.1	1.24	0.67			23.23	381		2.23	2509	32.81	−19.85	−2.08	−0.21		d	
5139	5.3	1.56	0.08		0.52	23.72	266		2.30	2469	32.75	−20.75	0.72	−0.57		d	
5194	5.7	1.18	0.82			24.13	161		1.81	2415	32.72	−18.47		−0.09		d	
5232	−2.0	1.18	0.35			24.49				1930	32.20	−17.70					
5321	5.9	1.07	0.16			23.28	262		2.18	4129	33.87	−20.06		−0.76		d	
5634	5.3	1.20	0.04			23.80	153		2.17	3148	33.30	−19.50		−0.47		d	
5643	3.0	1.41	0.73			24.23	395		2.26	2805	33.04	−19.94	−0.60	−0.51		d	
5998	5.9	0.88	0.18			22.10	212		2.07	3183	33.27	−19.43		−0.85		d	
6275	3.1	1.39	0.24	−0.18	0.55	23.57	322		2.23	2987	33.16	−20.42	−0.41	−0.27		d	
6656	0.0	1.58	0.53			24.21	397		2.26	1508	31.63	−19.26		−0.41		c, d	
6893	5.4	1.06	0.19			24.11	250		2.13	4701	34.15	−19.31		0.12		d	
6897	4.6	1.23	0.09	−0.04	0.59	22.97	313		2.35	4984	34.25	−21.43	−1.17	−0.97		d	
6993	1.1	1.37	0.04	0.33	0.83	23.10	124	2.13	2.10	1728	31.92	−19.58	1.28	−2.58		d, e	
7577	3.7	1.18	0.63			22.37				3486	33.49	−20.95					
7826	5.4	0.96	0.04			23.76	96		1.97	2379	32.69	−17.79		0.11		d	
7952	6.6	1.21	0.06			24.57			1.96	3410	33.42	−18.82		0.13		d	
8109		0.93	0.35			23.50	248		2.06	4516	34.06	−19.23	−1.79	−0.36		d	
8163	3.3	0.99	0.32			22.31				4410	34.00	−20.65	−0.79			d	
8165	3.0	1.13	0.25			22.47	363		2.29	4419	34.01	−21.19	−0.55	−0.61		d	
9126	6.5	1.20	0.14			23.45	118		1.83	1385	31.36	−17.78		−0.86		d	
9988	1.0	1.38	0.05			24.27	181		2.19	2630	32.81	−19.36		−0.17		d	
10 789	−1.8	1.00	0.39			22.08				2596	32.78	−19.69					
10 815	6.5	1.16	0.33			23.76			2.17	4502	34.01	−20.12		−0.38		d	
10 942	3.0	1.25	0.24			23.77	290		2.18	3040	33.15	−19.80	−0.83	−0.11		d	

Table 1. continued.

PGC	t	$\log D_{25}$ $(0'.1)$	$\log r_{25}$ $(0'.1)$	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_\mathrm{m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_\mathrm{cin}$	M_B	FIR-B	$\log \frac{M_\mathrm{HI}}{L_\mathrm{B}}$	$\log \frac{M_\mathrm{mol}}{L_\mathrm{B}}$	Ref.	Notes
25 467	0.1	1.04	0.28			23.05				2992	33.22	–19.21	–0.31			d	
25 985	2.2	0.89	0.22			23.45				1934	32.33	–17.14					
26 218	–2.0	1.14	0.27			23.65				1660	31.98	–17.93	–0.95			c, d	
26 512	3.0	1.88	0.32	0.27	0.79	22.64	607	2.33	2.50	638	30.38	–20.87	1.36	–0.87	–0.94	b, d	CR
26 690	4.1	1.41	0.69			23.23	601		2.46	4097	33.89	–21.45		–0.37		d	
26 979	0.5	1.03	0.07	–0.08	0.62	22.88	172		1.98	1697	32.06	–18.15	–1.70	–0.57		d	
27 077	4.0	2.10	0.36	–0.02	0.57	23.16	384	2.01	2.37	556	29.76	–20.90	–0.24	–0.94	–1.02	b, d, f	
27 157	–1.0	0.64	0.15			22.32				1473	31.80	–16.50					
27 311	2.8	0.89	0.43			23.50				1654	32.00	–16.71					
27 437	1.1	1.14	0.31			23.62	308		2.18	4060	33.87	–19.76		–0.51		d	
27 518	4.0	1.15	0.23			22.81	390		2.34	4981	34.26	–21.13	–0.46	–0.79		d	
27 792	4.3	1.00	0.09			23.29			1.97	1466	31.83	–17.36		0.09		d	
27 796	3.1	1.24	0.46			23.45			2.34	4940	34.28	–20.81	–0.05	–0.44		d	
27 968	6.5	1.10	0.30			24.89	191		1.95	3088	33.22	–17.66		0.42		d	
28 145	1.5	0.94	0.47			22.76				4679	34.19	–19.86	–1.90			d	
28 259	–1.7	0.92	0.07			23.21	198		2.14	1524	31.86	–17.10		–1.11		d	CR
28 401	3.6	1.13	0.04			23.75	60		1.55	3365	33.56	–19.88	–0.48	–0.41		d	
28 424	–1.9	1.25	0.04	0.09	0.63	23.29	241	1.91	2.28	1538	31.86	–18.67	–0.81	–1.43	–0.75	b, c, d, e	
28 485	5.3	1.57	0.19		0.69	23.54	294		2.19	1412	31.60	–19.78	0.38	–0.73		d	
28 672	3.1	1.24	0.50			22.45	312		2.12	2986	33.31	–20.78	0.12	–1.14		d	
28 758	0.8	0.84	0.22			22.91	202		1.93	1486	31.82	–16.90		–0.24		d	
29 009	1.1	1.25	0.15			23.11	261		2.18	2406	32.73	–19.75	–2.31	–0.63		d	
29 177	–3.1	0.74	0.07	–0.27	0.53	22.25				2605	33.04	–18.33	–1.68	–0.27		d	
29 198		0.63	0.19			23.15				1112	31.02	–14.87					
29 347	–2.4	0.82	0.03	–0.14	0.39	22.54	115		2.03	1362	31.62	–17.04		–0.97		d	
29 715	3.0	1.26	0.46			24.52	442		2.33	4754	34.21	–19.89	–0.95	0.01		d	
30 010	3.0	1.19	0.12	0.03	0.59	22.47	276		2.19	1308	31.49	–18.77	–2.03	–1.06		d	
30 197	5.2	1.89	0.48	–0.12	0.43	23.39	322	1.81	2.19	663	30.43	–20.21	0.69	–0.37		d	
30 310	4.0	0.92	0.13			24.18			1.93	2906	33.12	–17.49		0.13		d	
30 569	5.9	1.27	0.32			23.73	259		2.11	2127	32.64	–18.97	–0.31	–0.09		d	
30 858	4.5	0.90	0.15			23.59				2502	32.96	–17.63					
30 895	4.0	1.63	0.40	0.01	0.58	23.82	431	2.06	2.31	1352	31.62	–19.73		–0.44		d	
31 304	–0.9	1.08	0.11			22.89				957	30.63	–17.12					

Table 1. continued.

PGC	t	$\log D_{25}$ (0.′1)	$\log r_{25}$ (0.′1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_{\rm m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_{\rm cin}$	$\rm M_B$	FIR-B	$\log \frac{M_{\rm HI}}{L_{\rm B}}$	$\log \frac{M_{\rm mol}}{L_{\rm B}}$	Ref.	Notes
31 472	–1.9	1.21	0.28			23.42		2.20		3054	33.24	–19.76		<–1.57		c, e	
31 601		0.65	0.00			21.95	118			1699	32.22	–17.34		–0.61		d	
31 650	4.0	1.44	0.02	–0.45	0.32	21.98	233	2.05	2.24	988	31.19	–20.25	–1.45	–0.63	–1.50	b, d, g	ARP217
31 883	5.1	1.61	0.22	–0.07	0.51	23.47	352		2.26	1301	31.44	–19.87	0.08	–0.13	–1.11	b, d	
31 945	–2.0	1.11	0.49	–0.14	0.60	23.86	121		1.63	1321	31.52	–17.01	–0.80	–0.53		d	
32 183	5.2	1.86	0.20	–0.24	0.41	23.92	255		2.14	1012	31.28	–20.42	0.40	–0.18	–1.21	b, d	
32 364	0.1	0.98	0.36			22.43	167		1.82	712	30.12	–16.36		–0.81		d	
32 543	–1.8	1.26	0.36			22.98	186		1.86	646	30.27	–17.39	0.21	–0.20	<–0.82	b, c, d	
32 719	4.0	1.48	0.38			23.54	298		2.15	1258	31.70	–19.66	0.56	–0.32		d	
33 140	3.1	1.37	0.03			23.18	142		2.16	1434	31.66	–19.18		0.07		d	
33 375	0.0	0.87	0.06			22.53				1549	32.03	–17.65					
33 604	0.1	1.16	0.52			22.41				1344	31.50	–18.63					
33 726		0.98	0.07			23.61	100		1.84	1228	31.59	–16.65		0.23		d, g	
34 353	1.1	1.56	0.59			24.91	214		1.95	719	30.57	–17.16	–0.60	0.57		d	
34 692	4.4	1.07	0.40		0.39	22.01	158		1.83	1314	31.76	–18.84	–0.04	–0.56		d	
34 767	5.2	1.69	0.08		0.54	23.11	124		1.92	1159	31.49	–20.62	–0.17	–0.68	–0.55	b, d	ARP27
34 836	4.6	1.57	0.28	–0.10	0.55	23.08	532		2.54	4256	33.97	–22.57		–0.72		d	
34 908	–2.0	1.08	0.21			23.19				2050	32.52	–18.57				c	
34 935	4.9	1.17	0.18	0.01	0.58	21.51	310		2.26	1480	31.75	–19.89	–1.07	–0.99		d	
34 967	7.8	0.95	0.53			22.13	269		2.06	2607	32.86	–19.30	–0.75	–0.45		d	
35 025	4.7	1.17	0.24			22.71	242		2.09	1570	32.10	–19.01	0.11	–1.00		d	
35 164	3.0	1.80	0.25			23.30	429	2.08	2.37	767	30.70	–20.16		–0.87	–0.64	b, d	
35 225		1.04	0.38			23.43			1.30	1039	30.96	–16.71		–0.80		d	
35 266	0.0	1.25	0.17	0.01	0.71	23.16	295		2.21	1512	32.02	–18.90	–1.46	–1.17		c, d	
35 314	3.1	1.50	0.66			22.77	404		2.28	1724	32.02	–20.50	1.22	–0.82		d	
35 440	2.4	1.66	0.39	0.04	0.67	23.30	354		2.23	1017	30.92	–19.80	0.35	–0.63		d	
35 608	2.1	1.22	0.38			23.33	223		1.99	1913	32.48	–19.15	–0.06	–1.00		d	
35 676	5.1	1.78	0.17		0.44	23.22	288	1.86	2.16	857	30.92	–20.39	0.81	–0.53	–0.95	b, d	
35 955	–2.0	1.06	0.02			22.68				1269	31.68	–18.13				c	
36 037	–3.3	0.99	0.00			22.88				1337	31.78	–17.71				c	
36 043	–2.0	1.08	0.10			23.28	146		1.87	976	30.87	–16.88	–1.14	–0.80		c, d	
36 211	–3.8	0.86	0.28			23.61	164		1.81	1837	32.26	–16.87		–0.10		d	
36 215	3.8	1.11	0.15			22.55				1255	31.66	–18.46					

Table 1. continued.

PGC	t	$\log D_{25}$ (0.′1)	$\log r_{25}$ (0.′1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_{\rm m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_{\rm cin}$	$M_{\rm B}$	FIR-B	$\log \frac{M_{\rm HI}}{L_{\rm B}}$	$\log \frac{M_{\rm mol}}{L_{\rm B}}$	Ref.	Notes
36 266	3.3	1.30	0.29	–0.14	0.50	21.99	316		2.20	1466	31.85	–20.13		–0.67		d	
36 686	–2.0	1.02	0.09	–0.24	0.43	22.37	123		1.83	755	30.73	–17.28	–0.56	–0.67		c, d	
36 776	3.2	1.01	0.00			22.79	172		3.10	3572	33.69	–19.88		–1.13		d	
36 930	5.8	1.42	0.78			23.83	177		1.86	848	30.86	–17.81		–0.24		d	
37 213	5.0	0.82	0.10		0.20	22.35			1.68	1055	30.90	–16.46		–0.29		d	
37 235	–2.0	1.55	0.15	0.41	0.87	22.71	258	2.12	2.13	921	30.99	–19.87		–1.40		d, e	CR
37 244	–3.1	1.05	0.13			23.49		2.05		3650	33.67	–19.31					
37 290	4.0	1.43	0.23		0.38	22.15	281		2.13	800	30.82	–19.59	–0.78	–0.72	–1.18	b, d	
37 352	7.1	1.20	0.50			23.00	246		2.02	2384	32.67	–19.43		–0.50		d	
37 444	5.9	1.40	0.06			24.23	187		2.20	1892	32.19	–18.80		–0.10		d	
37 574	–2.0	1.02	0.10			23.61				3309	33.48	–18.82					
37 584	6.7	1.52	0.08			24.09	132		1.96	778	30.78	–18.14		–0.16		d	
37 795	–2.4	0.90	0.00			22.90				3139	33.37	–18.83					
37 838	4.3	0.94	0.33			23.32	121		1.71	622	30.25	–15.39		–0.43		d	
37 928	3.1	1.40	0.04			23.70	95		1.86	932	30.81	–17.96	0.75	–1.05		d	
38 068	4.0	1.71	0.06		0.62	23.09	284	1.94	2.39	710	30.60	–19.84	–0.07	–0.86	–0.85	b, d	
38 150	5.3	1.61	0.39	–0.03	0.66	22.99	301	1.99	2.18	769	30.63	–19.45	0.46	–0.97	–1.20	d, f	
38 277	1.3	0.78	0.07			22.68	175		2.11	581	30.13	–15.17		–0.70		d	
38 286	2.5	0.79	0.26			23.22				538	29.97	–14.49					
38 392	3.0	1.49	0.25			22.81	328		2.23	843	30.94	–19.38	–2.52	–1.20	–0.57	b, d	
38 527	–1.3	1.50	0.25	0.22	0.76	23.64		1.70		1656	31.96	–19.64		<–2.15		c, d, e	
38 582	2.0	1.06	0.19			23.03	153		1.89	946	31.08	–17.09		–1.16		d	
38 800	–1.7	0.82	0.05			22.94				1078	31.12	–16.22					
38 802	3.0	1.25	0.09			23.28	315		2.36	2460	32.83	–19.66	–0.14	–0.61	–0.91	a, d, e	
38 964	2.1	1.19	0.46			22.37	416		2.30	2083	32.43	–19.73	–1.26	–1.24		d	
39 251	–0.8	1.28	0.40	0.30	0.85	23.06				2072	32.41	–19.52		<–1.60		c, e	
39 393	4.0	1.32	0.19		0.80	22.51	259		2.16	864	30.69	–18.65	–0.34	–1.37	–1.30	b, d	
39 483	5.5	1.18	0.13		0.63	23.47	127		1.86	733	30.27	–16.53		–0.37		d	
39 525	1.0	0.95	0.09	–0.01	0.62	22.34				3875	33.81	–20.09	–1.88			d	
39 681	4.8	1.02	0.19			24.18				925	30.85	–15.57					
40 330	5.0	1.47	0.40			24.48	211		1.97	1248	31.54	–18.20	0.32	–0.13	–1.42	d, f	
40 396	1.0	1.32	0.02	–0.04	0.62	22.82	134		2.19	1028	31.22	–18.85	–1.20	–1.12		c, d	
40 475	1.0	1.11	0.11	–0.28	0.40	22.68	141		1.91	2513	32.98	–19.70	–1.02	–0.82		d	

Table 1. continued.

PGC	t	$\log D_{25}$ (0′.1)	$\log r_{25}$ (0′.1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log\sigma$ (km s^{-1})	$\log v_{\rm m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_{\rm cin}$	$M_{\rm B}$	FIR-B	$\log\frac{M_{\rm HI}}{L_{\rm B}}$	$\log\frac{M_{\rm mol}}{L_{\rm B}}$	Ref.	Notes
40 490	1.0	1.40	0.03	0.43	0.91	23.22	350	2.28	2.64	2551	32.85	–20.46		–0.79		d, e	
40 500	–3.0	1.05	0.00			23.00				1358	31.83	–17.96				c	
40 715	3.2	1.16	0.05			22.67	136		2.05	2295	32.62	–19.55	–1.16	–1.01		d	
40 775	4.7	1.30	0.32			22.51	208		1.98	1689	31.97	–19.72	–0.37	–0.81		d	
41 013	5.9	1.05	0.10			22.68	134		1.91	1702	32.07	–18.51	0.09	–1.06		d	
41 317	5.1	1.33	0.30		0.61	23.06	340		2.23	2443	32.76	–20.14	0.07	–0.66		d	
41 436	1.1	1.21	0.16	–0.10	0.53	22.72	332		2.29	3117	33.41	–20.55	–1.18	–0.96		d	
41 652	–2.9	1.12	0.09			22.63		1.96		979	30.96	–17.84				c	
42 174	1.6	1.30	0.15			22.90	196		2.07	1036	30.97	–18.39	–0.02	–1.89	<−1.38	b, d, a	
42 396	3.4	1.22	0.20			22.43	153		1.89	632	30.12	–17.66	0.47	–0.96		a, d	
42 497	–1.3	0.79	0.24			23.82				718	30.22	–14.18					
42 605	–3.4	0.98	0.32			23.84				1032	31.00	–15.84					
42 833	5.2	1.60	0.18		0.50	22.84	384		2.34	804	30.59	–19.58	0.08	–0.63	–1.07	b, d	ARP189, VV56
43 106	6.0	1.30	0.13			23.90	134		1.89	836	30.55	–16.98		–0.40		d	
43 113	2.6	0.95	0.55			23.11				4671	34.20	–19.58					
43 121	–3.4	0.79	0.15			23.24				830	30.75	–15.24				d	
43 254	1.4	1.58	0.24	0.37	0.83	22.99	417	2.24	2.40	1003	30.94	–19.64		–0.75	<−1.45	a, b, d, e	
43 375	–0.8	1.69	0.49	0.29	0.78	23.95	333		2.20	1324	31.56	–19.84	–0.62	–2.07	–1.03	b, c, d, e	
43 671	–1.6	1.74	0.27	0.36	0.82	23.52	80	2.34	1.48	1395	31.55	–20.59	0.85	–2.68	<−1.63	b, c, d, e, g	
43 931	3.0	1.22	0.15			22.12	308		2.28	862	30.97	–18.72	–1.10	–0.79		d	
44 370	6.2	0.97	0.17	–0.23	0.45	23.41			1.96	2526	32.93	–18.15		–0.53	<−0.10	a, d	
44 797	5.2	1.34	0.02		0.50	22.35	152		2.28	968	30.82	–19.01	–0.62	–0.82		d	
44 961	6.4	1.50	0.77			24.32	168		1.89	669	30.62	–17.44		0.27		d	
45 836	4.4	1.22	0.13			23.34	263		2.21	2612	32.99	–19.53	–0.80	–0.41	–0.86	a, d	
45 879	4.0	1.07	0.68			23.44				3142	33.45	–19.05	–0.84			d	
45 883	3.8	1.47	0.05			24.11	243		2.33	3360	33.47	–20.60	–1.55	–0.27		d	
46 934	3.3	1.31	0.07			23.71	226		2.25	1225	31.59	–18.21	–2.27	–0.30		d	
47 482	3.2	0.99	0.10	0.04	0.69	22.84	298		2.30	4130	33.92	–19.89	–0.25	–1.00		d	
47 577	5.9	1.06	0.17			23.06	121		1.79	1020	31.10	–17.16	–0.43	–0.62		d	
47 938	–1.6	0.90	0.49			24.08	122		1.58	853	30.85	–14.99		0.30		d	
47 985	3.1	1.34	0.65			24.02	257		2.05	1618	32.13	–18.47	–0.80	–0.25		d	
48 425	–2.0	1.07	0.06			23.56		2.17		2957	33.33	–18.99					
48 521	–1.9	1.44	0.10	0.33	0.82	23.47		1.83		1108	31.37	–18.90		<−1.76		c, e	

Table 1. continued.

PGC	t	log D_{25} (0′.1)	log r_{25} (0′.1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	log σ (km s^{-1})	log $v_{\rm m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_{\rm cin}$	$M_{\rm B}$	FIR-B	log $\frac{M_{\rm HI}}{L_{\rm B}}$	log $\frac{M_{\rm mol}}{L_{\rm B}}$	Ref.	Notes
48 959	5.3	1.54	0.19			23.83	231		2.09	1172	31.25	–18.94	0.41	–0.63		d	
49 112	5.2	1.48	0.30			24.27	307		2.19	2614	33.04	–19.89	–0.30	–0.16		d	
49 308	5.1	1.59	0.13			24.20	240		2.16	1382	31.56	–19.22	0.59	–0.43		d	
49 451		0.81	0.25			21.70				1716	32.27	–18.41	–1.68			d	
49 927	–1.0	0.83	0.03			22.78				2684	33.09	–18.27					
49 956	–0.1	1.05	0.15			23.39	346		2.31	3652	33.71	–19.37		–0.07		d	
50 116	3.1	1.03	0.56			22.18				3830	33.81	–20.46					
50 144	–2.0	1.15	0.00			25.31				1224	31.35	–15.70					
50 198	1.3	0.74	0.21			23.00				4334	34.06	–18.57	–1.97			d	
50 479	–1.4	1.19	0.35			23.91				1531	31.78	–17.73					
50 745	1.2	0.99	0.12			21.91				4277	33.99	–20.88	–0.05			d	
50 889	3.1	1.27	0.66			23.26	451		2.31	4574	34.14	–20.99	–0.86	–0.36		d	
51 091	2.8	1.07	0.40			23.28	390		2.28	4280	34.03	–19.86	–0.76	–0.20		d	
51 895	–1.9	1.10	0.38			23.80	238		1.98	1454	31.71	–17.24	–2.87	0.19		c, d	
51 951	0.1	0.60	0.03			21.66				4281	34.03	–19.25	–1.20			d	
52 273	5.4	1.52	0.52			23.02	310		2.15	1753	32.09	–20.50	–0.64	–0.69		d	
52 488	3.0	1.07	0.41			24.16			2.04	4605	34.14	–19.19		–0.22		d	
52 607	5.9	1.18	0.30			22.99	255		2.09	3284	33.53	–20.19	0.18	–1.15		d	
52 636	-3.8	0.90	0.00			23.93				3693	33.72	–18.30					
52 741	–1.9	0.91	0.07			22.90		2.07		1693	32.18	–17.68	–0.42			d	
52 887	3.8	1.17	0.13			24.20	189		2.06	1781	32.18	–17.70		0.00		d	
53 641	2.7	0.90	0.32			22.10	95		1.56	608	30.45	–16.60		–0.40		d	
54 265	0.9	1.12	0.49			23.61	453		2.33	3374	33.59	–19.41		–0.29		d	
54 909	5.9	0.92	0.54			23.80	181		1.88	1830	32.20	–16.84		–0.12		d	
55 419	4.7	1.52	0.16	–0.20	0.46	24.04	215		2.08	655	30.63	–17.95	–0.42	–0.07		d	
55 802	6.0	0.96	0.03			22.27			2.31	2864	33.27	–19.64	–0.63	–0.85		d	
56 108	5.8	1.15	0.73			23.16	345		2.20	4225	33.96	–20.34	–0.06	–0.53		d	
56 334	1.9	1.44	0.14	–0.04	0.59	23.62	178		1.99	1853	32.28	–19.77	0.13	–0.46		d	
56 925	3.2	1.00	0.21			22.30				3370	33.51	–20.13					
57 471	2.0	0.96	0.28			23.57				3904	33.88	–18.90	–1.15			d	
58 115	5.7	1.13	0.18			22.90	201		2.05	2416	32.92	–19.44	–1.28	–0.87		d	
58 183	–2.0	1.08	0.27			23.78				2409	32.84	–18.50					
58 336	5.8	1.22	0.45			24.85	243		2.05	2988	33.28	–18.40		0.31		d	
58 633	4.5	1.18	0.65			24.34	123		1.68	851	30.96	–16.20		–0.03		d	
58 827	4.9	1.47	0.38	–0.25	0.44	22.47	240		2.05	851	30.96	–19.59	–0.03	–0.76	–1.47	b, d	
69 898	5.9	1.27	0.05			24.73	204		2.27	3504	33.52	–19.27		–0.22		d	
71 133	1.2	1.18	0.01	0.13	0.70	22.50	207		2.59	1623	31.93	–19.22	–2.03	–0.44	–0.50	b, c, d	ARP212, VV280
71 360	1.0	1.03	0.60			23.69				3033	33.21	–18.59				d	
71 699	4.0	1.28	0.10			23.95	228		2.20	4042	33.84	–20.31	–0.06	–0.47		d	
71 796	4.0	0.87	0.19			23.20	201		2.02	4168	33.91	–19.01		–0.22		d	
73 163	4.2	1.14	0.04	–0.21	0.51	22.34	96		1.94	2404	32.75	–20.15	–1.27	–1.15		d	

Notes: the presence of the galaxy in Arp or Vorontsov Velyaminov atlases is reported with the original name (ARP and VV). The presence of peculiar kinematics such as counterrotation is indicated with CR. REFERENCES: a: Boselli, A., Gavazzi, G., Lequeux, J., Buat, V., Casoli, F., Dickey, J., & Donas, J. 1995, A&A, 300, L13; b: Young, J. S., Xie Shuding, Tacconi, L. J., et al. 1995, ApJS, 98, 219; c: Knapp, G. R., Guhathakurta, P., Kim, D.-W., & Jura, M. 1989, ApJS, 70, 329; d: (LEDA) Paturel, G., Andernach, H., Bottinelli, L., Di Nella, H., Durand, N., Garnier, R., Gouguenheim, L., Lanoix, P., Martinet, M. C., Petit, C., Rousseau, J., Theureau, G., & Vauglin, I. 1997, A&AS, 124, 109; e: Roberts, M., Hogg, D. E., Bregman, J. N., Forman, W. R., & Jones, C. 1991, ApJS, 75, 751; f: Sage, L. J. 1993, A&A, 100, 537 and A&A, 272, 123; g: van Driel, W., Ragaigne, D., Boselli, A., Donas, J., & Gavazzi, G. 2000, A&AS, 144, 463; h: Zhu, Ming, Seaquist, E. R., Davoust, Emmanuel, Frayer, David, T., Bushouse, Howard 1999, AJ, 118, 145.

Table 2. Main properties of the Perturbed galaxies. All the propertis were extracted form LEDA except the molecular gas content

PGC	t	log D_{25} (0′.1)	log r_{25} (0′.1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	log σ (km s^{-1})	log v_m (km s^{-1})	cz (km s^{-1})	$(m-M)_\mathrm{cin}$	M_B	FIR-B	log $\frac{M_\mathrm{HI}}{L_\mathrm{B}}$	log $\frac{M_\mathrm{mol}}{L_\mathrm{B}}$	Ref.	Notes
696	–0.1	1.08	0.12			24.31				4031	33.80	–18.79					
2357	–1.9	1.37	0.42	0.36	0.84	24.56				4231	33.89	–20.02					
2365	–1.2	0.97	0.10	0.05	0.59	23.52		2.30		4154	33.85	–19.03					
4777	3.1	1.45	0.26	0.02	0.65	23.12	394.08		2.32	2374	32.63	–20.63	–0.89	–0.78	<–0.96	b, d	
4801	–2.0	1.79	0.09	0.35	0.80	25.03	367.85	2.23	2.41	2365	32.62	–20.44		–1.32		c, d, e	ARP227
7525	3.0	1.85	0.25	0.15	0.65	23.80	472.06	2.15	2.47	2456	32.76	–22.23	0.38	–0.66	–0.60	b, d	ARP78
7533	6.5	1.15	0.33			24.87	190.50		1.96	4613	34.10	–18.92		–0.34		d	
7846	–1.9	1.18	0.24	0.41	0.85	23.72				3452	33.47	–19.66					ARP290, VV309
7856	3.1	1.40	0.42			23.97	381.50	2.10	2.26	3646	33.59	–20.53		–0.82		d	ARP290, VV309
8360	6.0	1.34	0.20			24.73	231.57		2.09	3256	33.31	–19.17		0.09		d	
26 232	1.1	1.43	0.46	–0.09	0.60	23.45	316.11		2.12	1739	32.17	–19.62	–2.66	–0.82	–0.42	b, d, e	ARP283, VV50
26 498	5.4	1.65	1.04		0.23	23.41	370.13		2.22	1580	32.07	–20.70	0.21	–0.18		d	
26 571	1.0	1.17	0.03			23.67	230.35	2.28	2.37	1782	32.21	–18.19		–0.47		d	
26 580	–0.9	1.27	0.25			24.45				1765	32.19	–17.88					
27 159	–2.1	1.57	0.17	0.43	0.89	24.27	518.66	2.37	2.40	3179	33.30	–20.79		–1.17		c, d, e	ARP232
27 939	1.6	1.16	0.06			23.27			2.39	4430	34.13	–20.87	0.09	–1.29		d	
28 197	5.8	1.21	0.83			23.56			2.04	3025	33.35	–19.68		–0.25		d	
29 814	0.2	1.64	0.29	0.32	0.84	23.50	139.08	2.11	1.82	1331	31.39	–19.92	–0.34	–1.59	–1.29	c, d, e	
29 855	1.2	1.67	0.27	0.19	0.76	22.90	508.46	2.23	2.25	1233	31.22	–20.50	0.09	–0.63	–0.61	b, d	
30 068	5.0	1.38	0.41	–0.28	0.36	23.85	262.37		2.07	1578	31.88	–18.72	–0.16	–0.52		d	ARP316, VV307
30 083	0.9	1.63	0.41	0.38	0.86	23.58	527.87	2.24	2.39	1312	31.51	–19.87	–0.10	–1.48		c, d, e	ARP316, VV307
30 445	1.4	1.70	0.23	0.21	0.75	23.32	418.71	2.13	2.35	1154	31.23	–20.19	–0.25	–1.09		d	ARP94, VV209
30 714	3.4	1.50	0.99			25.13	198.50		1.90	1324	31.58	–17.59		0.07		d	
32 292	–2.6	1.73	0.30	0.40	0.88	23.15	84.75	2.15	1.38	890	30.65	–19.97		–2.15		c, d, e, g	
32 306	5.3	1.45	0.35	–0.23	0.36	22.70	275.17		2.15	1291	31.42	–19.78		–0.79		d	
32 533	–2.1	1.50	0.14	0.52	0.92	23.32	324.42	2.39	2.27	1524	31.86	–19.92		–1.86		c, d, e, g	ARP162
32 584	3.1	1.44	0.55			23.14	399.35		2.24	1503	31.86	–19.66	–1.48	–0.69		d	
32 605	5.2	1.52	0.03			24.41	271.48		2.54	2719	32.98	–20.07		–0.21		d	
32 767	3.2	1.42	0.27			23.95	215.36		2.02	1107	31.14	–18.11		–0.28		d	
34 029	6.0	1.09	0.06			24.58	124.23		1.97	3052	33.36	–18.01		0.24		d	

Table 2. continued.

PGC	t	$\log D_{25}$ (0′.1)	$\log r_{25}$ (0′.1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_\mathrm{m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_\mathrm{cin}$	M_B	FIR-B	$\log \frac{M_\mathrm{HI}}{L_\mathrm{B}}$	$\log \frac{M_\mathrm{mol}}{L_\mathrm{B}}$	Ref.	Notes
34 415	–4.6	0.97	0.20	0.44	0.83	21.89		1.99		661	30.15	–17.07		<–2.03		e	
34 561	5.3	1.62	0.18			24.42	300.53		2.24	2331	32.80	–20.23	0.36	–0.25		d	
35 616	1.1	1.88	0.27	0.23	0.74	24.39	474.00	2.25	2.40	992	31.21	–19.97	1.88	–0.33	<–1.22	b, c, d	ARP214
35 999	3.4	1.44	0.50			22.73	255.24		2.06	730	30.66	–18.89		–0.40		d	ARP280
36 060	6.4	1.11	0.33	–0.18	0.39	23.72	222.94		2.03	3358	33.48	–19.09		–0.27		d	
36 158	1.1	1.30	0.28			23.66	450.89	2.15	2.35	2718	33.07	–19.74		–0.36		d	ARP294, VV228
36 160	2.2	1.23	0.57			22.76	541.72		2.42	2689	33.05	–20.21		–0.57		d	ARP294, VV228
36 193	3.1	0.85	0.21			21.94	438.28		2.40	3312	33.43	–19.62		–0.71		d	ARP83, VV350
36 197	3.1	1.24	0.52			22.89	430.32		2.31	3306	33.43	–20.56	–1.59	–0.97		d	ARP83, VV350
36 200	–1.8	1.46	0.22	0.35	0.84	23.99	329.75	2.25	2.21	3319	33.44	–20.65		–0.98		c, d	
36 871	4.7	0.78	0.51			22.63				4394	34.03	–19.12					
36 897	0.2	1.18	0.16		0.49	23.58	277.90		2.18	955	31.13	–17.25		0.42		d	
36 907	1.1	1.12	0.17	0.26	0.86	23.14				3301	33.53	–19.89				3	
37 466	4.0	1.57	0.57	–0.14	0.54	23.61	267.13		2.07	845	30.96	–18.90	0.65	–0.80		d	
37 618	–2.7	1.13	0.19	0.36	0.85	22.85		2.25		695	30.64	–17.26				c	
37 619	3.1	1.21	0.54			23.22	374.18		2.24	4826	34.25	–20.86		–0.74	0.07	b, d	
37 629	3.0	1.16	0.28	–0.15	0.47	23.35	280.67		2.13	4768	34.23	–20.49	–0.82	–0.39	–1.59	a, d	
37 642	–2.1	1.46	0.08	0.50	0.92	22.59	633.00	2.48	2.67	1042	31.32	–19.83		–1.41		c, d, e	
37 692	5.9	1.35	0.09	–0.07	0.52	23.29	215.83		2.15	767	30.72	–18.00		–0.38		d	
37 719	2.2	1.41	0.37	0.26	0.91	23.21	358.40	2.12	2.24	699	30.56	–18.15		–0.54		d	
38 287	1.3	1.02	0.50			22.73	411.05	2.24	2.28	4275	33.98	–20.18		–0.48		d	
38 503	–2.0	1.29	0.41			24.28	283.50	1.98	2.09	933	31.06	–16.97		–0.01		d	
38 885	1.9	1.08	0.22	0.14	0.75	23.28	270.24		2.14	1862	32.22	–18.23		–1.24		d	
38 892	–1.9	1.12	0.27	0.42	0.87	22.62	476.10	2.34	2.36	3814	33.77	–20.60		–0.86		c, d	
38 906	–0.2	0.84	0.35			22.31	423.57		2.19	3945	33.84	–19.54		–0.04		d, g	
38 912	3.2	1.14	0.63			22.74	261.72		2.03	3941	33.84	–20.53	–2.06	–0.60	–0.58	a, d	
39 568	3.0	1.61	0.78			23.52	545.50		2.42	2529	33.01	–21.28	1.73	–1.23		d	
39 687	–1.0	0.95	0.11	0.44	0.82	22.22				2632	32.92	–19.30				c	
39 708	–1.9	0.99	0.34			23.71	393.90		2.26	2291	32.63	–17.66		–0.12		d	
39 712	–0.2	1.17	0.37	0.41	0.94	23.09	292.41		2.07	2374	32.70	–19.23		–0.51		c, d	
39 719	–1.0	1.12	0.14			23.16				2208	32.55	–18.83				c	
39 759	0.2	0.91	0.27		0.92	23.11	278.75		2.13	2504	32.81	–18.04		–0.03		d	

Table 2. continued.

PGC	t	$\log D_{25}$ (0.′1)	$\log r_{25}$ (0.′1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_{\rm m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_{\rm cin}$	$M_{\rm B}$	FIR-B	$\log \frac{M_{\rm HI}}{L_{\rm B}}$	$\log \frac{M_{\rm mol}}{L_{\rm B}}$	Ref.	Notes
39 943	–2.0	1.03	0.27		0.73	23.10		2.29		4229	33.94	–19.85				c	
39 950	5.2	1.47	0.26		0.61	22.64	264.75		2.11	1140	31.24	–19.78	–0.42	–1.11	–0.62	b, d	
39 974	5.4	1.69	0.82		0.72	23.25	376.58		2.24	1118	31.20	–20.15		–0.60	–0.81	b, d	
39 981	2.4	1.43	0.28			23.57				1484	32.01	–19.45				d	
40 030	1.0	1.30	0.26		0.59	23.30				1893	32.26	–19.34					
40 032	–2.0	1.16	0.16			23.53				1650	31.98	–18.16					
40 245	–1.2	1.51	0.11	0.46	0.88	23.36		2.07		917	30.83	–18.85		<–2.23		c, e	
40 295	–1.8	1.46	0.28	0.42	0.88	22.91		2.29		1226	31.40	–19.63		<–2.26		c, e	
40 309	–1.8	1.06	0.06			23.76				4496	34.16	–19.57					
40 515	–1.3	1.85	0.11	0.38	0.84	23.02		2.26		742	30.44	–20.55		<–3.13		c, e	
40 581	2.8	1.74	0.59	0.15	0.58	23.41	386.07	1.93	2.33	2519	32.86	–21.92	–0.34	–1.53	–1.28	a, b, d	
40 614	2.9	1.54	0.02	0.18	0.81	23.12	177.64	2.15	2.32	921	30.85	–19.30	1.09	–1.35	–0.95	b, d	
40 836	–1.0	1.59	0.11	0.26	0.61	25.04		2.20		2662	33.11	–19.87	–1.06			c, d	
40 903	–1.8	1.17	0.27	0.41	0.86	23.48				1211	31.34	–17.55					
41 302	–1.8	1.18	0.06	0.47	0.92	23.15		1.91		850	30.65	–17.29				c	
41 363	0.1	1.56	0.50	0.30	0.76	24.43				994	30.91	–18.05				c	
42 064	4.0	1.44	0.13	0.26	0.68	22.82	320.95		2.25	2265	32.63	–20.88		–0.78	–0.62	b, d	VV219
42 069	4.1	1.64	0.34		0.76	22.98			2.27	2255	32.62	–21.66	–1.07	–1.39	–0.61	b, d	VV219
42 620	–4.3	1.32	0.12	0.09	0.61	23.52				765	30.65	–17.69				1	ARP281
42 710	8.5	0.71	0.17			23.30	160.75		1.90	1100	31.17	–15.22		0.14		d	
42 728	–2.7	1.39	0.16	0.40	0.89	22.80		2.11		1127	31.20	–19.22		<–2.12		e	
42 816	5.2	1.45	0.08	0.25	0.60	22.76	212.45		2.09	1415	31.66	–19.99	–0.57	–1.22	–0.57	b, d	ARP116, VV206
47 777	4.9	1.05	0.62			23.29				4600	34.15	–19.85	–1.66			d	
47 867	3.3	1.05	0.10		0.37	24.24	226.84		2.17	4962	34.34	–19.16		0.31		d	ARP183
48 018		0.84	0.34			24.19				3886	33.75	–17.61					
48 811	–1.1	0.98	0.22	0.35	0.56	23.88		2.43		7333	35.17	–20.05					
48 815	4.9	1.71	0.63	–0.06	0.49	23.60	415.44	2.21	2.29	2403	32.88	–21.54	0.58	–0.50		d	CR
48 860	–2.0	1.56	0.74		0.82	23.74		2.42	2.18	2021	32.58	–20.38		–1.58		c, d, e	
49 347	3.6	1.43	0.14	0.24	0.76	23.00	309.40		2.28	2315	32.80	–20.74	–0.21	–0.53		d	
49354	–2.1	1.32	0.18	0.49	0.91	22.83	288.90		2.16	2305	32.79	–20.38		–0.56		c, d	CR
49356	–2.1	1.30	0.20	0.58	0.92	22.38	295.90	2.45	2.18	2305	32.79	–20.73		–0.74		c, d, e	
49 508	–1.8	1.35	0.36			24.56	158.50		1.80	1762	32.32	–18.27		–0.04		d	

Table 2. continued.

PGC	t	$\log D_{25}$ (0.′1)	$\log r_{25}$ (0.′1)	$(U-B)_0$	$(B-V)_0$	μ_{25} (ma/arcsec^2)	W_{20} (km s^{-1})	$\log \sigma$ (km s^{-1})	$\log v_\mathrm{m}$ (km s^{-1})	cz (km s^{-1})	$(m-M)_\mathrm{cin}$	M_B	FIR-B	$\log \frac{M_\mathrm{HI}}{L_\mathrm{B}}$	$\log \frac{M_\mathrm{mol}}{L_\mathrm{B}}$	Ref.	Notes
49 548	–0.4	1.60	0.56	0.34	0.78	24.44		2.22		1842	32.40	–19.68	1.15			c, d	
49 739	3.1	1.28	0.26	0.06	0.54	23.46	595.50		2.50	3472	33.61	–20.30	–2.29	–0.22	–0.39	d, a	ARP84, VV48
49 747	3.2	1.41	0.28	0.04	0.53	22.42	625.93		2.51	3486	33.62	–21.98		–0.70	–0.62	d, a	ARP84, VV48
49 820	3.0	1.47	0.57			23.84	512.13		2.39	2743	33.13	–20.35	–1.18	–0.23		d	VV310
49 824	0.1	0.63	0.28			22.11				2748	33.14	–17.93					VV310
49 893	4.9	1.13	0.28			23.85	262.85		2.11	3721	33.76	–19.34	–1.15	–0.09	–0.62	d, a	VV256
50 331	–4.0	1.26	0.13			23.81		2.17		1885	32.43	–18.90				c	
50 776	–2.0	1.28	0.23			24.02		2.14		4991	34.33	–20.64					
51 223	3.0	1.56	0.61	0.04	0.68	23.76	254.06		2.02	1728	32.06	–19.84	0.03	–1.06		d	ARP286
51 233	1.5	1.82	0.46	0.34	0.78	23.69	504.51		2.43	1506	31.78	–20.99	1.65	–1.36		d, e	ARP286
51 241	5.8	1.15	0.09			24.75	105.53		1.83	1773	32.12	–16.98		0.14		d	ARP286
51 270	–2.7	1.16	0.17	0.28	0.78	23.04	613.60		2.38	1656	31.97	–18.63		–1.55		c, d, e	
51 668	–1.9	1.01	0.19			23.57	183.00	2.24	1.93	4370	34.07	–19.42		–1.17		d	
51 681	–2.0	1.24	0.02		0.90	23.13		2.43		4518	34.14	–21.14				c	
51 785	–0.4	1.15	0.17			23.86			2.31	1676	32.00	–17.74		–1.02		d	
51 965	3.2	1.42	0.48			23.69				4068	33.94	–21.08	0.52			d	
52 686	3.0	1.22	0.06			23.57	245.90	2.24	2.31	4400	34.10	–20.42		–0.58		d	ARP297
53 176	4.5	1.08	0.26			23.24	219.05	2.03	2.03	1576	31.88	–17.96		–0.36		d	
53 178	3.0	1.30	0.09			23.36	223.72		2.20	1577	31.88	–18.97		–0.72		d	
53 217	5.2	1.46	0.21			24.60	263.17		2.15	2334	32.85	–19.43	0.38	–0.17		d	
53 657	4.0	1.24	0.68			23.34	312.85		2.13	2544	33.01	–19.58	–1.09	0.16		d	
53 995	2.5	1.08	0.29	–0.13	0.64	22.52		2.22	2.38	4759	34.24	–20.98					
54 001	4.0	1.44	0.55	0.07	0.65	23.27	479.70		2.37	4756	34.24	–21.98	–0.29	–0.75		d	
55 647	4.3	1.43	0.89	0.23	0.76	23.30			2.42	2527	33.02	–20.54	0.75	–0.45		d	
55 725	3.1	1.71	0.30	0.08	0.68	23.73	534.80		2.49	2519	33.01	–21.61	0.99	–0.79		d	
57 579	–3.3	0.92	0.06			23.26				9444	35.72	–21.04					
57 627	5.1	1.34	0.80			23.67	226.50		1.99	2306	32.74	–19.59		–0.63		d	
69 630	0.3	1.22	0.18			23.78	394.22		2.35	4851	34.21	–20.59		–0.42		d	
70 348	1.1	1.16	0.12	–0.46	0.48	22.38	386.28		2.41	4916	34.25	–21.77	–2.79	–1.35	–0.64	b, d	ARP298
70 786	3.6	1.31	0.59	–0.19	0.46	23.14	363.39	2.07	2.16	2676	32.93	–20.29		–0.28		d	
70 795	4.7	1.52	0.46	–0.06	0.53	22.90	469.93	1.83	2.33	2683	32.93	–21.60	–1.44	–0.57	–0.67	b, d	
71 034	6.8	1.16	0.50	–0.24	0.37	23.97	227.62		1.97	4198	33.91	–19.84		–0.50		d	
71 113	–1.9	0.97	0.14	0.26	0.86	23.59		2.06		4094	33.86	–19.27				c	
71 868	3.1	1.28	0.17	–0.52	0.42	22.97	235.32		2.07	2799	33.01	–20.42	–1.86	–0.50	–0.87	b, d	ARP284, VV51
72 128	1.0	1.11	0.10	–0.03	0.66	23.86	206.58		2.11	2892	33.09	–18.77	–1.22	0.11		d	
72 638	1.1	1.38	0.31	0.24	0.67	23.35	609.69		2.49	4300	33.98	–21.58	–2.49	–0.79		d	

Notes: the presence of the galaxy in Arp or Vorontsov Velyaminov atlases is reported with the original name (ARP and VV). The presence of peculiar kinematics such as counterrotation is indicated with CR. REFERENCES: a: Boselli, A., Gavazzi, G., Lequeux, J., Buat, V., Casoli, F., Dickey, J., & Donas, J. 1995, A&A, 300, L13; b: Young, J. S., Xie Shuding, Tacconi, L. J., et al. 1995, ApJS, 98, 219; c: Knapp, G. R., Guhathakurta, P., Kim, D.-W., & Jura, M. 1989, ApJS, 70, 329; d: (LEDA) Paturel, G., Andernach, H., Bottinelli, L., Di Nella, H., Durand, N., Garnier, R., Gouguenheim, L., Lanoix, P., Martinet, M. C., Petit, C., Rousseau, J., Theureau, G., & Vauglin, I. 1997, A&AS, 124, 109; e: Roberts, M., Hogg, D. E., Bregman, J. N., Forman, W. R., & Jones, C. 1991, ApJS, 75, 751; f: Sage, L. J. 1993, A&A, 100, 537 and A&A, 272, 123; g: van Driel, W., Ragaigne, D., Boselli, A., Donas, J., & Gavazzi, G. 2000, A&AS, 144, 463; h: Zhu, Ming, Seaquist, E. R., Davoust, Emmanuel, Frayer, David, T., Bushouse, Howard 1999, AJ, 118, 145.