The PDS starburst galaxies

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ABSTRACT

We discuss the nature of the galaxies found in the Pico dos Dias Survey (PDS) for young stellar objects. The PDS galaxies were selected from the IRAS Point Source catalog. They have flux density of moderate or high quality at 12, 25 and 60 µm and spectral indices in the ranges $-3.00 \leq \alpha(25,12) \leq +0.35$ and $-2.50 \leq \alpha(60,25) \leq +0.85$. These criteria allowed the detection of 382 galaxies, which are a mixture of starburst and Seyfert galaxies. Most of the PDS Seyferts are included in the catalog of warm IRAS sources by de Grijp et al. (1987). The remaining galaxies constitute a homogeneous sample of luminous ($\log(L_{B}/L_{\odot}) = 9.9 \pm 0.4$) starburst galaxies, 67% of which were not recognized as such before.

The starburst nature of the PDS galaxies is established by comparing their $L_{\text{IR}}/L_{B}$ ratios and IRAS colors with a sample of emission line galaxies from the literature already classified as starburst galaxies. The starburst galaxies show an excess of FIR luminosity and their IRAS colors are significantly different from those of Seyfert galaxies – 99% of the starburst galaxies in our sample have a spectral index $\alpha(60,25) < -1.9$. As opposed to Seyfert galaxies, very few PDS starbursts are detected in X-rays.

In the infrared, the starburst galaxies form a continuous sequence with normal galaxies. But they generally can be distinguished from normal galaxies by their spectral index $\alpha(60,25) > -2.5$. This color cut–off also marks a change in the dominant morphologies of the galaxies: the normal IRAS galaxies are preferentially late–type spirals (Sb and later), while the starbursts are more numerous among early–type spirals (earlier than Sbc). This preference of starbursts for early–type spirals is not new, but a trait of the massive Starburst Nucleus Galaxies (Coziol et al. 1997a). Like in other SBNG samples, the PDS starbursts show no preference for barred galaxies.

No difference is found between the starbursts detected in the FIR and those detected on the basis of UV excess. The PDS starburst galaxies represent the FIR luminous branch of the UV-bright starburst nucleus galaxies, with mean FIR luminosity $\log(L_{\text{IR}}/L_{\odot}) = 10.3 \pm 0.5$ and redshifts smaller than 0.1. They form a complete sample limited in flux in the FIR at $2 \times 10^{-10}$ erg cm$^{-2}$ s$^{-1}$.

Subject headings: surveys – galaxies: starburst – galaxies: Seyfert – infrared: galaxies – X-rays: galaxies
1. Introduction

Since their discovery a few decades ago, starburst galaxies have been a constantly growing field of research. This increasing interest is due to the fact that what was once considered as a peculiar phenomenon affecting only a small fraction of the local population of galaxies turns out to be of a more general nature, involving mechanisms by which galaxies form and evolve (Larson 1990; Kennicutt 1990; van den Bergh et al. 1996; Coziol et al. 1997b, 1998; Driver et al. 1998). Yet, our present knowledge on the properties of starburst galaxies rests on the analyses of a rather limited number of data sets and fundamental questions on their nature still remain to be answered. For example, is there a relation between the small-mass and metal poor H II galaxies and the more massive and chemically evolved Starburst Nucleus Galaxies (SBNGs)? What is the difference between starburst galaxies which are UV-bright and those which are selected based on a strong emission in the far infrared (FIR)? Is there a relation between Active Galactic Nuclei (AGN) and starburst activity? Are all starbursts efficient X-rays emitters? What is the dominant morphology of starburst galaxies?

In this context, we have judged useful to present this new homogenous sample of relatively nearby and luminous starburst galaxies selected in the FIR: the PDS (which stands for Pico dos Dias Survey) starburst galaxies. The fact that starbursts are easily detected in the FIR is not surprising (Meadows et al. 1990; Allen et al. 1991; Contini et al. 1998). In their selected sample of IRAS galaxies, for example, Allen et al. (1991) found 90% starburst and 10% Seyfert galaxies. Similar ratios were found in the Contini et al. (1998) sample of Markarian UV-bright galaxies. In the Montreal Blue Galaxy (MBG) survey, 85% of the UV-bright starburst galaxies are also IRAS sources (Coziol et al. 1997a). Interestingly, the percentage of AGNs seems to increase with the FIR luminosity. In their sample of Luminous Infrared Galaxies (LIGs), Veilleux et al. (1995) found 41% Seyfert galaxies and 59% starbursts. For the PDS galaxies, the discovery ratios are 38% AGNs for 62% starbursts.

The organization of this paper is as follows. In section 2, we present the list of the PDS starburst galaxies. In section 3, the starburst nature of these galaxies is established by comparing their IRAS and optical characteristics with those of normal and starburst galaxies taken from the literature. The IRAS color–color diagrams of the PDS starbursts are compared to those of the AGNs and two criteria are proposed to distinguish between these two types of activity in galaxies. The application of these criteria allows us to identify 9 misclassified Seyfert galaxies. In section 4, some of the characteristics of the PDS starbursts are examined. A summary of our results is given in section 5.
2. The sample of PDS galaxies

The Pico dos Dias survey (PDS) is a systematic search performed at the Observatório do Pico dos Dias (OPD – operated by the Laboratório Nacional de Astrofísica (LNA), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNpq)) to discover young stellar objects from their FIR properties (Gregorio-Hetem et al. 1992; Torres et al. 1995). The candidates, selected from the IRAS Point Source Catalog (IPSC), have flux density qualities 2 or 3 at 12, 25 and 60 μm, and spectral indices in the ranges $-3.00 \leq \alpha(25, 12) \leq +0.35$ and $-2.50 \leq \alpha(60, 25) \leq +0.85$ (Torres & Quast 1995), where the spectral indices are defined as $\alpha(\lambda_1, \lambda_2) = \log(S_{\lambda_1}/S_{\lambda_2})/\log(\lambda_2/\lambda_1)$, and $S_{\lambda_1}$ is the flux in Jansky at wavelength $\lambda_1$. The appearance of all the young stellar candidates was examined on the Digitized Sky Survey plates and the galaxy-like objects were placed on a separate list, which we call the PDS galaxy list. Some star-like AGNs were also included in this list after establishing their nature from the Véron–Cetty & Véron (1996) compilation. The goal of the present paper is to determine the nature of all the objects in the PDS galaxy list.

Initially, the PDS galaxies were composed of 388 objects. An entry for all these sources was found in NED. Two objects turned out to be planetary nebulae and 3 others were identified with H II regions in M33 and M101. The luminous quasar 3C 273 was also detected. After removing these 6 objects, we were left with 382 galaxies.

There are 122 AGNs in our list, distributed among 4 LINERs, 76 Seyfert 2 (Sy2) and 42 Seyfert 1 (Sy1). The fact that there are so few LINERs is intriguing, considering the high volume density of these objects in the nearby Universe ($\sim 30\%$ of the local luminous galaxies; Heckman 1980; Ho, Filippenko & Sargent 1997). We note that 84% of the PDS AGNs are included in the warm IRAS source catalog of de Grijp et al. (1987); this suggests that they used similar selection criteria in the FIR as ours. Because de Grijp et al. were only interested in AGNs, they applied an arbitrary cut-off to the color $\alpha(60, 25)$ to separate them from normal galaxies. In the PDS, the limit applied to this color is slightly below this cut-off, allowing the inclusion of numerous non-AGN galaxies. However, we will show that these galaxies are not normal but mostly starbursts.

The 260 PDS non-AGN galaxies in our list are either already known starburst galaxies (33%) or unclassified galaxies that we consider to be starbursts. It is noteworthy that 67% of the PDS starburst

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5 The NASA/IPAC Extragalactic Database.
galaxies were not recognized as such before.

To facilitate our analysis, we retained only the galaxies which have fluxes with high or intermediate qualities in the IRAS Faint Source Catalog (IFSC). We rejected 14 galaxies of low quality flux and 46 others because they have a Galactic latitude $|b| < 10^\circ$, and consequently do not appear in the IFSC. 200 galaxies were thus left in our sample.

In Table 1 we present the 200 PDS starburst candidates. Column 1 gives their IRAS name. A capital X at the end of the name identifies the galaxy as an X-ray source, according to the ROSAT catalog (Voges et al. 1996). Column 2 gives another acronym from NED. Other properties also taken from NED are: the 1950 coordinates of the galaxy (columns 3 and 4), the redshift (column 4), the B magnitude (column 6) and the morphology (column 7). We note that our list contains two of the most famous starbursts: M82 and NGC 7714.

In Table 2, we give the optical and FIR characteristics of our sample of galaxies. Columns 2 and 3 correspond to the absolute magnitude and B luminosity, which were determined using the magnitudes quoted in Table 1 and assuming $H_0 = 75 \text{ km s}^{-1} \text{ Mpc}^{-1}$. No correction for Galactic reddening was applied. The infrared luminosity in column 4 was determined from the relation: $\log(L_{\text{IR}}) = \log(F_{\text{IR}}) + 2\log[z(z+1)] + 57.28$, where $z$ is the redshift and $F_{\text{IR}} = 1.26 \times 10^{-11} (2.5 S_{60} + S_{100}) \text{ erg cm}^{-2} \text{ s}^{-1}$ (Londsdale et al. 1985). The mean FIR luminosity of the PDS starbursts is $2 \times 10^{10} L_\odot$, slightly less than the mean luminosity of the LIGs studied by Veilleux et al. (1995). In columns 5, 6, and 7 we give the IRAS spectral indices. In general, the differences between the spectral indices determined using the IFSC or IPSC fluxes are marginal. The quality indices in the four IRAS bands are given in column 8.

An interesting characteristic of our sample is the different fractions of galaxies with different activity types detected in X-rays: 2 of the 4 LINERs (50%) were detected, as compared to 71% of the Sy1, 22% of the Sy2 and only 4% of the starbursts. These differences between the starbursts and the two Seyfert galaxies are highly significant considering that in our sample the Sy2 are almost twice as numerous as the Sy1 and the starbursts still more numerous than the Sy2.

3. The starburst nature of the PDS galaxies

We define a starburst galaxy as an emission–line galaxy where the source of ionization of the gas is of stellar origin, as determined from standard emission line ratio diagnostic diagrams (Baldwin, Phillips &
Terlevich 1981; Veilleux & Osterbrock 1987). This first criterion eliminates the Seyfert galaxies, but also the LINERs whose source of ionization is not clearly defined. The starburst galaxies have Hα luminosities from $10^{39}$ up to a few $10^{42}$ erg s$^{-1}$ (Balzano 1983; Coziol 1996), implying unusually high present star formation rates. Obviously, these galaxies cannot sustain such elevated star formation rates for a very long time (hence the name starburst; Weedman et al. 1981), unless they are replenished in gas, following some kind of interaction with another galaxy or with its environment (Huchra 1977; Taylor et al. 1996), or if the star formation is regulated by internal processes, probably related to supernovae feedback (Searle & Sargent 1972; Gerola, Seiden & Schulman, 1980; Krügel & Tutukov 1993). From the University of Michigan (UM) survey, Salzer et al. (1989) have shown that the starbursts present a variety of types related to their morphologies. Based on similar characteristics, we can regroup these types in two broad categories (Coziol et al. 1994): the H II galaxies which are small mass and metal poor galaxies and the Starburst Nucleus Galaxies (SBNGs) which are more massive and chemically evolved.

Starburst galaxies are usually detected by the presence of emission–lines in their spectra (using the objective–prism technique) or by a UV color excess (using the multiple filters technique). The two methods yield similar results (Coziol et al. 1993), the only difference being that objective–prism surveys are biased against SBNGs while multiple colors surveys are biased against H II galaxies (Coziol 1996). Starburst galaxies detected in the FIR are generally similar to the SBNGs detected in the optical (Allen et al. 1991; Veilleux et al. 1995). However, at the extreme end of the FIR range one finds a new type of starburst galaxy: the ultra Luminous Infrared Galaxies (uLIGs), which emit most of their energy in the FIR (Sanders et al. 1988). One important property distinguishes the uLIGs from the other two types of starbursts: while all the uLIGs are cases of massive galaxies in interaction (Mirabel & Duc 1993), only a small fraction (∼ 1/4) of the SBNGs and H II galaxies clearly are (Telles & Terlevich 1995; Coziol et al. 1997).

In what follows, we determine the starburst nature of the galaxies in our sample from their FIR luminosity and color. Our method is semi–empirical in nature. We use simple models to interpret the $L_{IR}/L_B$ ratios (Coziol et al. 1996) and IRAS colors (Sekiguchi 1987) of the galaxies and compare the characteristics of the PDS galaxies with those of different samples of normal and starburst galaxies taken from the literature. The sample of normal galaxies is composed of galaxies from the list of Stauffer (1982), Kennicutt (1983) and Hogg et al. (1993), from which we eliminated, using their identification in NED, all the known Seyferts, interacting, UV-bright and starburst galaxies (such as UM, Arp, Markarian, Kiso, MBG or Zwicky-like galaxies). The sample of starburst galaxies is composed of three samples representing the different types of starbursts: (a) SBNGs from the UM survey (Salzer et al. 1989), the Balzano’s sample.
of Markarian galaxies (1983) and the MBG survey (Coziol et al. 1993, 1994, 1997a, 1997b); (b) H II galaxies from the catalog of Terlevich et al. (1991) and from the Calan–Tololo survey (Peña et al. 1991); (c) Luminous Infrared Galaxies (LIGs), as observed by Veilleux et al. (1995), which most luminous members are similar to the uLIGs.

### 3.1. The FIR luminosity excess in starbursts

In Figure 1, we present the diagram of \(L_{\text{IR}}\) as a function of \(L_B\). Coziol (1996) showed that starburst galaxies present a typical excess of FIR luminosity as compared to normal spiral galaxies. In Figure 1a, this phenomenon is illustrated by comparing the luminosities of the PDS starbursts with the mean values found for different samples of galaxies, as determined in Coziol (1996). For comparison purposes, we distinguished between early-type (earlier than Sbc) and late-type galaxies (Sbc and later). It can be seen that most of the PDS galaxies show a ratio \(L_{\text{IR}}/L_B\) higher than 1, similar to the SBNGs.

In Figure 1b, which concerns the PDS Seyfert galaxies, we also show the mean values found by Roberts & Haynes (1994) for normal galaxies with different morphologies. This sample is probably more representative of normal galaxies than the samples of Stauffer, Hogg et al. or Kennicutt, because it is not biased towards emission-line galaxies. Comparing the PDS galaxies (starbursts and AGNs) with the normal galaxies, it can be seen that the former have normal blue luminosities. Like the SBNGs, their mean absolute B magnitude \(M_B = -20.0 \pm 1.0\) suggests that they generally are massive galaxies. This result is consistent with the fact that small-mass starburst galaxies (like the H II galaxies for example) are generally deficient in dust (Coziol 1996).

Although the FIR-luminosity-excess criterion enables one to distinguish starbursts from normal galaxies, it does not allow to separate them from AGNs. Indeed, in Figure 1b we see that, in general, the Seyfert galaxies show \(L_{\text{IR}}/L_B\) ratios comparable to those of SBNGs. This is a characteristic of Seyfert galaxies (Coziol 1996). The nature of the FIR excess in these galaxies is ambiguous, because the contribution of the active nucleus to the FIR luminosity is not well determined. If this contribution were negligible, then the excess of FIR luminosity would imply high star forming rates.
3.2. A model for the typical FIR colors of galaxies

In Figure 2a, we show the diagram of the spectral indices $\alpha(60,25)$ versus $\alpha(100,60)$ for the sample of normal galaxies, as defined above. It can be seen that normal galaxies occupy only a small region of this diagram. There also seems to be no difference in colors between the normal early–type galaxies and the late–types ones (see Sauvage & Thuan 1994 for a discussion of this phenomenon in normal galaxies).

In Figure 2b, the same diagram is shown for the samples of starburst galaxies. The FIR colors of the starbursts are clearly offset from those of normal galaxies, but a significant region of overlap exists. This result reminds one of the observation made by Huchra (1977) about the Markarian galaxies, namely that starbursts are not a new class of objects but rather a subset of normal galaxies. This seems to be true in the FIR as well.

To interpret the data, we use a two-blackbody model composed of a cirrus-like, cold component with a temperature $\sim 27$K, added to a hot component, associated with a burst of star formation (Sekiguchi 1987). In Figure 2, the temperature of the hot component varies from 60K to 100K. The numbers on the grid indicate the fractional contribution of the hot component to the total FIR luminosity. For the sample of normal galaxies, the contribution of the hot component varies between 0.6 and 0.9 and the temperature varies between 65K and 80K. In the starbursts, the contribution from the hot component is generally higher than 0.8 and the temperature is almost always higher than 70K. The interpretation of this difference is straightforward (Sekiguchi 1987; Coziol 1996): the higher star formation rates in starburst galaxies simply increases the quantity of hot dust.

It is instructive to study the location of the various types of starbursts in Figure 2b. The small dispersion for the colors of the SBNGs, for example, suggests similar characteristics for the bursts (similar intensities, ages or dust contents). The larger dispersion for the LIGs, on the other hand, suggests a more heterogeneous group. This difference between the two types of starbursts may be explained in part by different levels of extinction, which is generally higher in the LIGs than in the optically selected SBNGs (Veilleux et al. 1995). In Figure 2b for instance, some LIGs have colors similar to a pure blackbody. In these galaxies most of the light may be absorbed by dust and reemitted in the FIR. The fact, on the other hand, that many UV-bright SBNGs are also FIR emitters suggests that the dust distribution in these galaxies is rather patchy (Calzetti et al. 1996).

On average, the LIGs show a higher hot-component contribution and/or a higher dust temperature than the SBNGs. The LIGs, therefore, may have higher star formation rates or younger bursts than the
SBNGs (Coziol 1996). But, some may also hide an AGN (Sanders et al. 1988).

For the H II galaxies, the high dust temperatures suggested by the model are probably better explained by their low metallicities and young ages. A young starburst contains a larger number of massive stars than a more evolved one, and a metal-poor ionized gas reaches higher temperatures than a metal-rich one.

3.3. Discrimination between normal, starburst and Seyfert galaxies using FIR colors

In Figure 3a, we now apply our model to the PDS starburst galaxies. We deduce that the PDS starburst galaxies have IRAS colors which are typical of SBNGs. This conclusion is consistent with our previous classification based on the ratio $L_{\text{IR}}/L_B$.

In Figure 3a, we distinguish between the PDS starbursts detected in the UV, the galaxies assumed to be in interaction (the Arp galaxies) and the pure IRAS galaxies (that is, the FIR galaxies with no other special known characteristics). In general, the colors of the three types of galaxies are similar. Therefore, whatever the origin of the bursts in these galaxies, the result in terms of colors seems to be the same.

In order to test how arbitrary our criteria for selecting starbursts in the FIR are, we have examined the nature of the galaxies which have a IPSC color $\alpha(60,25) < -2.5$. This specific criterion was tested, because we noticed that it eliminates a good number of IRAS galaxies in the IPSC. Using NED, we identified a new sample of 210 IRAS galaxies with a IPSC color $\alpha(60,25) < -2.5$. Among these galaxies only 23 (11%) were recognized as Seyfert galaxies. We call the remaining 187 galaxies the IRAS normal galaxies. Indeed, in Figure 2a, we can see that the IRAS normal galaxies have colors typical of normal galaxies.

In Table 3, the mean B and FIR luminosities and dispersions for the IRAS normal galaxies are compared to those of the PDS starburst and Seyfert galaxies. All these galaxies have comparable luminosities. In column 4 of Table 3, we also give the $L_{\text{IR}}/L_B$ ratios observed in all these galaxies. The IRAS normal galaxies do not show the same excess of FIR luminosity as the PDS starbursts. A Kolmogorov–Smirnov test allows one to reject, at a level of confidence higher than 99.9%, the hypothesis that the two distributions were taken from the same population. Therefore, without completely separating them from normal galaxies our color criteria allow us to effectively select starburst galaxies.

In Figure 3b, we present the color-color diagram $\alpha(60,25)$ vs. $\alpha(100,60)$ for the PDS Seyfert galaxies. As already noted by de Grijp et al. (1987), the FIR spectral indices of Seyfert galaxies are generally flatter than those of starbursts. Only a small fraction of the PDS Seyfert galaxies in Figure 3b have FIR colors
similar to those of the starbursts. There seems to be more Sy2 than Sy1 in this situation: about 38% of the Sy2 compared to only 10% of the Sy1. Above the cut-off defined by de Grijp et al. ($\alpha_{(60,25)} > -1.5$) the Sy2 show a slightly flatter $\alpha_{(100,60)}$ spectral index than the Sy1. In Table 3, we also see that the Sy2 show a similar mean excess of FIR luminosity to that of the starbursts, while this ratio for the Sy1 is normal. Comparing them with the IRAS normal galaxies, a Kolmogorov–Smirnov test allows to reject, but only at the 92% confidence level, the hypothesis that the Sy2 distributions comes from the same population as the normal ones. The same hypothesis simply cannot be rejected for the Sy1.

The differences in FIR characteristics among the various types of galaxies are better observed in the diagrams $\alpha_{(60,25)}$ vs. $\alpha_{(25,12)}$, presented in Figure 4. In Figure 4a, most of the PDS starbursts have a color $\alpha_{(60,25)}$ between $-1.9$ and $-2.5$. In Figure 4b, the PDS Sy2 with a color $\alpha_{(60,25)}$ higher than $-1.9$ have a color $\alpha_{(25,12)}$ lower than $-1.5$, while it is the contrary for the Sy1. This last cut-off also seems to separate most of the X-ray AGNs from the non X-ray ones. But it is the contrary for the starbursts.

In Figure 4b, we have also placed the IRAS normal galaxies. As can be seen, the FIR color distribution of the normal galaxies merges with those of the starburst galaxies. In reality, all these galaxies form a continuous sequence in colors. We distinguished the starbursts based on the color criterion $\alpha_{(60,25)} > -2.5$. In section 3.4, we will show that this color cut–off also marks a change in the dominant morphological types of the galaxies.

3.4. Spectroscopic observations of misclassified AGNs

In Figure 4a, 17 of the PDS starbursts show a spectral index $\alpha_{(60,25)} > -1.9$. Considering the large difference between the rest of the starbursts and the AGNs in this diagram, we wondered if these 17 starbursts could not be misidentified AGNs. Likewise, the fact that many more PDS AGNs than starbursts are detected in X-rays (only 11 PDS starbursts are X-ray sources) also suggests that some of these starbursts are misidentified AGNs. To verify the nature of these galaxies, spectroscopic observations were obtained for 12 of the 17 starbursts with $\alpha_{(60,25)} > -1.9$ and 3 X-ray starbursts. In August 1997, 2 galaxies (IC2202 and IRAS14454-4343) were observed with the 1.6m telescope at the OPD and 2 others (IIIZw083 and IRAS19265-4338) were observed at the 1.52m telescope at ESO. The remaining starbursts were observed in January and March 1998 with the 1m WISE telescope in Israel.

$^6$Note that it is the spectral index as determined using the IFSC fluxes that we now use.
At the OPD, a Boller & Chivens spectrograph was used in conjunction with a 1024 × 1024, SIT, back-illuminated CCD. Two spectra with resolution ~ 2 Å were taken using a 600l/mm grating centered alternatively at 4600 and 6300 Å. The slit had a width of ~ 2.5 arsec and was aligned in position E–W across the center of the galaxies. At the 1.52m of ESO, the data were acquired with a Boller & Chivens spectrograph and a 2048×2048 Loral, UV flooded CCD. The grating used had a dispersion of 187 Å/mm providing a spectral coverage of ~ 3000 – 9000 Å and a resolution of about 10 Å. The slit width covered ~ 3 arsec of the center of the galaxies and was positioned close to the parallactic angle. At the 1m telescope of the Wise Observatory (Israel) a FOSC spectrograph was used with a 1024×1024 Tektronics CCD. The spectral coverage was ~ 3500 – 7300 Å and the resolution was about 8 Å. The slit width covered ~ 5 arsec of the center of the galaxies and was also positioned close to the parallactic angle. All the spectra were reduced according to standard procedures under IRAF. These include bias subtraction, flat-field and distortion corrections, cosmic ray removal, sky subtraction, wavelength and flux calibrations.

Table 4 gives the ratios of the most prominent emission lines which we used to classify the activity types of the galaxies. Although some of these galaxies have very strong emission lines, they do not seem to have broad components typical of Sy1 galaxies. Figure 5 shows one of the diagnostic diagrams which we used for our classification. The results are reported in column 7 of Table 4. Note that the same classification is obtained using other line ratios. As we suspected, 9 of the 12 PDS starbursts with \( \alpha(60,25) > -1.9 \) (identified by crosses in Figure 4a) are misidentified AGNs (Sy2 or LINER). The three remaining starburst galaxies have color values at the borderline between those of starbursts and AGNs (in Figure 4a, they are identified by a square and occupy the extreme positions at the top of the sequence traced by the starbursts). The color difference between the AGNs and the starbursts, in Figure 4a, seems remarkably well established since 99% of the PDS starbursts have a spectral index \( \alpha(60,25) > -1.9 \).

Following our spectral classification, the starburst nature of the 3 X-ray galaxies classified as starbursts on the basis of their colors is confirmed, although NGC 3310 could also be a LINER. The case of NGC 3690 is complicated by the fact that this is really two interacting galaxies. It is not clear, therefore, what is the origin of the X-ray emission in this system. It could come from hot gas between the two interacting galaxies or be related only to one of the galaxies. Again we note that the western galaxy of this pair shows line ratios at the borderline separating starbursts from LINERs. As a common characteristic, the 4 X-ray starbursts have slightly higher excitation levels than normal SBNGs. All these galaxies could be of intermediate nature between AGN and starburst (Véron et al. 1997).
4. Properties of the PDS starbursts

In Figure 1, we have verified that the PDS galaxies are preferentially massive galaxies. This result is consistent with the observation that small-mass starburst galaxies are usually deficient in dust. In the H II galaxies the dust could have been easily ejected into the intergalactic medium (with a good part of the metals) by strong starburst winds. Alternatively, these galaxies may also be too young and have not had enough time to produce a sufficient amount of dust to be visible in the FIR. Being massive, the PDS galaxies are more similar to SBNGs. In this section, we will therefore continue our discussion by comparing some of the characteristics of the PDS starburst galaxies with those of the SBNGs.

In Figure 6, we present the morphologies of the PDS starbursts compared to those of the Markarian galaxies and the SBNGs of Balzano (1983). We can see that the distribution of the morphologies of the PDS galaxies is intermediate between those of these two samples. In particular, the PDS galaxies seem to contain a relatively high number of early-type spirals (Sb and earlier). This is a common trend of SBNG samples (Coziol et al. 1997a). In Figure 6, we verify that this trend in favor of early-type spirals is not observed in the sample of IRAS normal galaxies. In this case, the fraction of early-type galaxies falls drastically against that of the late-type ones.

We can also see in Figure 6 that the fraction of barred PDS starbursts is similar to that observed in other samples of SBNGs. This fraction is high, but not particularly so, if we judge from the high fraction of barred galaxies also observed in the IRAS normal galaxy sample. Like in other samples of SBNGs (Coziol et al. 1997a; Contini et al. 1998) the fraction of PDS galaxies with a bar seems to increase towards late-type galaxies. The PDS galaxies show no evidence to be preferably barred.

In Figure 7, we compare the FIR luminosities and the redshifts of the PDS galaxies with those of the UV-bright MBGs and IRAS galaxies selected by Allen et al. (1991). Coziol et al. (1997a) showed that the MBGs are the equivalent of the IRAS luminous galaxies at lower redshifts. The PDS starbursts, on the other hand, are observed in similar redshift ranges (from 0 to 0.1) as the MBGs. These two samples are limited to relatively low redshifts. The PDS galaxies are simply the FIR luminous equivalent of the nearby UV-bright SBNGs. The two diagonal lines in Figure 7 suggest that the PDS galaxies are flux limited in the FIR at $10^{-10}$ erg cm$^{-2}$ s$^{-1}$ and the MBGs at $10^{-11}$ erg cm$^{-2}$ s$^{-1}$.
5. Summary and conclusions

In this contribution, we have confirmed that starburst galaxies can be effectively detected and discriminated from normal galaxies and AGNs using criteria based on their FIR emission.

In comparison with normal galaxies, the starbursts typically show an excess of FIR luminosity and distinct colors. These differences are explained by a higher quantity of hot dust due to the higher star formation rates in starbursts as compared to normal galaxies. In the FIR, the starbursts form a continuous sequence with the normal galaxies, but can be distinguished based on a color $\alpha(60,25) < -2.5$. This color cut–off also marks a variation in the dominant morphological types of the galaxies: normal IRAS galaxies are mostly late-type (Sb and later) spirals, while starbursts are more numerous among the early-type ones (Sb and earlier). This result is consistent with the observations made by Devereux & Hameed (1997), and suggests that many early–type spiral galaxies are still actively forming stars. However, this preference of massive starburst for early–type morphologies is not new, but a trait of SBNGs (Coziol et al. 1997a).

Like for other samples of SBNGs, no preference for barred galaxies is found among the PDS starbursts. The role of the bar in starbursts is not well established. The fact that the number of barred starbursts increases towards the late–type morphologies may suggest that the bar is important only in the late–type starbursts. Alternatively, the bar could also have a shorter life time in a galaxy with a stronger bulge.

The PDS starbursts are mostly massive ($M_B = -20.0 \pm 1.0$). This result is consistent with the fact that the small-mass H II galaxies are relatively deficient in dust. In the H II galaxies the dust may have been swept away by starburst winds, or these galaxies may be too young to have produced enough dust. The FIR colors of the H II galaxies suggest that their dust temperatures are higher than those of the SBNGs. This phenomenon probably has something to do with the low metallicities of these galaxies, but also suggests a larger number of young stars than in the SBNGs and, consequently, younger age for the bursts in the H II galaxies than in the SBNGs.

In general, there seems to be no difference between the FIR characteristics of the UV-bright starbursts and those selected in the FIR. The PDS starbursts simply correspond to the FIR luminous branch of the UV-bright SBNGs with a mean FIR luminosity $\log(L_{\text{IR}}/L_\odot) = 10.3 \pm 0.5$ and redshift $z < 0.1$. The PDS starbursts, in particular, are limited in flux in the FIR at $10^{-10}$ erg cm$^{-2}$ s$^{-1}$ while the UV-bright starbursts are limited in flux at $10^{-11}$ erg cm$^{-2}$ s$^{-1}$.

Another interesting result of our analysis is the very few starbursts detected in X-rays. Only 4% of the
200 PDS starbursts were detected by ROSAT. Furthermore, the nature of 3 of these X-ray starbursts for which we obtained a spectrum was found to be ambiguous, the galaxies showing spectral characteristics intermediate between those of starbursts and LINERs. This result, and the fact that a very high number of Sy1 (71%), but few Sy2 (22%) were detected in X-rays, cautions against the utilization of the FIR, without other means of discrimination, to select starburst galaxies in order to study their X-ray properties. Our observations suggest, instead, that the contribution by starbursts to the cosmic X-ray background, for example, could be negligible (Hasinger 1998).

The relatively high fraction (38%) of AGNs in our sample is consistent with observations which suggest that the probability of finding an AGN increases with the FIR luminosity (de Grijp et al. 1987; Veilleux et al. 1995). In our sample, 62% of the AGNs are Sy2, 34% are Sy1 and the remaining 4% are LINERs. The higher number of Sy2 encountered is consistent with the idea that these galaxies are slightly richer in dust than the Sy1 (Malkan et al. 1998). The low fraction of LINERs, on the other hand, is consistent with the idea that these galaxies are low luminosity AGNs which are not in a starburst phase (Coziol 1996). Only 10% of the PDS Sy1 and 38% of the PDS Sy2 have a spectral index in the range $-2.5 \leq \alpha(60,25) \leq -1.9$. But the most striking result of our analysis is the fact that only 1% of the PDS starbursts have a spectral index $\alpha(60,25) > -1.9$. The few starbursts which passed this limit are at the extreme of the sequence traced by the the starburst galaxies and show spectral characteristics at the borderline between those of starbursts and LINERs.

Our analysis clearly shows that Seyfert galaxies have distinct FIR colors from starburst galaxies. This means that the active nucleus in AGNs must contribute significantly to the FIR excess emission observed in these objects. Now, because this excess is, on average, barely equal to that observed in SBNGs, it suggests that the level of star formation in Seyfert galaxies may be different from that in starbursts. Taken at face value, our results imply that only a small fraction of the Seyfert galaxies, maybe $\sim 40\%$ of the Sy2 and $\sim 10\%$ of the Sy1, could be dominated by star formation. It is remarkable to find these fractions roughly consistent with those determined by González Delgado et al. (1997) based on their discovery of different star formation properties between Sy2 and Sy1 (for similar results see also Glass & Moorwood 1985; Maiolino et al. 1995; Hunt et al. 1997 and more recently Malkan et al. 1998). A better determination of the contribution of the active nucleus to the FIR is necessary in order to understand the relation of AGNs with starbursts.

The electronic version of the tables for the different samples of galaxies defined in this paper (including the 187 IRAS normal galaxies and the Seyfert galaxies) are available upon request to the first author.
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Fig. 1.— The FIR vs. B luminosities of a) the PDS starburst candidates, b) the PDS Seyfert galaxies. The diagonal lines correspond to the ratios \( L_{\text{IR}}/L_B = 1/3, 1, 3 \) and 10. In a), the mean values and dispersions of the luminosities for a sample of normal late-type spirals (sL), early-type spirals (sE) and SBNGs from the literature are indicated. In b), the mean values and dispersions of the luminosities for another sample of normal galaxies (Roberts & Haynes 1994), which is not biased towards emission-line galaxies are also indicated.

Fig. 2.— IRAS color–color diagram for the normal spirals and for different samples of starburst galaxies: the SBNGs, H II galaxies and LIGs. The grid corresponds to a two blackbody model, composed of a cold component at \( \sim 27\,\text{K} \) added to a hot component, associated to a burst of star formation (Sekiguchi 1987). The numbers on the grid indicate the fractional contribution of the hot component to the total FIR luminosity. In a), we call the IRAS Normal galaxies the galaxies with a IPSC color \( \alpha(60,25) < -2.5 \) (see section 3.3).

Fig. 3.— The same diagram as in Figure 2 for a) the PDS starbursts, b) the PDS Seyfert galaxies. The locus of a pure power law is also indicated for reference.

Fig. 4.— The color–color diagram \( \alpha(60,25) \) vs. \( \alpha(25,12) \), showing the distribution of a) the starbursts, b) the AGNs and normal IRAS galaxies. In a), the misidentified AGNs for which we have spectra are identified by crosses. Only 1% of the starbursts have a spectral index \( \alpha(60,25) > -1.9 \). These galaxies (identified by squares) are at one of the extreme of the sequence traced by the normal and starburst galaxies. In b), most of the Sy1 and X-ray AGNs with a color \( \alpha(60,25) > -1.9 \) have a color \( \alpha(25,12) > -1.5 \) as opposed to the Sy2 and X-ray starbursts. Following our definition in section 3.3, the IRAS normal galaxies have a color \( \alpha(60,25) < -2.5 \).

Fig. 5.— Diagnostic diagram for classifying some of the PDS galaxies. The PDS starbursts with a color \( \alpha(60,25) > -1.9 \) are identified by a circle with a cross and the capital X represent the X-ray PDS starbursts. 9 of the 12 starbursts with a color \( \alpha(60,25) > -1.9 \) turn out to be misclassified AGNs (mostly Sy2). The X-ray starbursts, on the other hand, have spectral characteristics suggesting an intermediate nature between one of a LINER and a starburst.

Fig. 6.— Distribution of the morphologies for the PDS starbursts, the Markarian galaxies and the sample of SBNGs from Balzano (1983). The high number of early-type PDS and Markarian galaxies (Sb and earlier) is a trait of SBNGs (Coziol et al. 1997a).

Fig. 7.— FIR luminosities vs. redshifts for the PDS starbursts, as compared to the UV-bright SBNGs
(MBG) and a sample of luminous IRAS starbursts from Allen et al. (1991). The diagonal lines correspond to the flux limits of the different surveys.
Table 1. PDS Starbursts

| IRAS        | Other names          | α  | δ    | z   | B   | Morph. |
|-------------|----------------------|----|------|-----|-----|--------|
| 00013 + 2028| NGC7817              | 0  | 24.90| 20  | 28  | 18.0   | 0.0083 | 12.56 | SAbc  |
| 00022 − 6220| NGC7823              | 0  | 14.05| -62 | 20  | 23.6   | 0.0148 | 13.40 | SA(s)ab|
| 00073 + 2538| MRK0545, NGC0023     | 0  | 18.40| 25  | 38  | 44.0   | 0.0159 | 12.85 | SB(s)a |
| 00317 − 2142| MBG00317-2142        | 0  | 31.70| -21 | 42  | 51.0   | 0.0268 | 13.66 | (R)SB(rl)bc|
| 00344 − 3349| AM0034-344           | 0  | 34.67| -33 | 49  | 49.0   | 0.0205 |       |       |
| 00345 − 2945| AM0034-294, NGC174   | 0  | 34.99| -29 | 45  | 10.6   | 0.0116 | 13.79 | SB(rs)0/a|
| 00386 + 4033|                     | 0  | 38.39| 40  | 33  | 40.1   | 0.0116 |       |       |
| 00450 − 2533X| NGC0253             | 0  | 45.75| -25 | 33  | 39.8   | 0.0008 | 8.04  | SAB(s)c|
| 00506 + 7248| MCG+12-02-001        | 0  | 50.50| 72  | 48  | 56.0   | 0.0164 |       |       |
| 01053 − 1746| MBG01053-1746, IC1623| 1  | 5.89 | -17 | 46  | 22.1   | 0.0202 |       |       |
| 01076 − 1707| MCG-03-04-014        | 1  | 7.84 | -17 | 7   | 11.5   | 0.0351 | 15.00 |       |
| 01171 + 0308| ARP227, NGC470       | 1  | 17.50| 3   | 8   | 53.0   | 0.0083 | 12.53 | SA(rs)b|
| 01384 − 7515| AM0138-751, NGC643B  | 1  | 38.00| -75 | 15  | 54.0   | 0.0127 | 14.57 | SB0   |
| 01579 + 5015| UGC01493A           | 1  | 57.29| 50  | 15  | 56.0   | 0.0169 | 14.40 |       |
| 02031 − 8413| AM0203-841           | 2  | 9.00 | -84 | 13  | 42.0   | 0.0108 | 13.42 | SAB(rs)c|pec|
| 02070 − 2338| MBG02070-2339, AM0207-233| 2  | 7.00 | -23 | 39  | 3.4    | 0.0178 | 13.21 | Sbc   |
| 02079 + 3725| ARK077, NGC0834      | 2  | 8.02 | 37  | 25  | 52.0   | 0.0160 | 13.84 |       |
| 02141 − 1134| MBG02141-1134, NGC873| 2  | 14.61| -11 | 34  | 48.0   | 0.0136 | 13.00 | Sc pec|
| 02208 + 4744| UGC1845             | 2  | 20.12| 47  | 44  | 36.6   | 0.0163 | 14.80 | Sab   |
| 02315 − 3915| MBG02316-3915, NGC 0986| 2  | 31.41| -39 | 15  | 49.0   | 0.0067 | 11.64 | (R)SB(rs)b|
| 02345 + 2053| ARK088, NGC0992, IIIZw004| 2  | 34.56| 20  | 53  | 4.0    | 0.0144 | 13.65 |       |
| 02360 − 0653| NGC1022             | 2  | 36.30| -6  | 53  | 24.0   | 0.0053 |       |       |
| 02395 + 3433| KUG0239+345, NGC1050| 2  | 39.32| 34  | 33  | 4.0    | 0.0137 | 13.47 | (R)SB(s)a|
| 03004 − 2303| MBG03004-2303, NGC1187| 3  | 0.23| -23  | 3  | 47.0   | 0.0048 | 11.34 | SB(r)c|
| 03021 + 7956| UGC02519            | 3  | 2.10 | 79  | 56  | 17.0   | 0.0086 | 14.30 | Scd   |
| 03064 − 0308| MRK0603, NGC1222    | 3  | 6.25| -3  | 8   | 43.0   | 0.0085 | 13.10 | S0- pec|
| 03266 + 4139| NGC1334             | 3  | 26.04| 41  | 39  | 40.0   | 0.0148 | 14.10 |       |
| IRAS          | Other names                          | α     | δ     | z    | B   | Morph.  |
|--------------|--------------------------------------|-------|-------|------|-----|---------|
| 03324 – 1000 | MBG03324-1000, NGC1363               | 3 32  | 25.20 | -10 0 30.0 | 0.0321 | 13.10 | ·      |
| 03344 – 2103 | NGC1377                              | 3 34  | 25.92 | -21 3 57.3 | 0.0060 | 13.36 | S0     |
| 03406 + 3908 | MRK1405                              | 3 40  | 38.17 | 39 8 16.0 | 0.0165 | 13.4  | S0     |
| 03419 + 6756 | IC0342                               | 3 41  | 58.60 | 67 56 26.0 | 0.0008 | 9.10  | SAB(rs)cd |
| 03443 – 1642 | MCG-03-10-045                        | 3 44  | 20.77 | -16 42 13.6 | 0.0043 | 14.00 | IB pec |
| 03451 + 6956 | UGC02866                             | 3 45  | 7.10  | 69 56 37.0 | 0.0048 | 15.50 |       |
| 03514 + 1546 | CGCG 465-012                         | 3 51  | 26.20 | 15 46 55.5 | 0.0227 | 15.20 | Sa     |
| 03524 – 2038 | NGC1482                              | 3 52  | 27.11 | -20 38 52.4 | 0.0065 | 13.10 | SA0+ pec |
| 04064 + 0831 | NGC1517                              | 4 6   | 29.00 | 8 31 1.0  | 0.0121 | 14.07 | Scd     |
| 04296 + 2923 | ·                                    | 4 29  | 39.91 | 29 23 39.5 | 0.0075 | 12.19 | ·      |
| 04326 + 1904 | UGC03094                             | 4 32  | 38.30 | 19 4 14.0 | 0.0253 | 16.50 | ·      |
| 04389 – 0257 | NGC1637                              | 4 38  | 57.50 | -2 57 11.0 | 0.0027 | 11.47 | SAB(rs)c |
| 04435 + 1822 | UGC03157                             | 4 43  | 35.74 | 18 22 18.0 | 0.0159 | 15.00 | ·      |
| 04519 + 0311 | MRK1088, NGC1691                     | 4 52  | 1.00  | 3 11 23.0 | 0.0157 | 13.01 | (R)SB(s)0/a |
| 04569 – 0756 | NGC1720                              | 4 56  | 55.60 | -7 55 59.0 | 0.0144 | 13.00 | SB(s)ab |
| 05053 – 0805 | MRK1093, NGC1797                     | 5 5   | 19.50 | -8 4 59.0 | 0.0151 | 15.50 | (R)SB(rs)a pec |
| 05054 + 1718X| CGCG468-002                          | 5 5   | 27.39 | 17 18 13.8 | 0.0181 | ·      | ·      |
| 05149 – 3709 | AM0514-370                           | 5 14  | 55.00 | -37 9 12.0 | 0.0044 | 13.04 | Sbc     |
| 06107 + 7822 | NGC2146                              | 6 10  | 42.16 | 78 22 27.6 | 0.0037 | 11.38 | SB(s)ab pec |
| 06141 + 8220 | UGC03435                             | 6 14  | 9.18  | 82 20 31.9 | 0.0150 | 14.72 | ·      |
| 06189 – 2001 | UGCA128                              | 6 18  | 56.00 | -20 1 24.0 | 0.0067 | ·      | ·      |
| 06194 – 5733 | AM0619-573, NGC2221                  | 6 19  | 26.00 | -57 33 12.0 | 0.0081 | 13.83 | SA pec |
| 06210 + 4932 | CGCG233-017                          | 6 21  | 3.58  | 49 32 13.0 | 0.0202 | 14.90 | ·      |
| 06259 – 4708 | AM0626-470                           | 6 26  | 0.00  | -47 8 36.0 | 0.0392 | 19.26 | ·      |
| 06399 – 5828 | AM0639-582                           | 6 39  | 57.00 | -58 28 36.0 | 0.0086 | 13.10 | (R)SAB(s)bc |
| 07007 + 8427 | NGC2268                              | 7 0   | 52.70 | 84 27 45.0 | 0.0081 | 12.24 | SAB(r)bc |
| 07027 – 6011 | AM0702-601                           | 7 2   | 44.50 | -60 11 6.0 | 0.0309 | ·      | ·      |
| IRAS          | Other names | $\alpha$  | $\delta$  | $z$     | $B$       | Morph. |
|--------------|-------------|-----------|-----------|--------|-----------|--------|
| 07107 + 3521 | UGC03752    | 7 10 45.14 | 35 21 55.0 | 0.0163 | 14.80     | ⋮      |
| 07176 − 3533 | ESO367-G017 | 7 17 38.00 | -35 33 48.0 | 0.0092 | 13.85     | (R)SB(rl)a |
| 07203 + 5803 | UGC03828    | 7 20 21.50 | 58 4 1.0   | 0.0124 | 12.90     | SAB(rs)b |
| 07204 + 3332 | MRK1199, UGC03829 | 7 20 28.30 | 33 32 20.7 | 0.0143 | 13.70     | Sc     |
| 07256 + 3355 | GC2388      | 7 25 38.17 | 33 55 17.4 | 0.0144 | 14.67     | ⋮      |
| 07278 − 6728 | AM0727-672, IC2202 | 7 27 50.00 | -67 28 12.0 | 0.0116 | 13.61     | SAB(s)bc |
| 07369 − 5504 | AM0737-550  | 7 36 59.00 | -55 4 30.0 | 0.0091 | 11.85     | SB(s)b  |
| 07568 + 1531 | UGC04145    | 7 56 50.30 | 15 31 30.0 | 0.0159 | 14.06     | Sa     |
| 08007 − 6600 | ⋮           | 8 0 43.59 | -66 0 51.9 | 0.0407 | 16.18     | pec    |
| 08311 − 2248 | AM0831-224, NGC2613 | 8 31 11.10 | -22 48 1.0 | 0.0057 | 11.16     | SA(s)b  |
| 08339 + 6517X | ⋮           | 8 33 57.30 | 65 17 45.0 | 0.0191 | 14.16     | ⋮      |
| 08406 − 1952 | ESO563-G014 | 8 40 41.70 | -19 52 19.0 | 0.0058 | 14.00     | SBd     |
| 08425 + 7416 | ARP080, NGC2633 | 8 42 33.80 | 74 16 54.0 | 0.0079 | 12.90     | SB(s)b  |
| 08437 − 1907 | NGC2665     | 8 43 45.00 | -19 7 12.0 | 0.0058 | 13.50     | (R)SB(r)a |
| 09004 − 2031 | ESO564-G011 | 9 0 30.00 | -20 31 36.0 | 0.0088 | 14.50     | Sa     |
| 09120 + 4107 | NGC2785     | 9 12 3.07 | 41 7 32.6  | 0.0098 | 14.73     | Im     |
| 09141 + 4212 | ARP283, NGC2798 | 9 14 9.41 | 42 12 34.0 | 0.0064 | 13.04     | SB(s)a  |
| 09395 + 0454 | MRK0708, NGC2966 | 9 39 34.54 | 4 54 6.5  | 0.0072 | 13.56     | ⋮      |
| 09399 + 3204 | MRK0404, NGC2964 | 9 39 56.90 | 32 4 34.0  | 0.0048 | 12.00     | SAB(r)bc |
| 09434 − 1408 | ARP245, NGC2993 | 9 43 24.01 | -14 08 12.6 | 0.0081 | 13.11     | Sa      |
| 09479 + 3347 | KUG0947+337, NGC3021 | 9 47 59.60 | 33 47 18.0 | 0.0058 | 12.91     | SA(rs)bc |
| 09510 + 0149 | NGC3044     | 9 51 6.00 | 1 48 57.0  | 0.0047 | 12.46     | SB(s)c  |
| 09511 − 1214 | NGC3058     | 9 51 10.43 | -12 14 45.1 | 0.0250 | ⋮         | ⋮      |
| 09517 + 6955X | M082        | 9 51 43.48 | 69 55 00.8 | 0.0007 | 9.3       | I0     |
| 09578 + 0336 | UGC05376    | 9 57 51.10 | 3 36 56.0  | 0.0072 | 14.02     | Sdm    |
| 09593 + 6858 | NGC3077     | 9 59 19.95 | 68 58 29.9 | 0.0007 | 10.61     | I0 pec |
| 10102 + 1716 | NGC3154     | 10 10 18.00 | 17 16 58.0 | 0.0225 | ⋮         | ⋮      |
Table 1—Continued

| IRAS       | Other names             | α (1950) | δ (1950) | z      | B      | Morph.  |
|------------|-------------------------|----------|----------|--------|--------|---------|
| 10138 + 2122 | NGC3177                 | 10 13 49.20 | 21 22 28.0 | 0.0049 | 13.04 | SA(rs)b |
| 10153 + 2205 | ARP316, NGC3189         | 10 15 20.64 | 22 4 54.9   | 0.0049 | 12.12 | SA(s)a pec |
| 10257 – 4338X | AM1025-433, NGC3256     | 10 25 43.40 | -43 38 48.0 | 0.0091 | 12.15 | ...     |
| 10270 – 4351 | AM1027-435, NGC3263     | 10 27 4.50  | -43 51 59.0 | 0.0093 | 12.50 | SB(rs)cd |
| 10292 – 4148 | ESO317-G041             | 10 29 12.00 | -41 48 12.0 | 0.0191 | 14.38 | SB(r)bc pec |
| 10356 + 5345X | ARP217, NGC3310         | 10 35 40.10 | 53 45 49.0  | 0.0033 | 11.15 | SAB(r)bc pec |
| 10409 – 4556 | ESO264-G036             | 10 40 57.00 | -45 56 54.0 | 0.0231 | 14.30 | SB(s)b   |
| 10484 – 0152 | ARK258, IC0651          | 10 48 25.30 | -1 53 4.0   | 0.0152 | 13.60 | SB(s)m pec |
| 10560 + 6147 | MRK0158, NGC3471        | 10 56 2.20  | 61 47 56.0  | 0.0078 | 13.23 | Sa       |
| 10567 – 4310 | AM1056-430              | 10 56 44.00 | -43 10 24.0 | 0.0170 | 14.97 | SA(rs)bc |
| 11004 + 2814 | KUG1100+282, NGC3504    | 11 0 28.50  | 28 14 31.0  | 0.0057 | 11.67 | (R)SAB(s)ab |
| 11005 – 1601 | NGC3508                 | 11 0 30.80  | -16 1 9.0   | 0.0131 | 13.20 | SA(r)b pec |
| 11082 – 4849 | ESO215-G031             | 11 8 18.00  | -48 49 54.0 | 0.0088 | 13.64 | (R)SB(r)b |
| 11122 – 2327 | AM1112-232, NGC3597     | 11 12 14.20 | -23 27 20.0 | 0.0117 | 13.60 | S0+ pec |
| 11149 + 0449 | NGC3611                 | 11 14 54.70 | 4 49 41.0   | 0.0057 | 12.77 | SA(s)a pec |
| 11186 – 0242 | CGCG011-076             | 11 18 39.08 | -2 42 36.5  | 0.0252 | 14.78 | SAB(s)b |
| 11257 + 5850X | MRK0171, NGC3690       | 11 25 41.40 | 58 50 15.4  | 0.0104 | 11.8  | SBm pec |
| 11330 + 7048 | NGC3735                 | 11 33 4.80  | 70 48 42.0  | 0.0097 | 12.50 | Sa       |
| 11442 – 2738 | AM1144-273, NGC3885     | 11 44 15.00 | -27 38 42.0 | 0.0060 | 11.89 | SAB(r)0/a |
| 12015 + 3210 | KUG1201+321, NGC4062    | 12 1 30.50  | 32 10 26.0  | 0.0032 | 11.90 | SA(s)c |
| 12038 + 5259 | NGC4102                 | 12 3 51.66  | 52 59 23.7  | 0.0035 | 11.99 | SAB(s)b |
| 12063 + 7511 | NGC4133                 | 12 6 24.80  | 75 10 52.0  | 0.0052 | 13.11 | SABb    |
| 12080 + 1618 | MRK0759, NGC4152       | 12 8 4.44   | 16 18 40.8  | 0.0077 | 12.66 | SAB(rs)c |
| 12115 – 4656 | AM1211-465              | 12 11 34.80 | -46 57 2.0  | 0.0182 | 14.17 | SA(rs)ab |
| 12116 + 5448X | MRK0201, NGC4194, IZw033 | 12 11 41.20 | 54 48 15.0  | 0.0090 | 13.01 | IBm pec |
| 12121 – 3513 | AM1212-351              | 12 12 8.00  | -35 13 54.0 | 0.0089 | 12.96 | SB(rs)b |
| 12142 – 4841 | ...                     | 12 14 12.79 | -48 41 39.2 | 0.0177 | 16.20 | E       |
| IRAS      | Other names       | α     | δ     | z     | B     | Morph.        |
|----------|-------------------|-------|-------|-------|-------|---------------|
| 12173 + 0537 | NGC4273           | 12 17 22.74 | 5 37 13.0 | 0.0083 | 12.39  | SB(s)c       |
| 12190 + 1452 | NGC4298           | 12 19 0.55  | 14 53 1.1  | 0.0043  | 12.04  | SA(rs)c      |
| 12193 − 4303 | AM1219-430       | 12 19 18.00 | -43 3 24.0  | 0.0234  | ...     | ...           |
| 12204 + 6607 | NGC4332           | 12 20 27.60 | 66 7 15.0  | 0.0102  | 13.12  | SB(s)a       |
| 12221 + 3939 | MRK0439, NGC4369  | 12 22 8.03  | 39 39 35.0  | 0.0041  | 12.33  | (R)SA(rs)a   |
| 12290 + 5814 | MRK0213, NGC4500  | 12 29 2.60  | 58 14 26.0  | 0.0112  | 13.10  | SB(s)a       |
| 12319 + 0227 | NGC4536           | 12 31 53.81 | 2 27 50.5  | 0.0064  | 11.16  | SAB(rs)bc    |
| 12351 − 4015 | NGC4575           | 12 35 9.00  | -40 15 42.0  | 0.0098  | 13.12  | SAB(rs)bc    |
| 12398 − 0641 | MRK1333, NGC4628  | 12 39 50.14 | -6 41 50.4  | 0.0097  | 14.50  | SA(s)b       |
| 12456 − 0303 | NGC4691           | 12 45 39.02 | -3 3 36.9  | 0.0040  | 11.66  | (R)SB(s)0/a pec |
| 12498 − 3845 | MCG-06-28-02      | 12 49 53.00 | -38 45 24.0  | 0.0141  | 13.29  | (R)SA(rs)b   |
| 12542 − 0815 | NGC4818           | 12 54 12.70 | -8 15 13.0  | 0.0041  | 12.00  | SAB(rs)ab pec |
| 12596 − 1529 | MCG-02-33-098     | 12 59 40.80 | -15 29 58.0  | 0.0160  | 14.50  | Sc pec       |
| 13063 − 1515 | NGC4984           | 13 6 18.20  | -15 15 1.0  | 0.0042  | 12.25  | (R)SAB(rs)0+ |
| 13078 − 4117 | ESO323-G090       | 13 7 47.00  | -41 17 36.0  | 0.0102  | 13.92  | SB(rs)0+     |
| 13109 − 4912 | ESO219-G041       | 13 11 0.00  | -49 12 54.0  | 0.0115  | 12.90  | (R)SB(s)ab   |
| 13136 + 6223 | ARP238            | 13 13 42.14 | 62 23 16.2  | 0.0317  | 15.00  | Sc           |
| 13166 − 1434 | NGC5073           | 13 16 41.20 | -14 34 50.0  | 0.0093  | 13.00  | SB(s)c       |
| 13286 − 3432 | AM1328-343, NGC5188 | 13 28 37.00 | -34 32 18.0  | 0.0077  | 12.96  | (R)SAB(rs)b  |
| 13301 − 2356 | AM1330-235, IC4280 | 13 30 7.90  | -23 57 1.0  | 0.0165  | 13.46  | ...          |
| 13304 + 6301 | ARP104, NGC5218   | 13 30 27.80 | 63 1 27.0  | 0.0102  | 13.10  | SB(s)b pec   |
| 13341 − 2936X | M083             | 13 34 11.55 | -29 36 42.2  | 0.0017  | 8.20   | SAB(s)c      |
| 13370 − 3123 | AM1337-312, NGC5253 | 13 37 5.12 | -31 23 13.2  | 0.0013  | 10.87  | Im pec       |
| 13373 + 0105 | ARP240, NGC5258   | 13 37 24.60 | 1 5 6.0    | 0.0228  | 12.93  | SA(s)b pec   |
| 13478 − 4848 | ESO221-IG010      | 13 47 48.00 | -48 48 30.0  | 0.0101  | ...    | ...          |
| 13549 + 4205 | MRK0281, NGC5383  | 13 54 59.99 | 42 5 22.3  | 0.0081  | 12.05  | (R)SB(rs)b pec |
| 13591 + 5934 | MRK0799, NGC5430  | 13 59 8.50  | 59 34 16.0  | 0.0108  | 12.72  | SB(s)b       |
| IRAS    | Other names                  | α     | δ      | z      | B      | Morph.                |
|---------|------------------------------|-------|--------|--------|--------|-----------------------|
| 14179 - 4604 | IC4402                     | 14 18 0.00 | -46 4 12.0 | 0.0053 | 12.00 | Sb                   |
| 14187 + 7149 | MRK0286, NGC5607, VIIIZw547 | 14 18 49.60 | 71 49 3.0 | 0.0260 | 13.90 | Pec               |
| 14280 + 3126 | NGC5653                     | 14 28 1.00 | 31 26 10.0 | 0.0125 | 12.86 | (R)SA(rs)b               |
| 14299 + 0818 | ARP049, NGC5665             | 14 29 57.70 | 8 17 58.0 | 0.0078 | 12.66 | SAB(rs)c pec               |
| 14376 - 0004 | NGC5713                     | 14 37 37.56 | -0 04 29.0 | 0.0063 | 11.84 | SAB(rs)bc pec               |
| 14430 - 3728 | ESO386-G019                 | 14 43 2.80 | -37 28 32.0 | 0.0148 | 13.65 | SA(r)0/a               |
| 14454 - 4343 | ESO273-IG004                | 14 45 26.00 | -43 43 24.0 | 0.0386 |      |                       |
| 14483 + 0519 | NGC5765                     | 14 48 20.76 | 5 19 17.7 | 0.0015 |      |                       |
| 14544 - 4255 | AM1454-425, IC4518A         | 14 54 26.00 | -42 55 48.0 | 0.0160 | 15.00 | Sc pec               |
| 14545 - 1900 | IC1077                      | 14 54 32.00 | -19 0 54.0 | 0.0116 | 13.44 | SA(s)bc               |
| 14556 - 4148 | NGC5786                     | 14 55 41.00 | -41 48 48.0 | 0.0098 | 12.00 | (R)SAB(s)bc           |
| 15005 + 8343 | MRK0839                     | 15 0 32.68 | 83 43 16.2 | 0.0136 | 13.82 |                       |
| 15042 - 3608 | NGC5843                     | 15 4 19.00 | -36 8 12.0 | 0.0139 | 13.11 | SB(s)b                |
| 15153 + 5535 | NGC5908                     | 15 15 23.00 | 55 35 37.0 | 0.0117 | 12.79 | SA(s)b                |
| 15188 - 1254 | NGC5915                     | 15 18 47.50 | -12 54 47.0 | 0.0077 | 12.75 | SB(s)ab pec           |
| 15243 + 4150 | IZw112, ARP090, NGC5930     | 15 24 20.73 | 41 51 0.1 | 0.0095 | 13.60 | SAB(rs)b pec           |
| 15268 - 7757 | ESO022-G010                 | 15 26 52.00 | -77 57 18.0 | 0.0084 | 13.72 | S0                    |
| 15276 + 1309 | NGC5936                     | 15 27 39.70 | 13 9 40.0 | 0.0138 | 13.11 | SB(rs)b               |
| 15281 - 0239 | NGC5937                     | 15 28 9.90 | -2 39 33.0 | 0.0095 | 13.17 | (R)SAB(rs)b pec       |
| 15347 + 4341 | IC564                       | 15 34 44.60 | 43 40 57.0 | 0.0195 | 14.42 |                       |
| 15420 - 7531 | AM1542-753, NGC5967         | 15 42 6.00 | -75 31 6.0 | 0.0092 | 12.70 | SAB(rs)c               |
| 15437 + 0234 | NGC5990                     | 15 43 44.80 | 2 34 11.0 | 0.0131 | 13.30 | (R)Sa pec              |
| 15467 - 2914X | NGC6000                    | 15 46 44.30 | -29 14 06.0 | 0.0070 | 13.01 | SB(s)bc               |
| 15496 + 4724 | UGC10070                    | 15 49 40.32 | 47 24 14.0 | 0.0205 | 13.98 |                       |
| 16030 + 2040 | MRK0297, NGC6052            | 16 3 1.40 | 20 40 37.0 | 0.0162 |      |                       |
| 16037 + 2137 | NGC6060                     | 16 3 41.60 | 21 37 8.0 | 0.0153 | 13.80 | SAB(rs)c               |
| 16104 + 5235 | MRK0496, NGC6090, IZw135   | 16 10 24.02 | 52 35 4.1 | 0.0300 |      |                       |
| IRAS              | Other names         | $\alpha$  | $\delta$  | $z$     | $B$     | Morph.         |
|-------------------|---------------------|-----------|-----------|---------|---------|----------------|
| 16180 + 3753      | I Zw141, NGC 6120   | 16 18 1.19| 37 53 36.0| 0.0312  | 14.60   | Pec           |
| 16284 + 0411      | CGCG 052-037        | 16 28 27.00| 4 11 24.0  | 0.0248  | 15.04   |                |
| 16301 + 1955      | NGC 6181            | 16 30 9.40| 19 55 48.0| 0.0084  | 12.49   | SAB(rs)c      |
| 16516 – 0948      | ...                 | 16 51 39.65| -9 48 31.3 | 0.0227  | 16.55   | Sc            |
| 17091 + 0803      | UGC10743            | 17 9 6.20 | 8 3 16.0  | 0.0089  | 14.74   |                |
| 17138 – 1017      | ...                 | 17 13 50.10| -10 17 25.0| 0.0177  | 16.57   |                |
| 17222 – 5953      | AM1722-595          | 17 22 16.00| -59 53 24.0| 0.0203  | 13.74   | Sbc           |
| 17363 + 8646      | MRK1116, VII Zw729  | 17 36 22.70| 86 46 38.8  | 0.0264  | 14.30   |                |
| 17442 – 6314      | IC4664              | 17 44 13.00| -63 14 18.0| 0.0163  | 13.64   | (R)SAB(r)b    |
| 17467 + 0807      | CGCG 055-018        | 17 46 42.66| 8 7 1.8    | 0.0211  | 15.5    |                |
| 17530 + 3447      | ARK534              | 17 53 4.42 | 34 47 0.8  | 0.0167  | 14.10   | Sab           |
| 18093 – 5744      | AM1809-574, IC4687  | 18 9 20.10 | -57 44 20.0| 0.0170  | 14.31   | Sb pec        |
| 18095 + 1458      | NGC 6574            | 18 9 34.70| 14 58 3.0  | 0.0080  | 12.83   | SAB(rs)bc     |
| 18097 – 6006      | AM1809-600          | 18 9 47.00| -60 6 24.0 | 0.0102  | 13.55   | (R)SAB(rs)a   |
| 18131 + 6820      | VII Zw778, ARP081, NGC 6621 | 18 13 9.01| 68 20 52.5  | 0.0213  | 14.00   | Sb pec        |
| 18262 + 2242      | UGC11246            | 18 26 16.88| 22 42 9.2  | 0.0143  | 14.90   | Sab           |
| 18293 – 3413      | ...                 | 18 29 21.38| -34 13 41.5| 0.0180  | ...      |                |
| 18329 + 5950      | VII Zw812, NGC 6670A | 18 32 57.44| 59 50 57.1  | 0.0296  | 15.70   | ...           |
| 18375 – 4150      | ESO336-G009         | 18 37 35.00| -41 50 30.0| 0.0192  | 14.00   | SB(s)b        |
| 18425 + 6036      | NGC 6701            | 18 42 35.12| 60 36 4.0  | 0.0139  | 13.01   | (R)SB(s)a     |
| 19070 + 5051      | NGC 6764            | 19 7 1.22 | 50 51 8.1  | 0.0087  | 12.56   | SB(s)bc       |
| 19265 – 4338      | ...                 | 19 26 34.51| -43 38 56.8| 0.0595  | 15.80   | ...           |
| 19384 – 7045      | NGC 6808            | 19 38 28.00| -70 45 6.0 | 0.0111  | 12.46   | SA(r)ab pec   |
| 19517 – 1241      | NGC 6835            | 19 51 46.10| -12 42 4.0 | 0.0055  | 13.41   | SB(s)a        |
| 19582 – 3833      | AM1958-383          | 19 58 14.50| -38 33 9.0 | 0.0166  | 13.54   | SA(rs)ab      |
| 20192 + 6634      | NGC 6911            | 20 19 12.15| 66 34 6.6  | 0.0090  | 15.10   | SBb           |
| 20243 – 0226      | IIZw083             | 20 24 20.10| -2 26 34.6 | 0.0294  | 15.20   |                |
| IRAS      | Other names                  | α   | δ     | z   | B    | Morph.          |
|-----------|------------------------------|-----|-------|-----|------|-----------------|
| 20272 − 4738 | NGC6918                     | 20 27 15.00 | -47 38 24.0 | 0.0057 | 14.42 | (R)SAB(rs)a     |
| 20338 + 5958X | ARP029, NGC6946            | 20 33 49.24 | 59 58 49.2 | 0.0002 | 9.61  | SAB(rs)cd       |
| 20550 + 1655 | IIZw096                     | 20 55 5.30  | 16 56 3.0  | 0.0363 | ...   | ...             |
| 20551 − 4250 | AM2055-425                  | 20 55 8.82  | -42 50 45.1 | 0.0426 | 14.74 | Merger          |
| 21008 − 4347 | ESO286-G035                 | 21 0 52.83  | -43 47 31.1 | 0.0171 | 15.00 | ...             |
| 21087 + 6557 | UGC11689                    | 21 8 45.11  | 65 57 50.9  | 0.0103 | 14.40 | SB(r)b          |
| 21171 − 0859 | NGC7051                     | 21 17 10.55 | -8 59 41.4  | 0.0086 | 14.00 | SB(r)a pec      |
| 21330 − 3846 | AM2133-384                  | 21 33 5.65  | -38 46 0.5  | 0.0192 | 15.07 | pec             |
| 21457 − 8145 | AM2145-814                  | 21 45 48.00 | -81 45 54.0 | 0.0080 | 12.23 | SB(s)c          |
| 23179 + 1657 | IIZw102, NGC7625            | 23 17 59.90 | 16 57 6.0  | 0.0058 | 12.83 | SA(rs)a pec     |
| 23192 − 4245 | AM2319-424, NGC7632         | 23 19 16.55 | -42 45 14.9 | 0.0048 | 12.95 | (RL)SB(l)0+     |
| 23256 + 2315 | MRK0326, NGC7677            | 23 25 36.50 | 23 15 22.0 | 0.0123 | 13.93 | SAB(r)bc        |
| 23336 + 0152X | MRK0538, NGC7714            | 23 33 40.58 | 1 52 42.3  | 0.0093 | 13.00 | SB(s)b pec      |
| 23568 + 2028 | MRK0332, NGC7798            | 23 56 52.00 | 20 28 17.0 | 0.0084 | 12.97 | ...             |
Table 2. PDS starbursts Optical–FIR characteristics

| IRAS        | $M_B$ | Log($L_B/L_\odot$) | Log($L_{IR}/L_\odot$) | $\alpha(25,12)$ | $\alpha(60,25)$ | $\alpha(100,60)$ | quality |
|-------------|-------|---------------------|------------------------|-----------------|-----------------|-----------------|--------|
| 00013 + 2028 | -20.18 | 9.96                | 10.10                 | -0.15           | -2.44           | -2.10           | 3332   |
| 00022 − 6220 | -20.46 | 10.07               | 10.37                 | -0.81           | -2.46           | -1.32           | 3332   |
| 00073 + 2538 | -21.30 | 10.41               | 10.80                 | -0.99           | -2.45           | -1.00           | 3232   |
| 00317 − 2142 | -21.56 | 10.51               | 10.95                 | -1.27           | -2.21           | -1.53           | 3332   |
| 00344 − 3349 | ⋯      | ⋯                   | 10.78                 | -2.44           | -1.09           | 0.50            | 3332   |
| 00345 − 2945 | -21.14 | 10.35               | 10.61                 | -1.58           | -2.49           | -0.99           | 3332   |
| 00386 + 4033 | ⋯      | ⋯                   | ⋯                     | 0.09            | -2.31           | -2.68           | 2322   |
| 00450 − 2533 | -19.83 | 9.82                | 10.20                 | -2.19           | -2.15           | -0.46           | 3332   |
| 00506 + 7248 | ⋯      | ⋯                   | 11.17                 | -2.15           | -2.05           | -0.34           | 3222   |
| 01053 − 1746 | ⋯      | ⋯                   | 11.38                 | -2.26           | -2.11           | -0.58           | 3332   |
| 01076 − 1707 | -20.79 | 10.20               | 11.35                 | -1.41           | -2.33           | -0.93           | 3332   |
| 01171 + 0308 | -20.15 | 9.95                | 10.11                 | -1.18           | -2.09           | -1.31           | 3232   |
| 01384 − 7515 | -19.13 | 9.54                | 10.53                 | -1.21           | -2.51           | -1.25           | 3332   |
| 01579 + 5015 | -20.96 | 10.27               | 10.53                 | -1.24           | -2.10           | -0.75           | 3322   |
| 02031 − 8413 | -20.20 | 9.97                | 10.15                 | -0.71           | -2.47           | -1.89           | 3332   |
| 02070 − 2338 | -21.06 | 10.31               | 10.58                 | -0.22           | -2.42           | -1.85           | 3332   |
| 02079 + 3725 | -20.34 | 10.02               | 10.68                 | -0.96           | -2.46           | -1.30           | 3332   |
| 02141 − 1134 | -20.70 | 10.17               | 10.51                 | -0.73           | -2.37           | -1.33           | 2232   |
| 02208 + 4744 | -20.57 | 10.12               | 10.83                 | -1.37           | -2.64           | -0.60           | 3322   |
| 02315 − 3915 | -22.07 | 10.71               | 10.46                 | -1.77           | -2.28           | -1.36           | 3332   |
| 02345 + 2053 | -20.56 | 10.11               | 10.76                 | -1.06           | -2.42           | -0.89           | 3332   |
| 02360 − 0653 | ⋯      | ⋯                   | 10.16                 | -2.07           | -2.09           | -0.57           | 3332   |
| 02395 + 3433 | -20.42 | 10.06               | 10.45                 | -2.08           | -1.71           | -0.71           | 3332   |
| 03004 − 2303 | -20.10 | 9.93                | 9.85                  | -1.37           | -2.28           | -1.48           | 3332   |
| 03021 + 7956 | -19.29 | 9.61                | 9.84                  | -0.58           | -2.46           | -1.89           | 3322   |
| 03064 − 0308 | -19.68 | 9.76                | 10.35                 | -2.03           | -2.04           | -0.28           | 3332   |
| 03266 + 4139 | -20.86 | 10.23               | 10.48                 | -0.55           | -2.48           | -1.47           | 3322   |
| 03324 − 1000 | -22.51 | 10.89               | 11.08                 | -0.62           | -2.39           | -1.48           | 3332   |
Table 2—Continued

| IRAS      | $M_B$ | Log($L_B/L_\odot$) | Log($L_{IR}/L_\odot$) | $\alpha_{(25,12)}$ | $\alpha_{(60,25)}$ | $\alpha_{(100,60)}$ | quality |
|-----------|-------|---------------------|------------------------|---------------------|---------------------|---------------------|---------|
| 03344 − 2103 | -18.61 | 9.33 | 9.76 | -1.92 | -1.58 | 0.46 | 3332 |
| 03406 + 3908 | -21.83 | 10.62 | 10.60 | -0.53 | -2.54 | -1.44 | 3322 |
| 03419 + 6756 | -21.87 | 10.64 | 9.18 | -2.26 | -1.69 | -0.89 | 3322 |
| 03443 − 1642 | -17.31 | 8.81 | 9.37 | -1.60 | -2.34 | -0.98 | 3332 |
| 03451 + 6956 | -17.63 | 8.94 | 10.33 | -1.84 | -2.06 | -0.46 | 3322 |
| 03514 + 1546 | -20.65 | 10.15 | 10.89 | -1.21 | -2.32 | -0.79 | 3332 |
| 03524 − 2038 | -19.05 | 9.51 | 10.54 | -1.47 | -2.23 | -0.68 | 3332 |
| 04064 + 0831 | -19.87 | 9.84 | 10.16 | -0.60 | -2.53 | -1.49 | 3322 |
| 04296 + 2923 | -21.61 | 10.53 | 10.71 | -2.17 | -2.12 | -0.32 | 3322 |
| 04326 + 1904 | -19.99 | 9.88 | 11.08 | -1.01 | -2.36 | -1.34 | 3322 |
| 04389 − 0257 | -18.85 | 9.43 | 9.14 | -1.29 | -1.94 | -1.84 | 3332 |
| 04435 + 1822 | -20.37 | 10.04 | 10.49 | -1.19 | -1.88 | -1.94 | 3322 |
| 04519 + 0311 | -21.19 | 10.36 | 10.65 | -1.56 | -2.36 | -0.96 | 3332 |
| 04569 − 0756 | -21.00 | 10.29 | 10.62 | -1.22 | -2.58 | -1.36 | 3322 |
| 05053 − 0805 | -18.61 | 9.33 | 10.71 | -1.89 | -2.09 | -0.93 | 3322 |
| 05054 + 1718 | ⋮ | ⋮ | 10.94 | -2.19 | -2.55 | -0.35 | 3322 |
| 05149 − 3709 | -18.29 | 9.20 | 9.30 | -0.18 | -2.65 | -2.06 | 3332 |
| 06107 + 7822 | -19.76 | 9.79 | 10.65 | -1.41 | -2.29 | -0.67 | 3332 |
| 06141 + 8220 | -19.42 | 9.65 | 10.42 | -1.10 | -2.27 | -1.02 | 3332 |
| 06189 − 2001 | ⋮ | ⋮ | 9.85 | -0.81 | -2.33 | -1.68 | 3322 |
| 06194 − 5733 | -18.89 | 9.44 | 9.98 | -1.22 | -2.46 | -1.59 | 3332 |
| 06210 + 4932 | -20.25 | 9.99 | 10.65 | -0.56 | -2.49 | -1.52 | 3322 |
| 06259 − 4708 | -16.85 | 8.63 | 11.55 | -2.05 | -2.06 | -0.67 | 3332 |
| 06399 − 5828 | -19.93 | 9.86 | 10.01 | -0.49 | -2.48 | -1.85 | 3332 |
| 07007 + 8427 | -20.51 | 10.09 | 10.05 | -0.39 | -2.47 | -2.02 | 3332 |
| 07027 − 6011 | ⋮ | ⋮ | 11.16 | -1.70 | -2.13 | -0.80 | 3332 |
| 07107 + 3521 | -19.52 | 9.69 | 10.15 | -1.20 | -1.32 | -0.64 | 3322 |
| 07176 − 3533 | -20.14 | 9.95 | 9.93 | -1.11 | -2.36 | -1.20 | 3322 |
| IRAS      | $M_B$  | Log($L_B/L_\odot$) | Log($L_{IR}/L_\odot$) | $\alpha(25,12)$ | $\alpha(60,25)$ | $\alpha(100,60)$ | quality |
|-----------|--------|---------------------|------------------------|-----------------|-----------------|-----------------|---------|
| 07203 + 5803 | -20.74 | 10.18               | 10.25                  | -0.88           | -2.22           | -1.91           | 3332    |
| 07204 + 3332 | -20.27 | 10.00               | 10.55                  | -2.06           | -1.96           | -0.29           | 3332    |
| 07256 + 3355 | -19.36 | 9.63                | 10.94                  | -2.08           | -2.33           | -0.77           | 3332    |
| 07278 - 6728 | -20.38 | 10.04               | 9.81                   | -0.68           | -1.73           | -2.38           | 3332    |
| 07369 - 5504 | -21.43 | 10.46               | 10.15                  | -0.70           | -2.52           | -1.95           | 3322    |
| 07568 + 1531 | -20.05 | 9.91                | 10.39                  | -1.35           | -1.72           | -0.98           | 3332    |
| 08007 - 6600 | -20.53 | 10.10               | 11.16                  | -1.76           | -1.38           | 0.34            | 3322    |
| 08311 - 2248 | -20.96 | 10.27               | 9.93                   | -0.18           | -2.30           | -2.73           | 3322    |
| 08339 + 6517 | -20.47 | 10.08               | 10.75                  | -1.91           | -1.92           | -0.19           | 3332    |
| 08406 - 1952 | -18.25 | 9.19                | 9.50                   | 0.01            | -2.72           | -2.39           | 3322    |
| 08425 + 7416 | -19.65 | 9.75                | 10.43                  | -1.68           | -2.21           | -0.98           | 3332    |
| 08437 - 1907 | -18.70 | 9.37                | 9.74                   | -1.70           | -2.03           | -0.86           | 3322    |
| 09004 - 2031 | -18.90 | 9.45                | 10.23                  | -2.05           | -2.24           | -0.42           | 3322    |
| 09120 + 4107 | -18.23 | 9.18                | 10.37                  | -1.00           | -2.45           | -1.20           | 3332    |
| 09141 + 4212 | -19.02 | 9.50                | 10.31                  | -1.86           | -2.08           | -0.85           | 3332    |
| 09395 + 0454 | -18.83 | 9.42                | 9.85                   | -1.51           | -2.24           | -0.64           | 3332    |
| 09399 + 3204 | -19.45 | 9.67                | 9.91                   | -0.97           | -2.49           | -1.35           | 3332    |
| 09434 - 1408 | -19.73 | 9.78                | 10.31                  | -1.78           | -2.19           | -0.90           | 3332    |
| 09479 + 3347 | -18.90 | 9.45                | 9.63                   | -0.21           | -2.71           | -1.79           | 3332    |
| 09510 + 0149 | -18.95 | 9.47                | 9.78                   | -0.91           | -2.54           | -1.33           | 3332    |
| 09511 - 1214 | · · ·   | · · ·               | 10.88                  | -1.10           | -2.39           | -1.66           | 3332    |
| 09517 + 6955 | -19.52 | 9.70                | 10.67                  | -2.10           | -1.60           | -0.11           | 3332    |
| 09578 + 0336 | -18.29 | 9.20                | 9.88                   | -0.95           | -2.41           | -1.53           | 3332    |
| 09593 + 6858 | -16.98 | 8.68                | 8.33                   | -1.69           | -2.24           | -1.30           | 3332    |
| 10102 + 1716 | · · ·   | · · ·               | 10.85                  | -0.30           | -2.53           | -1.18           | 3332    |
| 10138 + 2122 | -18.48 | 9.28                | 9.78                   | -0.87           | -2.44           | -1.18           | 3332    |
| 10153 + 2205 | -19.41 | 9.65                | 9.44                   | -0.15           | -2.52           | -2.26           | 3232    |
| 10257 - 4338 | -21.17 | 10.35               | 11.24                  | -2.18           | -1.95           | -0.52           | 3322    |
Table 2—Continued

| IRAS         | $M_B$   | $\log(L_B/L_\odot)$ | $\log(L_{IR}/L_\odot)$ | $\alpha_{(25,12)}$ | $\alpha_{(60,25)}$ | $\alpha_{(100,60)}$ | quality |
|--------------|---------|----------------------|-------------------------|--------------------|--------------------|--------------------|---------|
| 10270 − 4351 | -20.90  | 10.25                | 10.30                   | -0.81              | -2.33              | -1.91              | 3322    |
| 10292 − 4148 | -20.56  | 10.11                | 10.61                   | -1.08              | -2.16              | -1.44              | 3322    |
| 10356 + 5345 | -19.85  | 9.83                 | 10.07                   | -1.90              | -2.17              | -0.49              | 3332    |
| 10409 − 4556 | -21.38  | 10.44                | 10.96                   | -0.76              | -2.41              | -1.70              | 3322    |
| 10484 − 0152 | -20.39  | 10.04                | 10.51                   | -0.90              | -2.42              | -1.53              | 3332    |
| 10560 + 6147 | -19.24  | 9.58                 | 10.10                   | -1.82              | -2.15              | -0.96              | 3332    |
| 10567 − 4310 | -19.96  | 9.87                 | 10.68                   | -1.14              | -2.25              | -1.16              | 3322    |
| 11004 + 2814 | -20.15  | 9.95                 | 10.26                   | -1.71              | -1.98              | -0.85              | 3332    |
| 11005 − 1601 | -20.53  | 10.10                | 10.54                   | -1.06              | -2.31              | -1.43              | 3323    |
| 11082 − 4849 | -19.86  | 9.83                 | 10.07                   | -1.00              | -2.39              | -1.09              | 3322    |
| 11122 − 2327 | -19.96  | 9.87                 | 10.64                   | -1.52              | -2.12              | -0.72              | 3332    |
| 11149 + 0449 | -19.14  | 9.54                 | 9.61                    | -1.05              | -2.22              | -0.97              | 3232    |
| 11186 − 0242 | -20.36  | 10.03                | 10.99                   | -1.09              | -2.24              | -1.20              | 3322    |
| 11257 + 5850 | -21.44  | 10.47                | 11.48                   | -2.46              | -1.71              | -0.07              | 3332    |
| 11330 + 7048 | -20.45  | 10.07                | 10.33                   | -0.62              | -2.14              | -1.98              | 3332    |
| 11442 − 2738 | -20.36  | 10.03                | 10.02                   | -1.32              | -2.63              | -0.47              | 3232    |
| 12015 + 3210 | -18.62  | 9.34                 | 9.02                    | -0.12              | -2.28              | -2.81              | 3332    |
| 12038 + 5259 | -18.74  | 9.38                 | 10.16                   | -2.04              | -2.21              | -0.78              | 3332    |
| 12063 + 7511 | -18.61  | 9.33                 | 9.57                    | -1.32              | -2.36              | -1.43              | 3332    |
| 12080 + 1618 | -19.83  | 9.82                 | 9.86                    | -0.80              | -2.33              | -1.47              | 3232    |
| 12115 − 4656 | -20.60  | 10.13                | 10.69                   | -0.98              | -2.36              | -1.06              | 3322    |
| 12116 + 5448 | -19.78  | 9.80                 | 10.63                   | -2.24              | -1.83              | -0.37              | 3332    |
| 12121 − 3513 | -20.09  | 9.92                 | 10.39                   | -2.12              | -2.20              | -0.70              | 3332    |
| 12142 − 4841 | -18.61  | 9.33                 | 10.49                   | -0.43              | -2.47              | -1.55              | 3322    |
| 12173 + 0537 | -20.22  | 9.98                 | 10.30                   | -0.83              | -2.31              | -1.62              | 2232    |
| 12190 + 1452 | -19.18  | 9.56                 | 9.60                    | -0.30              | -2.67              | -2.80              | 3332    |
| 12193 − 4303 | · · ·   | · · ·                | 10.87                   | -0.81              | -2.51              | -1.13              | 3222    |
| 12204 + 6007 | -19.93  | 9.86                 | 10.31                   | -1.61              | -2.31              | -1.30              | 3332    |
| IRAS        | $M_B$ | $\log(L_B/L_\odot)$ | $\log(L_{IR}/L_\odot)$ | $\alpha(25,12)$ | $\alpha(60,25)$ | $\alpha(100,60)$ | quality |
|------------|-------|----------------------|--------------------------|-----------------|-----------------|-----------------|---------|
| 12221 + 3939 | -18.76 | 9.39 | 9.46 | -1.15 | -2.44 | -1.22 | 3332 |
| 12290 + 5814 | -20.15 | 9.95 | 10.11 | -1.07 | -2.13 | -0.83 | 3332 |
| 12319 + 0227 | -20.87 | 10.23 | 10.49 | -1.28 | -2.44 | -0.68 | 3332 |
| 12351 - 4015 | -20.31 | 10.01 | 10.32 | -0.84 | -2.44 | -1.59 | 3332 |
| 12398 - 0641 | -18.49 | 9.28 | 9.92 | -1.15 | -1.75 | -1.17 | 3232 |
| 12456 - 0303 | -19.37 | 9.64 | 9.77 | -1.66 | -2.06 | -0.66 | 3332 |
| 12498 - 3845 | -20.66 | 10.15 | 10.27 | -0.15 | -2.49 | -1.93 | 3332 |
| 12542 - 0815 | -19.14 | 9.54 | 9.91 | -2.08 | -1.88 | -0.45 | 3332 |
| 12596 - 1529 | -19.57 | 9.71 | 10.67 | -1.89 | -1.93 | -0.41 | 2332 |
| 13063 - 1515 | -18.92 | 9.45 | 9.67 | -1.17 | -2.13 | -0.53 | 3332 |
| 13078 - 4117 | -19.49 | 9.68 | 10.15 | -1.04 | -2.53 | -0.74 | 3332 |
| 13109 - 4912 | -21.32 | 10.41 | 10.03 | -0.43 | -2.13 | -2.33 | 3232 |
| 13136 + 6223 | -20.55 | 10.11 | 11.42 | -2.36 | -1.94 | -0.19 | 3332 |
| 13166 - 1434 | -19.96 | 9.87 | 10.33 | -1.84 | -2.42 | -0.73 | 3232 |
| 13286 - 3432 | -19.63 | 9.74 | 10.53 | -1.64 | -2.37 | -0.90 | 3332 |
| 13301 - 2356 | -20.92 | 10.26 | 10.67 | -0.65 | -2.59 | -1.23 | 3332 |
| 13304 + 6301 | -19.99 | 9.88 | 10.33 | -1.72 | -2.31 | -1.40 | 3332 |
| 13341 - 2936 | -21.08 | 10.32 | 9.97 | -1.91 | -1.97 | -1.49 | 3332 |
| 13370 - 3123 | -17.88 | 9.04 | 9.05 | -2.08 | -1.07 | 0.07 | 3332 |
| 13373 + 0105 | -21.88 | 10.64 | 11.17 | -1.06 | -2.31 | -1.46 | 3332 |
| 13478 - 4848 | ... | ... | 10.54 | -1.26 | -2.32 | -0.84 | 3322 |
| 13549 + 4205 | -20.51 | 10.09 | 10.05 | -0.91 | -2.25 | -2.03 | 3232 |
| 13591 + 5934 | -20.46 | 10.07 | 10.54 | -1.45 | -2.12 | -1.23 | 3332 |
| 14179 - 4604 | -20.06 | 9.91 | 9.81 | -1.22 | -2.24 | -1.31 | 3322 |
| 14187 + 7149 | -21.23 | 10.38 | 10.91 | -1.61 | -2.08 | -0.89 | 3332 |
| 14280 + 3126 | -20.63 | 10.14 | 10.69 | -0.82 | -2.44 | -1.26 | 3332 |
| 14299 + 0818 | -19.86 | 9.83 | 10.05 | -1.09 | -2.42 | -1.31 | 3332 |
| 14376 - 0004 | -20.37 | 10.04 | 10.38 | -1.17 | -2.33 | -1.18 | 3332 |
Table 2—Continued

| IRAS     | $M_B$ | $\log(L_B/L_\odot)$ | $\log(L_{IR}/L_\odot)$ | $\alpha(25,12)$ | $\alpha(60,25)$ | $\alpha(100,60)$ | quality |
|----------|-------|----------------------|-------------------------|----------------|----------------|----------------|---------|
| 14430 − 3728 | -20.51 | 10.09                | 10.52                   | -1.05          | -2.42          | -0.73          | 3322    |
| 14454 − 4343 | ⋮ ⋮   | ⋮ ⋮                  | 11.23                   | -1.88          | -1.16          | -0.06          | 3322    |
| 14483 + 0519 | ⋮ ⋮   | ⋮ ⋮                  | 8.32                    | -1.29          | -1.71          | -1.07          | 3332    |
| 14544 − 4255 | -19.54 | 9.70                 | 10.73                   | -1.82          | -2.01          | -1.02          | 3322    |
| 14545 − 1900 | -20.22 | 9.98                 | 10.24                   | -0.84          | -2.40          | -1.33          | 3332    |
| 14556 − 4148 | -21.31 | 10.41                | 10.22                   | -0.73          | -2.40          | -1.75          | 3322    |
| 15005 + 8343 | -20.05 | 9.91                 | 10.40                   | -1.53          | -1.99          | -0.83          | 3332    |
| 15042 − 3608 | -20.92 | 10.26                | 10.30                   | -0.60          | -2.53          | -1.88          | 3322    |
| 15153 + 5535 | -20.57 | 10.12                | 10.36                   | -0.47          | -2.46          | -2.68          | 3332    |
| 15188 − 1254 | -20.25 | 9.99                 | 10.20                   | -1.54          | -2.29          | -0.77          | 3332    |
| 15243 + 4150 | -19.37 | 9.64                 | 10.32                   | -1.97          | -2.01          | -0.67          | 3332    |
| 15268 − 7757 | -19.28 | 9.60                 | 9.86                    | -1.54          | -2.08          | -0.79          | 3322    |
| 15276 + 1309 | -20.69 | 10.16                | 10.67                   | -1.31          | -2.19          | -1.25          | 3332    |
| 15281 − 0239 | -20.11 | 9.93                 | 10.42                   | -0.78          | -2.45          | -1.44          | 3332    |
| 15347 + 4341 | -20.13 | 9.94                 | 10.28                   | -0.48          | -2.43          | -1.96          | 3332    |
| 15420 − 7531 | -20.42 | 10.06                | 9.92                    | -0.68          | -2.31          | -2.11          | 3322    |
| 15437 + 0234 | -20.59 | 10.12                | 10.64                   | -1.27          | -2.03          | -1.01          | 3332    |
| 15467 − 2914 | -19.89 | 9.84                 | 10.65                   | -1.91          | -2.23          | -0.77          | 3332    |
| 15496 + 4724 | -20.64 | 10.14                | 10.73                   | -0.22          | -2.50          | -2.02          | 3332    |
| 16030 + 2040 | ⋮ ⋮   | ⋮ ⋮                  | 10.65                   | -1.51          | -2.29          | -0.99          | 3332    |
| 16037 + 2137 | -20.32 | 10.02                | 10.13                   | -0.07          | -2.08          | -2.30          | 3332    |
| 16104 + 5235 | ⋮ ⋮   | ⋮ ⋮                  | 11.19                   | -1.97          | -2.05          | -0.58          | 3332    |
| 16180 + 3753 | -20.88 | 10.24                | 11.07                   | -0.98          | -2.38          | -1.37          | 3332    |
| 16284 + 0411 | -20.20 | 9.97                 | 11.09                   | -1.33          | -2.51          | -1.09          | 3332    |
| 16301 + 1955 | -20.37 | 10.04                | 10.29                   | -0.90          | -2.45          | -1.59          | 3332    |
| 16516 − 0948 | -19.24 | 9.58                 | 10.95                   | -0.88          | -2.78          | -1.76          | 3322    |
| 17091 + 0803 | -18.31 | 9.21                 | 9.76                    | -1.12          | -2.31          | -0.65          | 3332    |
| 17138 − 1017 | -19.17 | 9.56                 | 11.07                   | -1.65          | -2.28          | -0.44          | 3322    |
Table 2—Continued

| IRAS          | $M_B$ | Log($L_B/L_\odot$) | Log($L_{IR}/L_\odot$) | $\alpha_{(25,12)}$ | $\alpha_{(60,25)}$ | $\alpha_{(100,60)}$ | quality |
|---------------|-------|--------------------|------------------------|---------------------|---------------------|---------------------|---------|
| 17222 – 5953  | -21.15| 10.35              | 11.00                  | -1.78               | -2.30               | -0.32               | 3322    |
| 17363 + 8646  | -21.03| 10.30              | 11.00                  | -0.62               | -2.59               | -1.42               | 3332    |
| 17442 – 6314  | -20.76| 10.19              | 10.31                  | -0.23               | -2.23               | -2.11               | 3322    |
| 17467 + 0807  | -19.79| 9.80               | 10.49                  | -1.40               | -1.23               | 0.05                | 3322    |
| 17530 + 3447  | -20.19| 9.96               | 10.70                  | -0.70               | -2.47               | -1.51               | 3332    |
| 18093 – 5744  | -20.20| 9.97               | 11.08                  | -1.78               | -2.12               | -0.98               | 3322    |
| 18095 + 1458  | -20.53| 10.10              | 10.41                  | -0.94               | -2.40               | -1.47               | 3322    |
| 18097 – 6006  | -19.89| 9.84               | 10.21                  | -1.42               | -1.96               | -0.98               | 3322    |
| 18131 + 6820  | -20.87| 10.24              | 10.93                  | -1.68               | -2.21               | -1.16               | 3322    |
| 18262 + 2242  | -19.56| 9.71               | 10.40                  | -1.10               | -2.39               | -1.36               | 3322    |
| 18293 – 3413  | …     | ⋮                  | 11.47                  | -1.65               | -2.52               | -0.73               | 2322    |
| 18329 + 5950  | -19.86| 9.83               | 11.33                  | -1.45               | -2.38               | -1.20               | 3332    |
| 18375 – 4150  | -20.76| 10.19              | 10.50                  | -0.31               | -2.20               | -1.43               | 3322    |
| 18425 + 6036  | -20.95| 10.27              | 10.77                  | -1.34               | -2.44               | -1.40               | 3332    |
| 19070 + 5051  | -20.39| 10.04              | 10.13                  | -1.74               | -1.82               | -1.19               | 3322    |
| 19265 – 4338  | -21.42| 10.46              | 10.83                  | -0.74               | -0.57               | -0.68               | 3332    |
| 19384 – 7045  | -21.07| 10.32              | 10.46                  | -0.59               | -2.37               | -1.97               | 3332    |
| 19517 – 1241  | -18.84| 9.42               | 9.94                   | -1.60               | -2.28               | -0.76               | 3322    |
| 19582 – 3833  | -20.90| 10.25              | 10.43                  | 0.02                | -2.26               | -1.48               | 3332    |
| 20192 + 6634  | -18.46| 9.27               | 10.00                  | -0.86               | -2.24               | -1.72               | 3322    |
| 20243 – 0226  | -20.55| 10.11              | 10.41                  | -1.14               | -0.27               | -0.54               | 3332    |
| 20272 – 4738  | -17.46| 8.87               | 9.89                   | -2.01               | -2.22               | -0.74               | 3332    |
| 20338 + 5958  | -19.59| 9.72               | 9.11                   | -1.33               | -2.37               | -2.13               | 3322    |
| 20550 + 1655  | …     | ⋮                  | 11.60                  | -3.05               | -1.96               | 0.44                | 3322    |
| 20551 – 4250  | -21.49| 10.48              | 11.73                  | -2.60               | -2.17               | 0.49                | 3332    |
| 21008 – 4347  | -19.23| 9.58               | 10.76                  | -1.32               | -2.50               | -1.17               | 3332    |
| 21087 + 6557  | -21.08| 10.32              | 10.01                  | -1.00               | -2.25               | -1.45               | 3322    |
| 21171 – 0859  | -18.96| 9.47               | 9.90                   | -0.73               | -2.41               | -1.64               | 3332    |
Table 2—Continued

| IRAS         | $M_B$ | $\log(L_B/L_\odot)$ | $\log(L_{IR}/L_\odot)$ | $\alpha_{(25,12)}$ | $\alpha_{(60,25)}$ | $\alpha_{(100,60)}$ | quality |
|--------------|-------|----------------------|--------------------------|---------------------|---------------------|---------------------|---------|
| 21330 − 3846| -19.38| 9.64                 | 10.76                    | -1.56               | -2.17               | -0.82               | 3332    |
| 21457 − 8145| -20.72| 10.18                | 9.95                     | -1.20               | -2.35               | -1.83               | 3332    |
| 23179 + 1657| -19.08| 9.52                 | 9.96                     | -0.78               | -2.50               | -1.26               | 3332    |
| 23192 − 4245| -20.09| 9.92                 | 9.43                     | -0.97               | -2.30               | -0.94               | 3332    |
| 23256 + 2315| -19.68| 9.76                 | 10.20                    | -1.53               | -1.96               | -0.78               | 3332    |
| 23336 + 0152| -20.07| 9.91                 | 10.35                    | -2.47               | -1.47               | -0.21               | 3232    |
| 23568 + 2028| -19.81| 9.81                 | 10.00                    | -0.74               | -2.35               | -1.31               | 3332    |
Table 3. Mean luminosities and ratios

| Sample          | N  | log($\frac{L}{L_\odot}$) | log($\frac{L_{IR}}{L_\odot}$) | log($\frac{L_{IR}}{L_B}$) |
|-----------------|----|--------------------------|-------------------------------|---------------------------|
| IRAS normal     | 185| 9.9 ± 0.5                | 10.0 ± 0.5                    | 0.12 ± 0.43               |
| PDS starbursts  | 182| 9.9 ± 0.4                | 10.3 ± 0.5                    | 0.44 ± 0.48               |
| PDS Sy1         | 31 | 10.3 ± 0.4               | 10.4 ± 0.7                    | 0.13 ± 0.49               |
| PDS Sy2         | 62 | 10.1 ± 0.5               | 10.4 ± 0.7                    | 0.32 ± 0.49               |
Table 4. Spectral characteristics of the galaxies

| IRAS            | Other name          | [OIII]λ5007/Hβ | [NII]λ6584/Hα | [NII]λ6717+6731/Hα | [OII]λ3700/Hα | Activity Type |
|-----------------|---------------------|---------------|---------------|-------------------|--------------|---------------|
| 02395 + 3433    | NGC1050             | 0.40          | 1.47          | 0.54              | 0.05         | LINER         |
| 03419 + 6756    | IC0342              | 0.08          | 0.43          | 0.24              | 0.01         | SBNG          |
| 04435 + 1822    | ⋯                   | 2.37          | 1.63          | 0.28              | ⋯            | Sy2/LINER     |
| 07107 + 3521    | ⋯                   | 4.10          | 0.60          | 0.31              | 0.04         | Sy2           |
| 07278 – 6728    | IC2202              | 11.72         | 0.60          | 1.21              | ⋯            | Sy2           |
| 07568 + 1531    | ⋯                   | 18.26         | 1.34          | 0.48              | 0.12         | Sy2           |
| 08339 + 6517X   | ⋯                   | 1.65          | 0.27          | 0.25              | 0.02         | SBNG          |
| 10356 + 5345X   | NGC3310             | 1.94          | 0.52          | 0.40              | 0.05         | SBNG/LINER    |
| 11257 + 5850X – E | NGC3690         | 1.00          | 0.25          | 0.31              | 0.04         | SBNG          |
| 11257 + 5850X – W | NGC3690         | 1.36          | 0.44          | 0.33              | 0.05         | SBNG/LINER    |
| 12116 + 5448    | MRK0201             | 1.13          | 0.47          | 0.26              | 0.03         | SBNG          |
| 12398 – 0641    | NGC4628             | 8.36          | 0.70          | 0.46              | 0.06         | Sy2           |
| 12542 – 0815    | NGC4818             | 0.14          | 0.65          | 0.19              | 0.01         | SBNG/LINER    |
| 14454 – 4343    | ⋯                   | 14.88         | 1.04          | 0.34              | 0.09         | Sy2           |
| 19265 – 4338    | ⋯                   | 6.48          | 1.02          | 0.72              | 0.20         | Sy2           |
| 20243 – 0226    | IIZw083             | 3.43          | 0.54          | 0.44              | 0.14         | Sy2           |
Fig. 1
Fig. 2
Fig. 3
Fig. 4-
Fig. 5-
Fig. 6
Fig. 7